Department of Health, Sport and Exercise Science
Waterford Institute of Technology

Active for a Day: Physical Activity Relapse and Strategies for Maintenance following Participation in a Mass Event

By

Aoife Lane

A thesis submitted in fulfilment of the requirements for a Doctor of Philosophy

October, 2010

Research Supervisors: Dr Niamh Murphy and Professor Adrian Bauman

Declaration

I hereby declare that this submission is my own work and that it contains no material previously published or written by another person nor material which has been accepted for an award in any other university or institute of higher learning, except where due acknowledgment has been made in the text.

Signed____________________ Date _____________________

Aoife Lane

Acknowledgments

To Dr Niamh Murphy, a friend as well as a supervisor. Thanks for your energy, enthusiasm, ideas and encouragement, which meant that I hit the ground running three years ago and haven't looked back since.

I must also acknowledge the generosity of, and invaluable guidance provided by Professor Adrian Bauman. Thanks also to Adrian and Tien Chey for the statistical assistance you gave over the past three years.

To my family, especially my Mum and Dad. Thanks for continuing to make home my favourite place to be.

To all my friends and work colleagues, particularly Annalouise, Jean, Jenny and Mairead for always making me laugh and for making Waterford a good place to be too!

Thanks to all the staff and students at Waterford Institute of Technology who assisted with data collection on several occasions during this project.

This work was funded by and undertaken in collaboration with the Irish Sports Council. Many thanks to Peter Smyth who ensured we had a successful, enjoyable partnership with the ISC.

I must finally thank the Women's Mini Marathon Office in Dublin and Cork for facilitating data collection and all of the women who took part in this study, who gave so generously of their time to make this project possible.

Peer Reviewed Materials from this Thesis

Refereed Journal Articles

Lane, A., Murphy, N., Bauman, A., & Chey, T. (2010). Randomised controlled trial to increase physical activity among insufficiently active women following their participation in a mass event. *Health Education Journal, 69*(3), 287-296.

Bauman, A., Murphy, N., Lane, A. (2009). The role of community programmes and mass events in promoting physical activity to patients. *British Journal of Sports Medicine, 43*,44-46.

Lane, A., Murphy, N., Bauman A. Active for a day: predictors of relapse among previously active mass event participants. *Journal of Physical Activity and Health* (in press).

Non Peer Reviewed Materials from this Thesis

Reports

Lane, A., Murphy, N.M., & Bauman A. (2008). *The Impact of Participation in the Flora Women's Mini Marathon on Physical Activity Behaviour in Women. Research Report 1.* Ireland: Centre for Health Behaviour Research, Department of Health Sport and Exercise Sciences, Waterford Institute of Technology and Irish Sports Council.

Lane, A., Murphy, N.M., Smyth, P., & Bauman, A. (2010). *Do Mass Participation Sporting Events Have a Role in Making Populations More Active? Research Report 2.* Ireland: Centre for Health Behaviour Research, Waterford Institute of Technology and Irish Sports Council.

Table of Contents

List of Tables

List of Figures

Abstract

Debate exists about the potential public health benefits of mass community events that encourage participation in physical activity. There have been few previous attempts to investigate their impact on the behaviour of participants, and the rates of relapse following the event. The aim of the research in this thesis was (i) to describe participants in three women-only mass participation events in Ireland (N = 82,955), (ii) to identify relapsers who regressed from sufficiently to insufficiently active in the months following the event, and (iii) to recruit these individuals to trials to re-initiate participation in physical activity.

International Physical Activity Questionnaire (IPAQ) physical activity self report data were collected before and after the events and relapse (n=852) was defined as decreasing participation by at least 60 minutes and regressing from the high or moderate IPAQ category to low active. Subsequently, in 2007, 176 women participated in a minimal contact randomised controlled trial (RCT) while in 2008, 395 women were recruited to a cluster RCT, which promoted existing resources for physical activity in the community.

The majority of women participated for altruistic reasons and to have fun. Thus, the events motivated more than the ‘habitual exerciser’ to participate. Approximately 11% of participants were classified as relapsers and any contact appeared sufficient to re-stimulate physical activity. In both trials, all participants reported significant increases in physical activity, with no between group difference. In the cluster RCT, intervention participants reported a significant increase in vigorous intensity activity. Aspects of the latter have been adopted by agencies tasked with promoting physical activity in Ireland.

Mass events could be used as an initial prompt for physical activity even among sedentary women. Providing reinforcement strategies after events that utilise existing opportunities for physical activity and that adopt a ‘non fitness’ approach, could contribute to public health physical activity promotion efforts.

Chapter 1: Introduction

1.1 Physical Activity and Public Health

In the past 20 years, physical activity has become a primary focus of public health endeavours worldwide. Physical inactivity has been identified as a risk factor for many chronic diseases including heart disease (Morris & Heady, 1953; Paffenbarger et al., 1983; Powell et al., 1987; Berlin & Colditz, 1990; Kiely et al., 2004) and cancer (Paffenbarger, Hyde & Wing, 1987; Martinez et al., 1997). Furthermore, sedentarism has been suggested as a contributory factor to obesity (Prentice & Jebb, 2004), and along with physical inactivity has been cited as among the most important and contributory factors for many chronic diseases (Bouchard, 2000). As a result, it may be assumed that engaging in physical activity can lead to overall improved health.

In the mid 1990s, the US Surgeon General (US Department of Health and Human Services (USDHHS), 1996) noted that regular physical activity could lead to reduced risk of premature mortality, heart disease, cancer and type 2 diabetes. Physical activity has also been associated with improved mental well being (Stephens, 1988) and quality of life among both general and special populations. With respect to the latter, Rejeski and Mihalko (2001) observed improvements in quality of life among older people in several studies while Rimmer, Braddock and Pitetti (1996) commented on the considerable potential of using physical activity to enhance the well being of people with disabilities.

As well as adopting a causal and preventive role in ill health, physical activity is also used as a treatment for many conditions, particularly in cardiac rehabilitation. Fletcher et al. (1996) noted that prescribed, supervised exercise programmes for people with heart disease can decrease associated rates of morbidity and mortality. Furthermore, Martinsen (1994), in a review of studies that examined exercise as a treatment for depression found that exercise was equally effective to psychotherapy in achieving favourable health outcomes.

1.2 Rates of Physical Inactivity Worldwide and in Ireland

Despite the accumulating evidence about the benefits of physical activity, over the past two decades rates of inactivity and sedentary behaviour have remained high with the World Health Organisation recently stating that up to 60% of the world's population do not meet minimum guidelines for regular physical activity (WHO, 2009).

Typically, inactivity rates are higher among females compared to males and consequently associated ill health is greater among females. For example, in Europe, Sjöström et al. (2006) reported that men were 1.6 times more likely to be sufficiently active than females while in 2008, the WHO stated that 61.5% of all female deaths and 57.9% of male deaths were due to preventable disease, with disparity in mortality rates from heart disease the main source of this difference. Lower sufficiently active rates among adult females begin with decreases in participation by girls during adolescence. In the UK (UK Department of Health, 2004) two thirds of boys and girls aged 2-11 years reported engaging in 60 minutes of moderate intensity activity per day, this was maintained among boys to, but decreased by half among girls, at age 15.

In Ireland, Sjöström et al. (2006) reported that 36% of males and 22% of females were sufficiently active, somewhat similar to findings produced from a population health (SLÁN) survey in Ireland that used a standardised instrument. In the latter, 32% of males were categorised as high active, an indicator of sufficiently active, compared to 16% of females (Morgan et al., 2008). As per UK data, participation in regular vigorous activity decreased among girls in Ireland between the ages of 11 and 15 years; from 58% to 28% (Nic Gabhainn et al., 2007). While efforts to understand and lessen this adolescent age-related decline in activity are widespread, and will be discussed in more detail later, it is unlikely that it can be eradicated and thus, promotion of physical activity among adult females is also warranted. At this stage of the lifespan many barriers to physical activity specific to women, such as marriage, parenthood, and an associated lack of time and motivation (Brown & Trost, 2003; Bellows-Riecken & Rhodes, 2008; Chinn et al., 1999) must be overcome to facilitate engagement in physical activity by females.

1.3 Promoting and Maintaining Regular Physical Activity

A substantial number of interventions have been undertaken to promote physical activity among women at a population level. Programmes to induce change have included the delivery of low cost, minimal contact interventions using print, mass media and the internet and/or the administration of population and community level interventions such as mass events and national campaigns. These interventions are commonly theoretically based and, according to the theory or model of behaviour change applied, have attempted to increase participation in activity by focusing on factors including self efficacy, social support, barriers to activity and environmental attributes.

Specifically, the use of the transtheoretical model and social cognitive theory to target constructs such as readiness to change and self efficacy has been quite common (Marcus et al., 1998a; 1998b; Miller et al., 2002; Marshall et al., 2003a; 2004; Napolitano et al., 2006; Marcus et al., 2007a) and has yielded some positive changes in physical activity. Recently social-ecological frameworks have been used in community settings to increase physical activity. These interventions attempted to test multi level intervention strategies that targeted personal, psychological, social and environmental factors related to being active (Winkleby et al., 1996; Wen et al., 2002; Perry et al., 2007; Speck et al., 2007; Keyserling et al., 2008; Wendel-Vos et al., 2009).

These well designed efforts can and have increased individual and population levels of physical activity but these frequently dissipate over time and do not often have lasting positive effects. Consequently, it is important to investigate the maintenance of physical activity behaviour change as well as its continued promotion among sedentary populations. Inherent in such efforts to enhance maintenance is consideration of behavioural relapse. Relapse is apparent in many interventions where participants display an initial increase in physical activity before regressing to pre intervention levels of activity. Despite this, relapse has rarely been comprehensively investigated. Studies that have addressed this concept have applied contrasting definitions of relapse (Marcus et al., 1998b; Sallis et al., 1990; Bock et al., 2003; Barnett et al., 2008). Predictors of these various relapse states were infrequently described while no study was identified that actually attempted to encourage relapsers to re-commence regular physical activity.

1.4 Aims of this Research

Given the background described above, the aims of this research are to:

1. Evaluate the impact of mass community physical activity events in promoting and maintaining physical activity amongst women before and after the event.
2. Investigate the incidence of relapse to ‘insufficiently physically active’ following participation in these events.
3. Design, administer and evaluate two evidence based, controlled trials to maintain and support increased physical activity levels post event among women who had relapsed and who were consistently low active pre and post event.

1.5 Theoretical Framework

The theoretical underpinnings of this research vary across the different phases of the project. Initially, the relationship between mass events and physical activity was explored using theoretical frameworks reviewed by Murphy and Bauman (2007). Secondly, predictors of physical activity derived from models and theories of behaviour change were used to identify potential determinants of physical activity among participants prior to, and following, their participation in the mass event. These theories included the transtheoretical model, social cognitive theory and the social-ecological model and they also served as a guide to the design and delivery of interventions designed to promote physical activity among selected event participants. These models and theories are discussed in detail in chapter 2. This research was not uniquely grounded in or reliant on any particular theory or model of behaviour change. Theory was used in intervention development but the overall aim was to identify the public health, real life impact of participation in mass events and to develop practical, transferrable strategies to promote physical activity. This equates to maximising both the external and the internal validity of findings generated.

1.6 Research Methodology

This research adopted quantitative methodologies to collect data on variables of interest. The first phase of the research incorporated a longitudinal, cohort design, gathering information from event participants prior to and following their participation in a mass event. A randomised controlled design was then implemented in the second phase of the work; to investigate the effectiveness of interventions to maintain increased physical activity levels. An outline of the study is depicted in *Figure* 1. Short term follow up refers to two/three months post baseline and long term follow up six months post baseline. Self report questionnaires were used to collect information throughout this research. A discussion on measurement issues and options specific to physical activity is presented in chapter 2 (p.43-44) while the specific tools to be used in this study (International Physical Activity Questionnaire and Active Australia Questionnaire) will be reviewed in subsequent chapters.

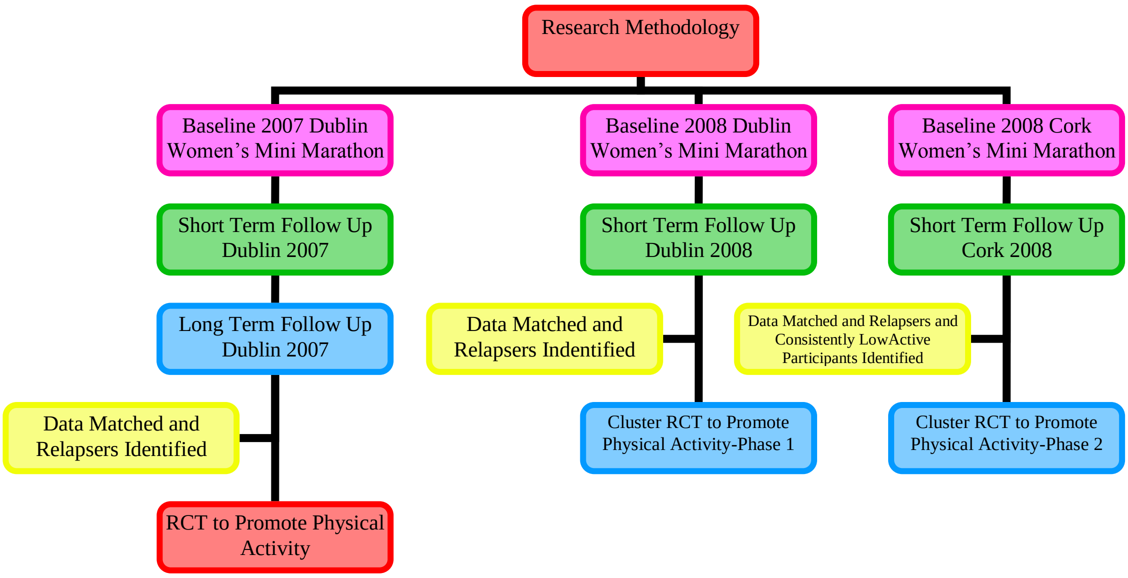


Figure 1. Overview of research methodology

1.7 Structure of Thesis

This thesis incorporates eight chapters, organised into four parts. Part A includes chapter 1, which has presented a general introduction to the thesis, and chapter 2, which provides some additional background information to the topic being assessed. Part B, and chapters 3-5 contain an assessment of mass events, while Part C (chapter 6-7) describes original interventions to promote physical activity. A discussion of the limitations, recommendations and conclusions arising from each part of the research is presented at the end of each chapter. In Part D and chapter 8 the main findings and overall implications of this research are summarised.

1.7.1 Part A: Introduction and background.

Part A includes this chapter, which has presented a general introduction and overview of this thesis. Chapter 2 provides an overview of the various correlates of physical activity, theories and models of behaviour change, mediators of change and measurement issues specific to collecting physical activity data.

1.7.2 Part B: The role of mass events in promoting and maintaining increased participation in physical activity.

Part B comprises chapter 3-5. Chapter 3 presents an overview of mass events and evidence for the effectiveness of these initiatives in promoting physical activity. Cross sectional results from the surveys carried out prior to the three events included in this research are outlined and used to illustrate any support for the use of mass events to promote physical activity.

Chapter 4, an adjunct to the previous chapter, includes the cohort data (matched baseline and follow up) provided by mass event participants. Analysis similar to that undertaken in chapter 3 permitted an investigation of the long term impact of mass events, changes in physical activity and how these vary across demographic, psychosocial and event participation parameters.

In chapter 5, a more specific and detailed assessment of matched cohort data is undertaken. The concept of relapse from 'sufficient' to 'insufficient' levels of physical activity is described. Finally, factors associated with relapse are assessed. Participants identified as relapsers are subsequently scheduled for inclusion in the proposed interventions to re-initiate participation in physical activity.

1.7.3 Part C: Interventions to promote physical activity among populations based samples of Irish women.

Chapter 6 describes the background, design, administration and evaluation of a minimal contact, print based intervention to promote physical activity among a defined sample of participants (as per chapter 5) recruited from the 2007 Dublin Mini Marathon. This intervention served as a pilot randomised trial, (Trial 1) prior to further efforts to promote physical activity following the 2008 event.

In chapter 7, the results of a subsequent cluster randomised controlled trial (Trial 2) to promote physical activity, using the community as a resource, are presented. Participants similar to those in chapter 6, as well as consistently low active participants, were recruited to the trial. These women had participated in the 2008 Dublin and Cork Mini Marathon events.

1.7.4 Part D: Conclusions.

The conclusion section contains a summative assessment of the findings generated in this research as well as a discussion on potential implications and recommendations for public health efforts to promote physical activity.

Chapter 2: Study Background

2.1 Physical Activity and Health

The positive effects of physical activity are well established. Evidence has accrued from a number of studies on different populations in different settings. In this chapter, many of these will be reviewed with initial focus allocated to some of the major epidemiological studies that first highlighted the beneficial effects of physical activity in relation to chronic disease. These studies incorporated male and female samples, across a variety of age groups and their findings will be used to illustrate the importance of physical activity for all and the merit for the promotion of an active lifestyle.

2.1.1 Chronic Disease Rates

The World Health Organisation (2008b) presented an updated report on the Global Burden of Disease and observed that, in 2004, out of ten deaths worldwide, six were attributable to non communicable or chronic disease. Of the many diseases in this category, cardiovascular disease (CVD) was the leading cause of death, accounting for approximately 30% of mortality among males and females. Cancer was the next most prominent chronic disease with a 12% mortality rate, while the rate for diabetes was comparably low at approximately 2%. These death rates from chronic disease were at their highest in Europe in comparison to other regions worldwide. Within Europe, mortality from CVD and cancer was highest in Ireland, Italy and France, at approximately 30%, compared to 7-8% rates in Uzbekistan and Kyrgyzstan. These rates have been forecast to increase further due to ageing populations and worsening health behaviours.

In relation to the latter, the World Health Organisation (2009) noted that of the many factors in the causal paradigm for chronic disease and general ill health, physical inactivity is responsible for 6% of all cause mortality and may also be implicated in the 13% and 5% of deaths that are due to high blood pressure and overweight/obesity. These detrimental effects of being insufficiently active were deemed more prominent in middle and high income countries largely unsurprising given the high mortality rates from chronic disease in the more affluent, developed countries in Europe. In the sections below, the role of physical inactivity in specific chronic diseases, such as CVD, cancer and diabetes will be assessed.

2.1.2 Physical Activity and Cardiovascular Disease

The earliest and most convincing support for the benefits associated with being active were generated from several large, cohort studies undertaken in England, the US and Finland. Morris and Heady (1953) collated mortality data for men in England and observed that those employed in 'light' jobs, in terms of the physical activity involved in them, had greater mortality rates for coronary heart disease than men involved in 'heavy' jobs. Later, Paffenbarger et al. (1983) reported on the relationship between physical activity and hypertension. Health related data on men who entered Harvard University between 1916 and 1950 were supplemented with a series of physical activity and health questionnaires administered following graduation. Previous findings from this Harvard Alumni Health Study revealed that there was a link between physical activity and heart disease. Results from this analysis, on a total sample of just under 15,000 males, highlighted that 59% of those who engaged in no vigorous activity had a 35% increased risk of hypertension; this remained upon adjustment for age and BMI.

Powell et al. (1987) undertook a systematic review of trials linking physical activity and CVD and observed a consistent, inverse, causal relationship between physical activity and heart disease. Berlin and Colditz (1990) later pooled relative risks for vigorous activity versus moderate or low intensity activity and noted that the association between activity and CVD was greatest upon comparison of vigorous and sedentary data. Kiely et al. (1994) evaluated the link between physical activity and stroke using data from another prospective cohort study, the Framingham study, which included over 5,000 participants who have been assessed bi-annually since 1948. Findings revealed that men who engaged in low levels of physical activity had an increased risk of stroke; there was no association detected in females. Kaplan et al. (1996) reported on a similarly designed study, the Alameda County Study, which began in 1965 and boasted a sample size of 6,928. Physical activity and other variables were measured at nine year intervals and mortality was recorded. Results indicated that participants in the lowest bands of physical activity had the highest mortality rates and that leisure time activity, adjusted for other health factors and changes over time, was protective against CVD.

Much analysis of the physical activity and CVD paradigm has incorporated gender and age specific assessments. The majority of earlier studies, including the Harvard Alumni Health Study cited above, incorporated a male only sample. A further report on the latter stated that a positive change in lifestyle during the 30-year study period and the uptake of moderate intensity activity was equally efficacious in protecting against mortality (Paffenbarger et al., 1993). This suggests that being physically active at any age throughout the lifespan can induce significant health benefits. Among women, Sherman et al. (1994) noted that the relationship between physical activity and CVD was less well established. They did however; find that more active women had a 30% lower risk of overall mortality than their less active counterparts using data from the Framingham Study. Later, Manson et al. (2002) did observe that walking and vigorous intensity physical activity were associated with a decreased risk of CVD among postmenopausal women who were recruited to the Women's Health Initiative Observational Study; a prospective study with an approximate six year follow up period.

Oguma et al. (2002) undertook a systematic review of literature pertaining to the link between physical activity and all cause mortality in women. Over 60% of the studies reviewed reported a significant inverse relationship between these factors, with an approximate 34% reduced risk, while the remainder also showed a decreased risk associated with being active that did not reach significance. More importantly, risk reductions were very similar to those apparent among male populations.

2.1.3 Physical Activity and Cancer

As well as the beneficial effects on CVD, physical activity also reduces the risk of several types of cancer. Paffenbarger, Hyde and Wing (1987) analysed research on San Francisco Longshoremen where results suggested a protective role for physical activity in cancer among males recruited to an 18-year long cohort study. They also assessed the previously referenced Harvard Alumni study and found that more active males had a reduced risk of rectal and colon cancer. Slattery et al. (1997) later undertook a case control study of male and female participants in California who were diagnosed with colon cancer. Physical activity was assessed retrospectively and results showed that long term engagement in vigorous activity was associated with a reduced risk of colon cancer; no strong relationships were generated for moderate activity, which was most commonly reported by the participants.

Martinez et al. (1997) used data from the Nurses Health Study to further investigate if moderate, leisure oriented physical activity could reduce the risk of colon cancer. This largest ever women only cohort study involved over 120,000 nurses and began in 1978 with follow up assessments undertaken every two years. Cases of colon cancer were identified between 1986 and 1992 and, in this instance, involvement in leisure time physical activity was independently associated with a reduced risk of colon cancer. Thune et al. (1997) recruited a large sample of over 20,000 women in Norway and identified cases of breast cancer, which they discovered had a favourable dose response relationship with physical activity. Later, Thune and Furberg (2001) reviewed literature relating to physical activity and all types of cancer, specifically research that incorporated case control and cohort study designs. Strongest evidence was found for a protective effect of physical activity on colon and breast cancer while less convincing support was identified for the role of physical activity in preventing prostate and endometrial cancer. This was re-affirmed in a review of the causes of cancer completed in 2007 by the World Cancer Research Fund and American Institute for Cancer Research.

2.1.4 Physical Activity and Diabetes

Physical inactivity is also associated with the development of type 2 diabetes. Helmrich et al. (1991) reviewed data from the University of Pennsylvania alumni study, which included almost 6,000 male participants. Over almost 100,000 man-years follow up, it was observed that participation in leisure time physical activity was inversely related to incidence of diabetes. Among women, Manson et al. (1991), using eight year follow up data from the Nurses Health Study noted that the risk of developing diabetes decreased among women who exercised regularly compared to their sedentary counterparts. Carnethon et al. (2009) reported on the relationship between objective measurements of fitness and incidence of diabetes in the CARDIA study, a longitudinal study of lifestyle, which began in the 1980s and has tracked over 5,000 young adults for 20 years. Results indicated that decreases in fitness after seven years were significantly related to developing diabetes at 20 years post baseline. This finding was apparent in men and women and indicates the importance of maintaining adequate levels of fitness into middle and old age.

2.1.5 Physical Activity and Obesity

In many of the previously noted cohort studies that identified physical inactivity as a risk factor for chronic disease, being overweight or obese was also detrimental to well being (Paffenbarger et al., 1983; Manson et al., 1991; Martinez et al., 1997). These two risk factors for chronic disease are linked and have attracted attention due to the growing obesity epidemic worldwide (WHO, 2004). Indeed, Prentice and Jebb (2004) assessed reasons for increasing obesity levels, citing changes in diet, and decreased participation in physical activity, accompanied by increased sedentarism as primary causal factors.

Prentice (2006) reviewed statistics contributing to this epidemic and noted that obesity rates, most commonly assessed using BMI, are high and increasing in Europe and North America while they also appear to be escalating in developing as well as developed countries. Recent data from the NHANES Survey in the US, presented by Ogden et al. (2006) showed significant increases in obesity between 1999 and 2004 among adults and children with prevalence currently at 50% overweight/obesity among children and 66% among adults. Rates in the UK are similar; approximately 60% of adults were classified as overweight or obese in 2003 with higher rates among males (Zaninotto et al., 2006). Not surprisingly, it was also noted that obesity rates were greatest among the least active.

In Ireland, rates are somewhat lower than the UK, perhaps due to the reliance on self report data. Morgan et al. (2008) reported that 50% of the overall adult population were overweight or obese, 59% of males fulfilled this criteria compared to 41% of females (objective data were collected for this same research but has not yet been published). Meanwhile, Fahey, Delaney and Gannon (2005) remarked that approximately 20% of Irish children, aged 5-12 years are overweight or obese. While these rates are lower than US and UK statistics, it is possible that they will increase.

2.1.6 Physical Activity and Mental Well Being

Evidently, physical activity is beneficial for physical well being but it can also play a prominent role in the promotion of positive mental health. Stephens et al. (1988) analysed data from four North American population surveys conducted in the late 1970s and early 1980s. More active people performed better on mental health indices and this relationship was particularly prominent among women and elderly groups. This was only cross sectional evidence but does reinforce the premise that being active is good for mental well being. Assessment of data from a more reputable longitudinal study, specifically the Alameda County Study (Camacho et al., 1999) revealed that low levels of activity at baseline were related to increased risk of depression at follow up among males and females despite the effect being diminished by other health and social class indicators.

Dunn, Trivedi and O'Neal (2001) reviewed literature on physical activity and its subsequent effect on anxiety as well as depression and found that all cross sectional and prospective studies reviewed did report some link between this risk factor and outcome. Even more recently, Hamer, Stamatakis and Steptoe (2008) used data from three separate Scottish Health Surveys to assess if a dose response relationship existed between mental well being and physical activity. Results indicated that any type of physical activity was associated with reduced risk of psychological distress with the greatest risk reduction apparent among participants who played sports, irrespective of gender or age. Conn (2010) undertook a meta-analysis of the effect of physical activity interventions on depressive outcomes and reported a positive effect of this intervention strategy on indicators such as anxiety and mood. This offers further evidence of the value of physical activity for mental wellness.

2.1.7 Economic Costs of Physical Inactivity

The disease and disability induced by physical inactivity also has economic implications. Colditz (1999) reported that the direct costs of insufficient physical activity in the US accounted for 2.4% ($24 billion) of the total health expenditure in 1995. Also, obesity, independent from a lack of activity, accounted for a further $70 billion. Katzmarzyk, Gledhill and Shephard (2000) investigated the economic burden of physical inactivity in Canada and found that direct health care costs associated with physical inactivity amounted to approximately $2 billion in 1999, 2.5% of total health care costs; similar to the US statistics. The UK Department of Health (2004) observed costs similar to Canada and the US, of £8.2 billion per year, also equating to approximately 2.5% of national health care costs.

As well as the direct health care costs attributable to physical inactivity, indirect costs including absenteeism and decreased productivity are also attracting considerable interest. Absence rates are higher among inactive workers (van Amelsvoort et al., 2006; Jacobson & Adana, 2001), which leads to lower productivity and associated costs to a workplace, such as staff replacement. In Ireland, the cost of work absenteeism to small firms was reported as approximately €757 million per year (Finfacts, 2007).

Considering the cost associated with inactivity, it is likely that savings could be induced if activity levels were modified. Indeed, in a fact sheet presented by the British Heart Foundation for Physical Activity and Health (2010), it was stated that as well as saving lives, a decrease in physical inactivity could lead to savings to the health service and other economic benefits. Specifically, in Northern Ireland Swales (2001) reported that achieving a defined national target of a 5% decrease in the proportion of adults classified sedentary (20% to 15%) could reduce inactivity related deaths by approximately 121 per year among those aged less than 75. The associated economic benefit of this reduction in mortality was estimated at £131 million while savings for the health service were valued at £620,000 per year.

Overall, this discussion of the economic costs of physical inactivity illustrates that a sedentary lifestyle has implications that extend beyond ill health. It is important that this economic argument for physical activity promotion is presented at local, national and international political settings. Given the global financial crisis that currently exists worldwide, it is likely that this may prove to be the most important aspect of any argument presented by physical activity advocates seeking intervention and change at a policy level.

2.1.8 Summary

The World Health Organisation (2008b) in an updated report on the global burden of disease noted that 60% of all deaths were attributable to chronic disease; this increased to 90% in developed nations and was highest in European countries. The report also offered projections on mortality in 2030 and predicted that death from chronic disease would increase among high, middle and low income countries and that this would be complimented by a decrease in mortality from infectious disease, particularly in the latter nations.

Given the plethora of evidence discussed on the link between physical inactivity and this ill health, and their associated economic costs, it is clear that inactivity is a significant public health problem for populations worldwide. Furthermore, population attributable risk (PAR) estimates, which estimate the burden of a disease due to a specific risk factor (physical inactivity), have been generated and have suggested that 35% of mortality from CVD was due to physical inactivity (Kesaniemi et al., 2001). There is also a dose response gradient between physical inactivity and all cause mortality, which implies that the risk of mortality decreases consistently with increased engagement in physical activity (Lee & Skerrett, 2001). Lastly, the WHO (2009) has identified physical inactivity as one of the five leading risk factors for mortality, along with high blood pressure, smoking, and high blood glucose and ahead of overweight and obesity.

2.2 A Brief History of Physical Activity Recommendations

In 1988, as evidence for the benefits of physical activity were becoming apparent, the American College of Sports Medicine (ACSM) produced the first set of guidelines for exercise prescription. Bijnen, Caspersen and Mosterd (1994) then presented a position statement for the World Health Organisation on physical activity in relation to heart disease and called for national policies and surveillance systems to be instigated to curb increasing rates of inactivity, particularly in developed countries. Bijnen et al. (1994) also advocated engaging in any type and amount of activity rather than being completely inactive while acknowledging the increased health benefits associated with moderate and vigorous intensity activity; both are advantageous for health (Paffenbarger et al., 1983; Berlin & Colditz, 1990; Paffenbarger et al., 1993). Subsequently, Haapanen et al. (1996) in their study in Finland reported that the most notable increase in risk of mortality occurred when an individual's activity status moved from somewhat active to sedentary.

Findings from these and other studies led to the development of specific guidelines for physical activity, which were produced by the Centre for Disease Control (CDC) and ACSM (Pate et al., 1995) and later adopted and supported by the US Department of Health and Human Services (1996). The specific recommendation was that adults should accumulate at least 30 minutes of moderate intensity activity on most days of the week. Lee and Skerrett (2001) observed that even minimal adherence to these recommendations could lead to risk reductions for mortality of between 20-30%. Haskell et al. (2007) later moved to clarify these initial proposals on physical activity; defining most days as five days, incorporating vigorous intensity activity and muscle strengthening in the guidelines and advocating more than the minimum engagement. Furthermore, these recommendations were promoted as being an addition to activities of daily living; perhaps due to findings from Haapenan et al. (1996) and Yu et al. (2003), who both noted that occupational physical activity alone was not sufficient to generate health effects; it must be supplemented with some leisure based activity.

Warburton, Nicol and Bredin (2006) assessed the health effects of physical activity and physical fitness in a narrative review, which assimilated and presented much of the evidence and literature discussed previously. The review addressed the contrasting risk reductions associated with physical activity and physical fitness; the latter accruing a greater decreased risk (up to 50%) of mortality, compared to 30-40% for physical activity. Despite this, the more consumable, acceptable and less daunting term, physical activity, is the chosen message that is used worldwide. Indeed, the most recent US edition of physical activity guidelines (USDHHS, 2008) focused on physical activity and health related fitness. Also, the main physical activity message of the guidelines was adapted to advocate the accumulation of at least 150 minutes of moderate intensity activity (or 75 minutes of vigorous intensity activity, or both) per week in various ways. It was also recognised that even low amounts of physical activity are beneficial while additional favourable outcomes occur with greater involvement in higher intensity activities, with a new ‘high’ level of activity set at 300 minutes per week. Guidelines for physical activity and national policy documents are becoming more common worldwide with many countries formulating their own guidelines or adapting those produced by the USDHHS (Bull et al., 2004). Also, Daugbjerg et al. (2009) identified 213 physical activity related documents across Europe. Despite the production of these and the health related benefits of being active, population physical activity rates remain low.

2.3 Prevalence of Physical Activity among Adults Worldwide

Table 1 below illustrates the prevalence and range of sufficiently active worldwide. In the US, using data from the 2007 Behavioural Risk Factor Surveillance System (BRFSS) there was disparity between the proportion deemed sufficiently active using the old and new guidelines for physical activity. The CDC (2008) noted that the different results generated by these two definitions was due to the removal of the frequency requirement in 2008 as well as the additional allowance to recruit physical activity minutes using a combination of vigorous and moderate activities. Bauman et al. (2009) later produced an international assessment of physical activity behaviour. This study included countries that produced physical activity data on a representative sample of at least 1500 adults using the International Physical Activity Questionnaire (IPAQ). The authors used of a common, validated measurement tool to facilitate worldwide comparisons. In the US, 84% of respondents were categorised as moderate or high active and thus, achieving minimum physical activity requirements, as per USDHHS (1996) criteria. This sufficiently active rate is considerably higher than those produced by the CDC (2008) possibly due to the inclusion of walking in the IPAQ instrument, its generic nature and assessment of all domains of physical activity, and the combination of moderate and high active in the definition of sufficiently active.

Bauman et al. (2009) did note that although high active equates to more than the minimum requirements for physical activity, it is more suitable to use as an indicator of sufficiently active, primarily because IPAQ uses multiple domains in its assessment of physical activity. This alternative expression of sufficiently active revealed that 62% of the US adult population were meeting physical activity guidelines, closer to those observations by the CDC (2008). In Australia and New Zealand, data collected revealed comparable sufficiently active rates to the US while rates were notably lower in Brazil. The Health Survey for England (Craig & Mindell, 2008), albeit using a different measurement tool, reported that 34% of the adult population were active. Sjöström et al. (2006) provided an assessment of physical activity in Europe, using IPAQ data collected in the Eurobarometer Survey in 2002. The average sufficiently active rate for Europe was 31%, considerably lower than the US and Australia.

Table 1

Physical Activity Rates Worldwide

Author (Year)	**Setting and Sample Size**	**% Sufficiently Active (USDHHS, 2008)**		**% Sufficiently Active (USDHHS, 1996)**	
CDC (2008)	US (n=430,912)	64.5		48.8	
Craig & Mindell (2008)	UK (n=14,142)	-		34	
		% Sufficiently Active (IPAQ High Only)		**% Sufficiently Active (IPAQ High and Moderate)**	
		Overall	Females	Overall	Females
Bauman et al. (2009)	US (n=2,691)	62	57	84	82
	Australia (n=4,671)	59	51	83	80
	New Zealand (n=n=1,449)	63	52	88	83
	Brazil (n=981)	25	13	70	66
Morgan et al. (2008)	Ireland (n=10,176)	24	16	71	69
Sjöström et al. (2006)	Ireland (n=1,000)	29	22	-	-
	Great Britain (n=1,000)	29	22	-	-
	Netherlands (n=1,000)	44	40	-	-

2.3.1 Physical Activity in Ireland

While no systematic monitoring of physical activity takes place in Ireland, a measurement of physical activity has been included in the National Health and Lifestyle (SLÁN) Surveys, albeit using different measures, since 1998. The first two of these three cross sectional surveys used a basic three by twenty minute assessment of physical activity, while the most recent version used the IPAQ instrument to measure physical activity. Although comparisons are limited due to the different assessment methods, frequency and intensity of physical activity was measured in all three surveys. In *Table 1*, it is apparent that according to the most recent SLÁN survey (Morgan et al., 2008), 24% of the overall adult population in Ireland are high active, considerably lower than equivalent rates in the US, Canada and Australia and marginally lower than European countries, such as Great Britain, and the Netherlands. It is also notable that sufficient activity rates for females are quite low in Ireland similar to those in Brazil, compared to other countries. Higher rates of activity evident in the US, Australia, Norway, and the Netherlands may be due to more facilities in these countries and a long history of exercise promotion (Bauman et al., 2009).

It is perhaps more appropriate to compare insufficiently active rates across the three aforementioned lifestyle surveys in Ireland. Subsequent analysis revealed an overall decrease in those doing no physical activity in an average week between 1998 and 2007. In 1998, approximately 23% (n = 6,539) of the Irish adult population (Friel Nic Gabhainn & Kelleher, 1999) did not partake in any physical activity, this increased in 2002 to 28% (n = 5,992) and decreased in 2007 to 19% (n = 10,364) (Kelleher et al., 2003; Morgan et al., 2008). Further IPAQ analysis in 2007 indicated that 29% of the Irish adult population were low active (Morgan et al., 2008), and thus do none or limited amounts of physical activity and do not meet minimum physical activity recommended levels (US Department of Health and Human Services, 2008).

In another Irish study it was reported that 50% of the adult population in Ireland engage in insufficient physical activity or are sedentary (Lunn & Layte, 2009). This latter study examined the sport and leisure time physical activity domains only and this may explain the higher rates of inactivity than more generic physical activity measures. Indeed, Henderson (2009) observed that participation rates in sport are often low. In the most recent Eurobarometer survey, participants were asked to indicate how often they partake in sport and physical activity; domain or intensity specific physical activity data was not collected. Approximately 42% of Irish respondents indicated that they seldom or never participate in sport, similar to the findings from Lunn and Layte (2009). A lower proportion (26%) reported a similar lack of engagement in physical activity outside of sport (TNS Opinion and Social, 2010).

Irrespective of the nature and type of data collection and the variation in sufficiently active rates across countries, worldwide there exists individuals who are not participating in enough or any physical activity. To assist efforts to promote physical activity, an understanding of the correlates of being physically (in)active is necessary.

2.4 Correlates of Physical Activity

There has been some debate about the terminology which should be used to describe factors associated with physical activity. Martin et al. (2000a) referred to determinants of physical activity in a study on the personal factors that influence activity levels. Personal factors included demographics, activity history, psychological traits, and attitudes and beliefs. Environmental determinants though not assessed were also alluded to; encompassing access to facilities, social support and time to be active. A later discussion by Bauman et al (2002) questioned the use of this term 'determinant' in this context, stating that it refers to cause-effect relationships, which are uncommon in cross sectional physical activity research. Rather, it was claimed that correlates of physical activity and behaviour change exist. This suggests associations or predictive relationships, rather than causal equivalents, between personal, environmental and social factors and physical activity.

The Ottawa Charter for health promotion, produced by the World Health Organisation in 1986 was one of the first formal international statements to highlight the wide variety of factors (political, economic, social, cultural, environmental, behavioural and biological) that influence health and well being. It is likely that subsequent attempts to understand influences on physical activity and other health behaviours could be based on the charter. Trost et al. (2002) undertook a review of the many correlates of adults participation in physical activity, an update on work previously undertaken by Sallis and Owen (1999). Correlates included demographic and biological factors, psychological, cognitive and emotional factors, behavioural attributes and skills, social and cultural factors, physical environmental factors and physical activity characteristics. It is important at this point to consider briefly this wide variety of interpersonal, community and environmental factors as it is likely that they all are related to physical activity and will facilitate a greater understanding of the activity status of participants in the current research.

2.4.1 Personal Factors

2.4.1.1 Gender.

Gender and age have been identified as two of the strongest demographic correlates of physical activity. The majority of physical activity literature, descriptive, longitudinal or intervention based, observes higher physical activity rates among males (Martin et al., 2000a; Bengoechoea, Spence and McGannon, 2005; Annear, Cushman and Gidlow, 2009), at all ages. Dowda et al. (2003) assessed correlates of physical activity specifically for young adults aged 18-30 in the US. Results indicated that males engaged in significantly more moderate vigorous physical activity (MVPA) per week than females. This was reaffirmed recently by the CDC (2008), who reported that 51% of men and 47% of women met minimum physical activity requirements in the US.

Even more disparity was apparent in the UK, 40% of men and 28% of women reported exercising for at least 30 minutes a day, most days of the week (Craig & Mindell, 2008), and in Ireland where twice as many males (32% v 16%) than females were deemed high active (Morgan et al., 2008). Indeed, across Europe overall, Sjöström et al. (2006) noted that males were more likely to be deemed sufficiently active than females while Bauman et al. (2009) reported a comparable pattern in Australia, Brazil, Hong Kong and New Zealand with some exceptions in Argentina, Portugal and Saudi Arabia where more women were categorised as high active. Physical activity levels among females in Ireland is a core component of this research and is analysed in greater depth in the next chapter.

2.4.1.2 Age.

Age typically has an inverse relationship with physical activity, especially leisure time physical activity. Cross sectional studies from the US, UK and Ireland all reported declines in physical activity with increasing age (CDC, 2008; Craig & Mindell, 2008; Morgan et al., 2008). Specifically, in Ireland, it was noted that inactivity increased from 22% in the 18-29 age group to 44% in the 65+ age group (Morgan et al., 2008) while 20% of the youngest age group of females were high active compared to 9% of the oldest group. Using different measures and focusing primarily on participation in sport, Lunn and Layte (2008) observed a similar age related trend. In their retrospective, cross sectional assessment of Irish sporting lives it was reported that after the age of 15, participation in sport decreased consistently with age, most notably among females. Sjöström et al. (2006) noted that in comparison to the 15-29 age group adults in Europe aged 30-54 years and older than 55 years were approximately 25% and 60% less likely to be sufficiently active. Bauman et al. (2009) observed similar disparity between those aged 18-39 and 40-65 in their international comparison of physical activity, with similar trends among males and females.

While it is accepted that physical activity declines with age, many studies on older adults typically observe that physical activity remains relatively unchanged within sub groups of the elderly. For example, Conn et al. (2003) recruited a sample of women aged 65-93 years and found that age, in this sample, did not have a significant effect on exercise. Furthermore, Annear et al. (2009), using data from a similarly aged sample of older adults from various socio-economic backgrounds, also reported no effect for age on physical activity.

2.4.1.3 Education/Income/Socio-economic status (SES).

Low socioeconomic status (SES), or other expressions of this such as low income or education, also has a negative association with physical activity. In Ireland, Morgan et al. (2008) noted that 27% of the highest social class group were high active compared to 25% of the lowest class while Lunn and Layte (2008) observed a decrease in physical activity as educational attainment lowered among males and females. More notably, in the US, the CDC (2008) reported that 38% of respondents whose education ceased before the end of high school were meeting physical activity requirements compared to 54% of college graduates. Dowda et al. (2003) also reported a strong association between years of education and physical activity among young adult males and females in the US. In Europe, Sjöström et al. (2006) found that individuals with between 16 and 19 years of education had a 20% increased chance of being sufficiently active compared to those who reported 15 years or less education. It is unsurprising then that Trost et al. (2002) observed that SES, occupational status and educational attainment were all consistent correlates of physical activity.

Parks, Housemann and Brownson (2003) also noted that income was a very important factor in determining an individual’s activity status in their study, which used data from the BRFSS on US adults (n=1,818). Lower income participants were less likely to meet physical activity recommendations than their higher earning counterparts.

A similar observation was presented by Phongsavan, McClean and Bauman (2007) in their assessment of cross sectional data from New Zealand on approximately 8,000 participants. Respondents who earned more than $70,000 per year had a 25% increased chance of being sufficiently active. Annear et al. (2009) reported on engagement in leisure time physical activity (LTPA) among older adults from diverse socio-economic communities. Results indicated that participants from low deprivation neighbourhoods participated in significantly more LTPA than their counterparts from highly deprived areas.

Finally, Cleland et al. (2009) investigated the role of SES and social mobility in physical activity behaviour over the lifespan. Over 8,000 participants, aged 7-15, were initially recruited in 1985 and followed up an average of 19.6 years later. Self reported physical activity and fitness were assessed at baseline and follow up, resulting in a final sample size of over 2,000 participants. Baseline SES was based on parental education, and social mobility reflected changes between this and participant SES at follow up. Subsequent findings indicated that females who improved their socio-economic position were 38% more likely to increase their physical activity than to remain inactive. Hence, no lasting impact of parental education levels on their child's health was detected. Thus, the authors advocated the use of education, among other strategies, to facilitate favourable changes in physical activity across the lifespan.

2.4.1.4 Marital status.

Literature has remarked that any unmarried state (single, divorced, widowed) is associated with greater mortality risks than being married, although the mechanism behind this relationship is unclear (Molloy et al., 2009). King et al. (1998) investigated the relationship between marital status and physical activity. Subjects were male and female participants in the Stanford Five City Project, a cohort study which operated over a ten year period and included the administration of frequent health surveys. A final sample size of over 500 participants had complete data necessary for this analysis. Over 10% changed their marital status over the assessment period; 60% of these moved from single to married and the remainder from married to single. Analysis indicated that overall, there was no difference in physical activity between marital states. However, getting married was associated with initial decreases in physical activity in the pre-marriage period followed by net overall increases in activity compared to remaining single, with no gender effect apparent.

In contrast, a cross sectional study in Europe (Martinez-Gonzalez et al., 2001) highlighted that participants who were married or cohabiting or widowed/divorced reported lower physical activity levels than their single counterparts. This was also noted by Brown and Trost (2003) upon analysis of data from the Australian Longitudinal Study on Women's Health (ALSWH), which recruited three cohorts of young, middle aged and older women (n = 40,000) in 1996 and assessed their health behaviours at three year intervals. In the young cohort of women aged 18-23, getting married was associated with increased odds of decreasing physical activity. A similar finding was presented by Dowda et al. (2003) where unmarried men and women reported higher MVPA scores. Lee et al. (2004) undertook another analysis of the effect of marital transition on health behaviours, using data from the Nurses Health Study. Women who were divorced, widowed or remained single increased their physical activity compared to those who remained married.

In another cross sectional study by Kaleta and Jeiger (2007) conducted in Poland, the odds of physical inactivity was twice as high among married women. In a similarly designed study Seo and Torabi (2007) interviewed a random sample of over 900 US adults, and found that a greater proportion of single people met physical activity guidelines. Recently, Molloy et al. (2009) found that there was no association between physical activity and marital status in an assessment of three waves of the Scottish Health Survey. Among older adults (average age of 73 years, n = 2,880), Pettee et al. (2006) found that married men and women reported greater engagement in physical activity than their unmarried counterparts; the latter group included participants who were never married, widowed, divorced or separated. Overall, these studies offer support for the inverse relationship between getting married and physical activity.

2.4.1.5 Parenthood.

Parenthood, as well as marital status has emerged as a correlate of physical activity. Bellows-Riecken and Rhodes (2008) reviewed literature on this topic and included 25 research articles in their analysis. A compilation of results from cross sectional studies indicated that parenthood was negatively associated with physical activity, with a moderate effect size of 0.48. Results from the previously mentioned longitudinal study on the ALSWH, presented by Brown and Trost (2003) found that increasing physical activity was significantly less likely upon having a child among the youngest cohort of women. This risk appeared to be apparent among mothers and fathers. Nomaguchi and Bianchi (2004) used data from a national health survey on US adults carried out in 1995 and found that overall, participants with no children engaged in more physical activity than those with children.

Fathers did however participate in one hour more activity than mothers over two weeks but this trend was also apparent among non parents, which suggests it was due to gender differences in physical activity more than marital status. Bellows-Riecken and Rhodes (2008) tried to clarify the combined effect of parenthood and marital status, as well as employment status, on physical activity. Inconsistent results were noted; different studies reported that single mothers or married women who did not work were most likely to be inactive; it appears that these factors interact with each other.

2.4.1.6 Body mass index (BMI).

Overweight or obesity is a commonly investigated correlate of physical activity, manifesting typically as negatively associated with physical activity. In the US (CDC, 2008) 54% of all participants in the normal weight range, as measured by BMI met physical activity requirements compared to 41% of those categorised as obese. Dowda et al. (2003) reported that BMI was negatively associated with physical activity among women only in an assessment of young adults in the US. Among an older sample of 12,000 male and female participants in Canada, frequent participation in physical activity decreased as BMI increased (Kaplan et al., 2001). Martinez-Gonzalez et al. (2001) in a study of European physical activity levels also noted that a lower proportion of overweight or obese respondents engaged in LTPA, among males and females. In the UK, Craig and Mindell (2008) reported that 50% of male participants with a normal BMI were categorised as high active compared to 32% of obese respondents; a similar pattern was noted among females. BMI as an indicator of overweight and obesity has a consistent relationship with physical activity irrespective of age or gender.

2.4.3 Psychological Factors

In an attempt to explain the demographic differences in physical activity, many researchers have examined intrapersonal variables such as self efficacy, barriers to physical activity, outcome expectancies, motivational readiness and knowledge about physical activity, which are established independent correlates of physical activity. Trost et al. (2002) reviewed the role of these correlates and found strong negative associations with physical activity for barriers to exercise and strong positive associations for the enjoyment of exercise, positive outcomes from being active, self efficacy and self motivation. In the following sections, self efficacy, outcome expectancies and barriers to physical activity will be addressed in greater detail.

2.4.2.1 Self efficacy.

Self efficacy refers to the confidence in one's ability to be active in a variety of situations. Typically, self efficacy is assessed based on how an individual would respond in a number of difficult personal and environmental contexts such as when tired, stressed or experiencing bad weather and it generally increases as an individual adopts and maintains a new behaviour (Godin, 1994). Trost et al. (2002) noted that self efficacy has emerged as one of the strongest, most consistent correlates of physical activity; among a variety of populations groups. In the interim, Rovniak et al. (2002) investigated the effect of self efficacy on young adults, in a prospective study and found that self efficacy had a strong effect on physical activity. Ainsworth et al. (2003) found that self efficacy was also related to being physically active in a group of approximately 900 African American women. Eyler et al. (2003) reported on a survey undertaken on a diverse sample of women and discovered that self efficacy again was one of the strongest correlates of physical activity; respondents who were very confident in their ability to be active were up to five times more likely to be active or meet physical activity recommendations than women who had low confidence to be active.

Marquez and McAuley (2006) investigated the role of self efficacy in predicting physical activity in a group of Latino adults (n = 213). Results indicated that high self efficacy was significantly related to exercising on a regular basis. Phongsavan et al. (2007) in their report on health data from New Zealand found an extremely strong relationship between high self efficacy and meeting minimum physical activity requirements; participants with high self efficacy were seven times more likely to meet these guidelines than those with low self efficacy. In 2009, Williams-Piehotta et al. also found that self efficacy was related to physical activity, specifically to being sufficiently active, in a group of over 600 participants with diabetes while Cramp and Bray (2009) reported that high self efficacy to be active and overcome barriers to physical activity was related to being more active during pregnancy (n = 160). It is apparent that self efficacy is a relatively consistent predictor of physical activity across a variety of population sub groups, emphasising its universal importance in the likelihood of an individual being physically active.

2.4.2.2 Outcome expectancies.

Williams, Anderson and Winett (2005) reviewed the role of outcome expectancies in physical activity, defining it as an expectation that a certain outcome will follow a particular behaviour. It was noted that positive outcome expectancies were akin to benefits associated with being active and that studies have presented mixed results on the link between this construct and physical activity. For example, in a previously cited study by Rovniak et al. (2002), outcome expectancies were assessed in relation to physical activity and no direct effect of this construct was noted. Rather, higher self efficacy did lead to higher outcome expectancy suggesting that the two are related, and together have an influence on physical activity. This was also reported by Plotnikoff et al. (2008) in a sample of diabetes patients.

Subsequently, Conn et al. (2003) measured these and other constructs in a descriptive study of older women and observed a similar finding; self efficacy was linked to outcome expectancies. The study also found that outcome expectancies did directly influence exercise behaviour. Subsequent to findings by Conn et al. (2003), Williams et al. (2005) stated that outcome expectancies were perhaps more important among older adults. It is possible that perceived benefits associated with being active are more pertinent among the elderly as they have a greater identification with any strategy that promotes health and well being. Williams et al. (2005) suggested that outcome expectancy was not the strongest or universal independent correlate of physical activity. Despite this, the direct and more importantly, indirect effects on activity do warrant consideration, particularly amongst older adults. Consequently, the authors noted that promoting the benefits of being active particularly to the most sedentary individuals is a worthwhile endeavour.

2.4.2.3 Barriers to physical activity.

Williams et al. (2005) noted that negative outcome expectancies are often termed barriers to physical activity; not entirely appropriate considering barriers prevent behaviour while negative outcome expectancies result from engaging in a particular behaviour. Consequently, it is necessary to address barriers separately, which according to Trost et al. (2002) are an emerging and strong predictor of physical activity. Barriers to physical activity are common and vary among population sub groups and across personal, social and environmental paradigms. Due to their considerable variation, a summary of barriers across these groups are presented in *Table 2*.

A degree of consistency in barriers among women is apparent. Chinn et al. (1999) assessed barriers to physical activity among a group of over 6,000 adults in the UK. Illness and disability were considerably greater barriers to activity among older adults while a lack of money and transport were also notable barriers among the less well educated, lower income respondents. Ball et al. (2006) investigated the influences on physical activity in a group of women from a variety of social class areas in Melbourne. Women from lower classes identified work commitments as a reason for their lack of time while family demands were more common among higher classes. In a population based study in Norway including almost 5,000 participants, barriers were assessed and grouped into different factors, such as practical hindrances (no opportunity to be active, lack of transport, no one to do activity with) and health related (health hinders activity, need time to relax) barriers. The latter provided the highest barrier scores while males reported more barriers than females (Sørenson and Gill, 2008). Overall, it is apparent in *Table 2* that lack of time is the most universal barrier to physical activity among these studies at least.

Table 2

Summary of Barriers to Physical Activity

Barrier	**Studies**	**Population Groups**
Lack of Motivation	Chinn et al. (1999)	Men and women
	Ball et al. (2006)	Lower classes
Lack of Time	Chinn et al. (1999)	Women, married people
	Ball et al. (2006)	All classes
	Sørenson & Gill (2008)	Younger people
	Bellows-Riecken & Rhodes (2008)	Parents
	Jewson et al. (2008)	Overweight women
	Bragg et al. (2009)	Low income young adults
Lack of Money	Chinn et al. (1999)	Women, less educated, low income, single people
Illness/Disability	Chinn et al. (1999)	Older adults
	Jewson et al. (2008)	Overweight women
Lack of Transport	Chinn et al. (1999)	Less educated/low income
Tiredness	Bellows-Riecken & Rhodes (2008)	Parents
	Bragg et al. (2009)	Low income young adults
Fear of Injury/Discomfort	Bragg et al. (2009)	Low income young adults
	Parks et al. (2003)	Urban residents

Evidently barriers are present and operate in different contexts and this can help to explain and predict variations in activity among population sub groups. Parks et al. (2003) assessed data from a cross sectional survey in the US to investigate variations in physical activity in urban and rural areas. An accumulation of barriers among high income urban and rural respondents was related to decreased likelihood of meeting physical activity recommendations. Barriers to physical activity are an important indicator of overall activity status and strategies to overcome these barriers are an important facilitator of becoming more active.

2.4.3 Behavioural Factors

A number of behaviours present and past are related to current physical activity status. These include previous participation in physical activity, diet, smoking, alcohol consumption, drug taking, and stress levels. In their review of correlates of physical activity, Trost et al. (2002) noted that previous participation in physical activity and dietary habits showed a particularly strong positive relationship with physical activity. In contrast, smoking was negatively correlated with being active. These factors, along with sedentary behaviour and other behavioural factors that Trost identified, specifically processes of change and decisional balance, will be considered below.

2.4.3.1 Health behaviours.

Britton et al. (2000) investigated the characteristics of a group of women (n = 1,501) who engaged in regular physical activity and noted that those who participated in high amounts of exercise at age 12, 13 or 20 were more likely to be high active between the ages of 20 and 44. In another longitudinal, cohort study, Tammelin et al. (2003) assessed data from a birth cohort in 1966 in Finland 14 and 30 years post baseline. Complete follow up results from almost 8,000 initial participants indicated that participation in sport at least once or twice during adolescence by males and females was related to being active during adulthood. Walters et al. (2009) reported on a similar study, based in the US, which involved a five year follow up of adolescents from different SES backgrounds. Irrespective of SES and gender, those who participated in organised sports in high school reported higher weekly participation in physical activity during adulthood despite an overall decline in activity between these time points.

Paavola, Vartiainen and Haukkala (2004) specifically investigated the relationship between physical activity and smoking in a longitudinal study of participants (n = 640) at age 15, 21 and 28, based in Finland. At each time point, smokers engaged in less physical activity than non smokers. Poortinga (2007) also attempted to explore the relationship between smoking and physical activity. Data from over 11,000 participants who completed the Health Survey for England in 2003 were assessed and results indicated that smoking was negatively associated with sports participation or membership of a sports club. Lastly McDermott, Dobson and Owen (2009) reported on the ALSWH focusing on data from the initial young cohort, aged 18-22, recruited to the study. Almost 60% of the sample never smoked and 4% remained ex smokers. The odds of smoking relapse were considerably lower for women who engaged in regular physical activity.

Walker, Walker and Adam (2003) discussed changes in dietary behaviour throughout the ages, and described a notable shift in diet in the twentieth century; specifically an increased sugar, fat and animal protein intake and decreased cereal and fibre intake. The authors noted that this has been accompanied by a considerable decline in physical activity and increase in illness and ill health in later life. This suggests the presence of a link between these two lifestyle behaviours. Dutton et al. (2008a) specifically examined the relationship between dietary behaviour and physical activity in a group of over 200 sedentary women recruited to a trial to promote physical activity. At baseline participants who were in the more advanced stages of change (adopting or maintaining regular physical activity) and reported higher weekly physical activity consumed significantly more fruit and vegetables than their less active counterparts.

Sedentary behaviour is correlated with physical activity but Mayer et al. (2008) noted that evidence to support this relationship is not plentiful. These authors, using a prospective design with assessments at baseline and six years post baseline in a random sample of over 15,000 participants, endeavoured to clarify this association and subsequently found that regular TV viewers were approximately 30% more likely to be insufficiently active than those who watched TV rarely, with TV viewing acting as a proxy measure for sedentary time. In turn, high TV viewing was related to a greater than recommended consumption of salty snacks, sweets, total fat and saturated fat intake as well as lower amounts of fruit and vegetables. Parsons, Thomas and Power (2009) later observed in a sample of middle aged British adults that more time spent watching television was related to less engagement in leisure activities. Owen, Bauman and Brown (2009) noted that if time spent sitting (including TV viewing time) decreased then participation in physical activity should increase, further indication of a relationship between these behaviours. However, being active and being sedentary are not exact 'opposites' or correlates of each other and reducing sedentary time does not necessarily always equate to higher physical activity levels.

Indeed, it is becoming apparent that physical activity and sedentarism can have independent effects on health. In a recent study by Katzmarzyk et al. (2009) on the long term health effects of sedentary behaviour (specifically sitting), undertaken on Canadian adults, it was discovered that greater daily time spent sitting was associated with increased all cause mortality; this observation was consistent even amongst physically active individuals. This suggests that sitting time is an independent risk factor for mortality, irrespective of activity status; a finding also presented by Owen et al. (2009). Wijndaele et al. (2010) assessed television viewing data from the Australian Diabetes study, and observed that over five years, an increase in television viewing was significantly related to increases in waist circumference, diastolic blood pressure and cardio-metabolic risk factors. This suggests that television viewing, as well as sitting, may be an independent risk factor for chronic disease. Thus, while there is a relationship between sedentarism and physical activity, they are unique behaviours that occur in different contexts and should be targeted for change as such. Overall, this assessment of health behaviours indicates relatively strong support for the role of previous participation in physical activity, diet, smoking and sedentarism as correlates of current physical activity status.

2.4.3.2 Processes of change.

Plotnikoff et al. (2001) reported that the use of both experiential and behavioural processes of change predict becoming active and/or maintaining regular physical activity, rather than just behavioural processes alone. Prochaska, Reading and Evers (2008) discussed the processes of change in an overall assessment of the Transtheoretical Model (TTM), which will be reviewed in more depth in a later section of this chapter. Ten processes, each categorised as experiential or behavioural, have been identified as covert or overt activities that individuals use as they attempt to change their behaviour. The experiential processes include consciousness raising, dramatic relief, self re-evaluation, environmental re-evaluation and social liberation and are believed to be most important in initial stages of behaviour change (Prochaska and Marcus, 1994; Marcus et al., 1992a). Behavioural processes, believed to be more pertinent in the adoption and maintenance of behaviour change (Prochaska and Marcus, 1994; Marcus et al., 1992a) include self liberation, counterconditioning, stimulus control, contingency management and helping relationships.

An investigation was carried out by Riebe et al. (2005) where overweight participants (n = 144) were recruited to a six month programme to induce healthier eating and exercise behaviours. Two year follow up revealed an association between processes of change and physical activity. Participants who never met physical activity guidelines reported lower use of the behavioural process than those who did meet requirements while those who maintained increased physical activity levels had a higher use of all processes of change. It appears that rather than the different processes of change predicting differing states/stages of being physically active, all processes are important in the movement of inactive people to sufficiently active.

2.4.3.3 Decisional balance.

Decisional balance was defined by Prochaska et al. (2008) as an individual's assessment of the pros and cons related to changing particular problem behaviours. Prochaska et al. (1994) combined data from a number of different samples resulting in a final sample size of approximately 4,000 participants and investigated the role of decisional balance in a variety of behaviour change scenarios such as quitting cocaine, smoking cessation and exercise acquisition. Pros were higher among participants who maintained behaviour change than those who had not changed their behaviour while cons were higher among the latter group suggesting that decisional balance was a viable predictor of physical activity. Plotnikoff et al. (2001) using a more rigorous longitudinal design found only partial support for this construct in predicting physical activity. Pros were highest among maintainers but were also in operation to a greater extent than cons among participants who had no intention to change; this in contrast to results from Prochaska et al. (1994). It appears that further assessment of decisional balance as a correlate of physical activity is warranted.

2.4.4 Social Factors

Social factors manifested primarily as social support have proven to be consistently associated with physical activity. Indeed, social support, according to Trost et al. (2002) has emerged as one of the strongest predictors of activity status.

2.4.4.1 Social support.

Social support, according to House (1981, as cited in Heaney and Israel, 2008) refers to the functional aspect of relationships that can be classified into four types of supportive behaviours. These include emotional support, which is the provision of love, trust and empathy; instrumental support, characterised by some direct, tangible assistance; informational support, which is the dissemination of advice and suggestions, and finally appraisal support involving the distribution of information useful for self evaluation purposes. Kaplan et al. (2001) investigated the role of social support, among other variables, in predicting physical activity in a population based sample of over 12,000 participants in Canada. Participants were older adults living in community dwellings. Analysis of data collected indicated that social support was related to frequent participation in physical activity among females only. A similar finding was reported by Phongsavan et al. (2007) in their New Zealand based study where high social support was related to increased odds of being sufficiently active, but again only among women. In contrast, Dowda et al. (2003) observed that for both men and women, a higher social support score was related to participation in moderate to vigorous physical activity.

As per previous discussion in relation to psychological variables, such as self efficacy and barriers to physical activity; social support is often assessed in an attempt to explain demographic differences in physical activity. For example, Plotnikoff et al. (2004) found that more friends being active was associated with higher physical activity levels among males and females, across all age groups, living in both urban and rural areas. Indeed, this expression of social support was identified as the strongest predictor of physical activity in this study and more importantly, appeared important across various demographic characteristics. Also, Kamphuis et al. (2008) noted that respondents from lower SES groups who reported less participation in sport than those from high SES groups were more likely to report a small social network and poor social cohesion, both indicators of social support. Social support is apparently a relatively consistent predictor of physical activity.

2.4.5 Physical Environment Factors

Trost et al. (2002) observed that, in contrast to previous assessments of the correlates of physical activity, their analysis should have included an assessment of environmental factors and their subsequent influence on physical activity. In the intervening period, the role of both the immediate and wider physical environment in predicting physical activity has been even more frequently assessed.

2.4.5.1 Urban/rural residence.

Brownson et al. (2000) reported on the correlates of physical activity in women aged over 40 in a US based study. Results indicated that women living in rural areas had an approximate 33% increased risk of doing no leisure activity and were more likely to participate in household related activity than their urban residing counterparts. Wilcox et al. (2000) reported on an older sample of over 2,000 women also in the US and similar to the previous study found that rural women were more likely to be classified as sedentary than urban women. Parks et al. (2003) too noted that respondents from rural areas were less likely to meet physical activity recommendations than those living in urban or suburban regions. Contrary to the above findings, Sjöström et al. (2006) found no relationship between place of residence and odds of being sufficiently active but living in a town or city was related to increased sedentary behaviour.

Most results appear to offer consistent evidence for lower engagement in activity in rural areas. Subsequently, Plotnikoff et al. (2004) noted that it was important to investigate the different predictors of activity between these sub groups to perhaps better design and deliver more tailored interventions to promote activity for different regions. Interestingly, findings indicated that urban women were in fact more likely to be inactive; a direct contradiction to previous commentaries. The author did note that this study was based in Canada and hypothesised that urban/rural distinctions may not be as notable as in the US.

2.4.5.2 Environmental factors.

In the previously noted study by Wilcox et al. (2000), urban women were more likely than rural women to report the presence of sidewalks, streetlights and recreational facilities in their environment, which were potentially related to their higher involvement in physical activity. Rural women reported the presence of dogs and unpleasant scenery in their neighbourhoods, the latter related to their higher reported engagement in sedentary behaviour. Brownson et al. (2001) in response to the growing focus on environmental and policy related interventions investigated the role of environmental characteristics in predicting physical activity in a population based US sample of approximately 1,700 adults. Men were more likely to report the availability of places to be active, while the majority of both genders and all income groups noted the presence of sidewalks, enjoyable scenery and streetlights. The latter as well as access to parks, gyms and treadmills were all positively associated with physical activity.

Humpel, Owen and Leslie (2002) assessed these and other studies in their review of environmental factors associated with adult physical activity. Studies that included perceived and/or objective measures of these factors were included and overall, access to facilities and attractiveness of the local environment were consistently related to physical activity. Less consistent associations were discovered for the role of the weather and safety in determining physical activity. The authors noted that more research was warranted to clarify the role of these environmental factors in promoting physical activity.

De Bourdeaudhuij, Sallis and Saelens (2003) investigated environmental correlates of physical activity in a cross sectional study of Belgian adults (n = 521), using self report data. Environmental variables were compared across various demographic characteristics and it was apparent that access to shopping and public transport, higher levels of safety, more convenient facilities to be active and availability of home exercise equipment was greater among more educated respondents while older people had more favourable opinions on the aesthetics of the environment and more concerns about safety and access to facilities. Subsequent participation in MVPA among males and females was related to access to home exercise equipment and local facilities.

Bengoechea et al. (2005) investigated gender variations in environmental correlates of physical activity. The sample of over 1,000 participants were recruited in Canada and mailed questionnaires pertaining to the study objective. Easy access to places that facilitated activity was related to increased physical activity among both genders while shops within walking distance for males and seeing other people being active for females were also positively associated with physical activity. Many of these associations were modified upon adjustment for self efficacy and socio-demographic variables. Lee, Cubbin and Winkleby (2007a) investigated this same topic but used longitudinal data from the Stanford Health Project and objective assessments of environmental attributes. Neighbourhoods were identified and local resources were assessed using phone books. Rather unusually, the availability of resources was greater in lower SES areas and an increase in gym and park density was related to increased energy expenditure and moderate intensity activity among low income respondents, suggesting that the presence of facilities is particularly important among this sub group.

Phongsavan et al. (2007) observed a notable association between the availability of recreational facilities and being sufficiently active in New Zealand; high availability was related to an approximate 70% increased chance of meeting physical activity guidelines. More recently, Casagrande et al. (2009) reviewed the role of the built environment in relation to physical activity among African Americans. Seven studies were identified that focused on the effect of environmental factors on activity in this cohort and findings were inconsistent. Some reported that sidewalks and light traffic was positively associated with physical activity while another indicated that safety was most important in an urban setting.

Sallis et al. (2009) also presented an analysis of environmental correlates for adult physical activity across 11 countries. Countries taking part in this International Physical Activity Prevalence Study (IPS) recruited population samples (n = 11,541) and administered questionnaires to assess physical activity and perceived environmental attributes. Over three quarters of respondents reported meeting physical activity guidelines and this was related to a number of environmental variables; having many shops and transit stops nearby, sidewalks on most streets, bicycle facilities and low cost recreational facilities with sidewalks being the strongest predictor. An increase in the number of these attributes was positively related to meeting minimum physical activity requirements. It is apparent that environmental factors and attributes are related to physical activity although the specific detail of this relationship is still unclear, primarily due to the inconsistent findings illustrated above and the over reliance on cross sectional data.

2.5 Mediators of Change

Bauman et al. (2002) noted that consistent correlates of physical activity, such as self efficacy, social support and perceptions about the environment could potentially be mediators of change. MacKinnon and Luecken (2008) also stated that is important to understand how an intervention works to subsequently develop efficient and effective interventions to induce behaviour change. Thus, the measurement of mediating processes is important as it provides clearer indications of the reasons for the effectiveness, or lack thereof, of interventions that aim to promote physical activity.

Consequently, many of the materials, websites and communications designed to promote physical activity have been purposely designed to alter psychological constructs and these may subsequently lead to an improvement in physical activity. Lewis et al. (2002) presented a review of mediators of physical activity behaviour in adults in general. It was apparent the most commonly assessed and supported mediators included self efficacy, processes of change, decisional balance and social support. However, no definite assumptions about the role of mediators were presented and further research in this area was advocated. The authors noted that the understanding and clarification of mediators would be helped by using validated and reliable measurement scales, measuring the selected constructs at different intervals before and throughout the intervention period and through the assessment of a greater variety of mediators using different theoretical models. Also, it was observed that inducing an intervention effect is essential as without this, mediators cannot be assessed.

In turn, Barrera et al. (2008) reported on a more diverse set of mediators of change in a group of post menopausal women with Type 2 diabetes who were recruited to the Mediterranean Lifestyle Programme, a comprehensive lifestyle intervention. Almost 300 women were randomly allocated to the intervention or standard treatment group and assessed at six, twelve and 24 months. The intervention group were more likely to improve use of resources (for example neighbourhood, policy, work resources) and physical activity and use of these resources at six months were related to long term changes in activity.

As this discussion suggests, a lack of evidence exists for the role of mediators in inducing increases in physical activity, confirming the observation by Lewis et al., in 2002. This may simply be due to the absence of a role for these constructs in behaviour change but it is more likely that interventions are not adequately designed to measure or alter these concepts. Indeed, Baranowski, Anderson and Carmack (1998) did suggest that interventions to promote physical activity are often unsuccessful because they do not have a substantial effect on these mediating variables and recommended that future research should focus on changing these physical activity related constructs. Such an approach may facilitate long term maintenance of behaviour change, which is often not achieved.

2.5.1 Summary

This discussion on the correlates of physical activity and mediators of change indicates the multitude of factors acting both independently and in conjunction with others, which must be considered when attempting to identify why certain individuals and/or populations are more active than others and how to make people more active. This assessment will facilitate the more accurate design of interventions to promote activity, yet results are varied and are unable yet to provide conclusive evidence on the factors associated with being (in)active.

Lee et al. (2007a) accounted for 72% of the variance in physical activity in their sample using factors such as age, education, income and occupation. Alternatively, Plotnikoff et al. (2004) managed to account for approximately 21% of the variance in physical activity among males and females using psychological, behavioural and social correlates. Conn et al. (2003) explained 46% of the variance in exercise upon consideration of factors such as age, efficacy, barriers and processes of change. Rovniak et al. (2002) managed to explain 55% of the variance in physical activity using their model of predictors such as self efficacy, social support and outcome expectancy. De Bourdeaudhuij et al. (2003) managed a much lower assessment of variance; 13% of vigorous intensity in males was explained by factors such as age, the presence of home exercise equipment and more convenient facilities to be active.

The strength of associations between correlates and physical activity can vary considerably but there has been advances in this as well as in study design, with a greater use of longitudinal designs to identify potential correlates. Consequently, interventions have become increasingly tailored and targeted to defined populations and to target certain mediators of change. These studies are generally undertaken using defined theoretical approaches. Several theories on physical activity and associated behaviour change exist and are addressed in the next section.

2.6 Theories/Models of Behaviour Change

As noted in the previous section, a multitude of correlates exist in relation to physical activity with many extrapolated from different theories and models of behaviour and behaviour change. Theories are a set of concepts that attempt to explain or predict an event whereas a model draws on a number of theories to help understand a specific occurrence (Glanz, Rimer and Viswanath, 2008). These theories and models relate to individual or population level behaviour change; the former include the health belief model (HBM), the theory of reasoned action/planned behaviour (TRA/TPB) and the transtheoretical model (TTM) while the latter includes the social-ecological model of behaviour change.

The HBM was developed in the 1950s and professes that the adoption of behaviour to prevent or control a particular condition is dependant on an individual's perception of a threat of disease and the potential of a reduced health risk by undertaking this new behaviour (Champion and Skinner, 2008; Godin, 1994). According to the model, the likelihood of a behaviour change is related to individual beliefs, an assessment of the benefits and barriers associated with this action and perceived self efficacy, and is modified by demographic characteristics. Furthermore, cues to action, such as media publicity and family illness, have been identified as important triggers for change. Recent research using this model in a physical activity context is limited (Biddle & Mutrie, 2008) rather it is applied to studies of disease.

The TRA originated in the 1970s and has one main premise; that behaviour is a function of behavioural intention, which is effected by attitudes and subjective norms (Montaño & Kasprzyk, 2008). Attitudes are determined by an individual's beliefs and their perceptions about the outcomes associated with the behaviour. Subjective norms are a function of an individual's normative beliefs about the behaviour and their motivation to comply with referent characters that approve or disapprove of the action. The TRA is rarely used in its initial form; rather it is now typically manifested as the TPB, which was developed by Azjen (1991) to account for some of the limitations in the TRA. The main concern with the latter was that its success was dependant on the behaviour of interest being under complete volitional control (Biddle & Mutrie, 2008). To cater for those behaviours, which do not comply with this, Azjen (1991) included perceived control in the TRA to account for factors outside an individual's control, which may subsequently affect intention and behaviour (Biddle & Mutrie, 2008).

A more in-depth assessment of social cognitive theory, the transtheoretical model and social-ecological models is presented underneath as these were used in this research.

2.6.1 Social Cognitive Theory (SCT)

The previous models are primarily focused on individual factors associated with behaviour change. However, behaviour is also dependant on social and environmental factors. Consequently, SCT was devised with the premise that individual and environmental factors interact to influence and determine behaviour, termed reciprocal determinism. McAlister, Perry and Parcel (2008) also noted that SCT focuses on how people create environments to suit their own purposes and how they work in groups to achieve societal and environmental change. As well as previously referred to constructs such as self efficacy (p.25) and outcome expectancy (p.25), SCT also includes the following:

- Reciprocal determinism: environmental factors influence individuals and groups and vice versa
- Collective efficacy: beliefs about the combined ability of a group to bring about certain actions
- Observational learning: learning to perform new behaviours by observing them
- Incentive motivation: use of rewards and punishments to change behaviour
- Facilitation: provision of tools, changes that make behaviour change easier
- Self regulation: self control through techniques such as goal setting, feedback and sourcing self support
- Moral disengagement: violations of moral standards, engagement in unpleasant acts and viewing this as acceptable and beneficial

Self efficacy has emerged as the most important component of this theory and is used extensively in the design and delivery of interventions to mediate and facilitate changes in physical activity as it is a well established correlate of behaviour change. Biddle and Mutrie (2008) confirmed that self efficacy can be modified through intervention and subsequently predicts participation in physical activity but typically declines post intervention after a period of inactivity. Its importance has led to self efficacy being included in many theories and models of behaviour change, such as the TTM and HBM.

2.6.2 Transtheoretical Model (TTM)

The TTM considers the cyclical, dynamic and non-linear nature of behaviour change. The model includes several constructs, namely stages of change, processes of change (p.30), decisional balance (p.31) and self efficacy (p.25); the latter three having being discussed in a previous section and included in other theoretical frameworks. Spencer et al. (2006) noted that stages of change refer to an individual's readiness to be active, while Prochaska and Marcus (1994) observed that they could be stable or dynamic in nature. An individual may reside in one stage for a long period of time but also can move readily between stages as they attempt successful behaviour change. Inherent in this is the concept of relapse characterised by regression from later to earlier stages of change (Biddle & Mutrie, 2008). The six stages are as follows:

- Precontemplation: no intention to be active in the coming six months
- Contemplation: some intention to be active in the next six months
- Preparation: intention to take action in the next 30 days, some behavioural steps are taken
- Action: behaviour change for less than six months
- Maintenance: behaviour change for more than six months
- Termination: no temptation to relapse, 100% confidence

Spencer et al. (2006) reviewed the application of the TTM to exercise and identified 150 suitable studies for inclusion ranging from intervention to population to validation studies. The TTM has been used in intervention studies to tailor materials to an individual's readiness to change. Over 75% of the stage matched interventions included showed support for this approach, demonstrated by positive but short term increases in physical activity. Furthermore, of those interventions that compared a stage matched intervention to a standard intervention, over half demonstrated more favourable outcomes. In the discussion on population studies, it was apparent that the TTM has been applied to many different population sub groups; adults, young people, college students, females, employees and clinical populations. Typically, this application was successful with participants classified into the various stages of change and relationships observed between these stages and physical activity levels.

Lastly, Spencer et al. (2006) considered predictive validation studies where the accuracy of the TTM in predicting exercise levels among participants was assessed. Correlation between stages and physical activity was noted as well as associations between the different constructs in the model. The authors concluded that the model is useful when applied in full but most evidence is from cross sectional studies on adult populations. Indeed, one longitudinal study carried out in Canada by Plotnikoff et al. (2001) provided only partial support for the ability of the TTM to predict stage transition using its aforementioned constructs. This latter study demonstrates the discrepancy between longitudinal and cross sectional designs and the evidence they generate, indicating that the TTM, as with all other models, must be assessed and used in context and in consideration of other potentially more suitable models. Indeed, Prochaska et al. (2008), in their discussion of the TTM, noted that no single theory or model can alone explain behaviour and behaviour change; integration across theories and generation of combined models may be more appropriate.

2.6.3 Social-Ecological Models of Behaviour Change

Sallis et al. (2006) noted that studies adhering to and assessing aspects of the models discussed hitherto, have demonstrated their apparent effectiveness in the field of behaviour change, but long term behaviour change has not always been achieved and poor effect sizes and difficulties with recruitment have been noted. Also, a good deal of the correlates addressed in the previous section have not, as Bauman et al. (2002) observed, been based on or incorporated in any of the specific theories pertaining to physical activity. Fleury and Lee (2006) too observed that most models and theories fail to adequately account for the role of social and environmental factors in determining behaviour.

The most readily available and suitable models that encompass the various personal, psychological, social and environmental factors related to physical activity appears to be the social-ecological models of behaviour change (Bauman et al., 2002). These models acknowledge the multiple direct and interacting influences on behaviour and also posit that successful behaviour change can be induced if interventions operate at numerous levels (Sallis, Owen & Fisher, 2008). Such models typically include intrapersonal factors (demographic and psychological – where many of the models reviewed earlier can be adopted and implemented), interpersonal (social support/norms), environmental (neighbourhood design, availability of programmes), organisational (partnerships, advocacy groups) and policy (laws, rules) factors.

Fleury and Lee (2006) used such a framework to identify and assess the correlates of physical activity among African American women. Upon consideration of intrapersonal factors, it was noted that a positive perception of health, higher income, higher levels of education and employment were all associated with increased physical activity levels. Furthermore, knowledge of the benefits of activity and high self efficacy were also correlated with being active. On an interpersonal level, low social support was related to being sedentary while favourable social norms about exercise and positive role models were associated with physical activity. Environmental resources also appeared to facilitate physical activity, specifically well designed neighbourhoods and access to safe, affordable facilities. Community based initiatives which generate community capacity also had favourable effects on activity. Lastly, partnerships between community organisations, low cost facilities and policies in the workplace were deemed supportive of behaviour change.

Later, Cerin and Leslie (2008) investigated if environmental as well as individual factors, could explain the link between socio-economic dependant factors, such as educational attainment and income, and physical activity using data from the PLACE study in Australia. The relationship between income and walking was explained by self efficacy, social support and barriers to walking. Also, residents from mid to high income areas had less open space and this subsequently affected walking rates. Self efficacy and social support were identified as important mediators in the relationship between education and physical activity and the authors concluded that individual, social and environmental factors can explain variations in health across socio-economic groups.

Many of the factors in social-ecological frameworks are components of models and theories, such as the TTM and SCT. Consequently, it is un-necessary to address once more the value of self efficacy and specific environmental attributes in, for example, predicting and promoting physical activity. Rather, it is pertinent to further address the policy aspect of this particular model, which was not been hitherto addressed. Schöppe, Bauman and Bull (2004) reviewed physical activity related policies in several countries, including Australia, New Zealand, Canada, the Netherlands and Scotland. It was noted that all countries reviewed had developed national physical activity policies in a consultative process and had used needs assessments to highlight potential priority areas and ideas for change. Subsequently, all countries designed and disseminated a number of strategies to enhance population physical activity levels, which were operated at different levels within the country. Furthermore, successful partnerships were apparent and intersectoral collaboration between physical activity and diet for example was also noted.

Difficulties were highlighted in relation to funding, evaluation and monitoring of policies, which prevents true estimates of the success of these initiatives. Evaluation that did exist, primarily within annual surveillance undertakings, failed to offer convincing support for these initiatives; population physical activity rates from Canada did increase between 1981 and 1995 during which time a mass campaign was delivered, although it was difficult to attribute these changes directly to this programme.

Daugbjerg et al. (2009) carried out a content analysis of physical activity policies in Europe only and reported similar concerns about evaluation with only 56% of policies reviewed intending to undertake some surveillance.

High cycling prevalence is often an example of the role of policy in the promotion of physical activity. Pucher and Buehler (2008) noted that some countries, namely the Netherlands, Germany and Denmark have managed to make cycling an everyday mode of transport. In the Netherlands, for example, 27% of trips are made on a bicycle compared to 1% in the US. Furthermore, cycling is equally prevalent among males and females and across all age and income groups. One of the main reasons for the popularity of cycling is the supportive policies and programmes implemented in these countries, which include the provision of separate cycling facilities, intersection modification, traffic calming, bike parking, co-ordination with public transport and safety education. The authors concluded that such policies developed and administered in a co-ordinated, mutually reinforcing manner can increase cycling rates.

Overall, despite, the lack of one specific model, some common messages and guidelines for generating a greater understanding of physical activity and designing effective interventions to promote activity can be derived from the generic framework of social-ecological models (Sallis, Bauman & Pratt, 1998). This may lead to more comprehensive strategies being developed and sustained population level increases in physical activity. An assessment of physical activity is required to evaluate the effectiveness of these interventions; an overview of some measurement issues specific to physical activity is presented below.

2.7 Measurement of Physical Activity

Indirect assessment of markers associated with physical activity include heart rate monitoring and the double labelled water method. In this research, consideration of the direct measurement of physical activity is more relevant due to resource constraints and large sample sizes in all phases of the study. Thus, discussion will be confined to subjective measurements, such as self report questionnaires and objective measurements, such as activity monitors.

2.7.1 Questionnaires

Questionnaires are the most commonly used, and indeed abused, method of data collection for physical activity. They typically assess the amount of energy expended being active in their measurement of physical activity (Kriska & Caspersen, 1997). Many different versions and templates of questionnaires exist including instruments designed for children, older adults, people with disabilities as well as those for the general adult population. These instruments vary considerably in terms of length, complexity, recall periods and the aspects and domains of physical activity that they assess, and thus, unsurprisingly offer different estimates of reliability and validity (Jacobs et al., 1993). Of greatest concern is that respondents may have different interpretations of questions posed and can be susceptible to a social desirability bias, which may in turn lead to overestimation of their engagement in physical activity.

In an effort to present some consensus on the large variety of questionnaires that were then available, Shephard (2003) noted that questionnaires did consider the intensity, frequency and duration of participation but limitations were inherent in these measurements. For example, in relation to intensity, questionnaires typically asked the participant to indicate the absolute intensity of their efforts rather than the intensity relative to their overall individual ability. Also, distinction between aerobic and resistance activity and the environmental context of the behaviour was rarely examined. Furthermore, large variation in reliability and validity assessments and measures, in recall periods, in definitions of intensities and a lack of consideration of low intensity activities were observed.

This discussion suggests that greater consistency in areas such as recall and definition of varying intensities and the development of standardised instruments may enhance the credibility of using questionnaires in the measurement of physical activity. However, irrespective of their limitations, questionnaires are a useful assessment tools for population studies, providing practicality, applicability and accuracy (Kriska & Caspersen, 1997), particularly when well designed, validated versions are used.

2.7.2 Activity Monitors

Activity monitors, which provide an objective assessment of physical activity, include accelerometers and pedometers. Accelerometers are small, unobtrusive instruments that can measure both the intensity and amount of physical activity. Freedson and Miller (2000) noted that accelerometers eliminate the subjectivity associated with questionnaires and are particularly useful for assessment of physical activity over a long period of time. Also, equations have been developed that permit accurate estimations of energy expenditure from step counts (Andre & Wolf, 2007).

Despite these strengths, Tudor-Locke and Myers (2001) indicated that the cost and complexity of accelerometers can limit their use.

Pedometers are a cheaper alternative to accelerometers that are most efficient in studies of walking as they do not detect changes in intensity or activity patterns (Freedson & Miller, 2000; Tudor-Locke & Myers, 2001). Furthermore, pedometers offer limited accuracy as they are sensitive to even minor movements and variability in measurement exists between different brands (Tudor-Locke & Myers, 2001). Some brands are more accurate and consistent than others (Bassett, 2000), however and pedometers have also been identified as a particularly useful tool for measuring physical activity among sedentary populations (Tudor-Locke & Myers, 2001; Andre & Wolf, 2007). Furthermore, efforts have been undertaken to classify pedometer based physical activity in adults; equating steps with levels of activity, ranging from sedentary to highly active (Tudor-Locke & Bassett, 2004).

Both of these instruments offer a useful and more accurate alternative to the use of questionnaires to measure physical activity and have been used in large scale population studies. For example, Troiano et al. (2008) reported on the level of adherence to minimum requirements for physical activity in the US, using self report and accelerometer data. Data from over 4,000 participants were assessed and while gender and age trends were consistent between accelerometers and self report questionnaires, large discrepancies existed in relation to the total proportion deemed sufficiently active. Accelerometer data indicated that less than 5% of adults engaged in 30 minutes of at least moderate intensity on most days of the week compared to 51% based on self report data. An explanation for this considerable disagreement between assessment methods was the likelihood of misclassification of physical activity intensity in questionnaires, which suggests that validated and well designed instruments should be used and that care must be taken when interpreting results acquired through this method.

2.8 Summary and Implications for this Research

The health benefits of physical activity are clear yet large proportions of women worldwide fail to engage in sufficient physical activity. In order to promote physical activity among this ‘at risk’ group, it is important to consider specifically who merits intervention and why. For example, an understanding about why and how women who are older, who may have lower educational qualifications, and who have children differ in relation to physical activity (all typically display low participation rates) will assist efforts to increase activity in these respective groups. As well as these demographic predictors of activity, a number of psychosocial correlates of activity and mediators of change specific to women exist that can be targeted and manipulated to induce behaviour change. It is these considerations that must be factored into analyses of physical activity behaviours among women in different populations and settings, as well as in the design of effective, replicable and transferrable strategies and interventions to tackle inactivity. Thus, this chapter has presented a framework to address the aims of the current research; to understand and explain the physical activity behaviour of participants in and following women only mass participation events and to develop interventions to promote increased or maintained activity levels post event.

Chapter 3: The Immediate Impact of Mass Community Physical Activity Events

3.1 Background

The previous chapter included a review of physical activity prevalence worldwide and in Ireland and indicated that although rates vary within and between countries, up to 60% of the world's population (WHO, 2009) do not engage in sufficient physical activity for health benefits. Of particular interest in this study is the physical activity behaviour of the Irish female population.

3.1.1 Physical Activity among Females in Ireland

The latest Health Behaviour in School Children (HBSC) Survey (Nic Gabhainn et al., 2007), which included responses from over 10,000 children in Ireland revealed that Irish girls participated in lower amounts of vigorous activity and were active less frequently than boys of similar age. Furthermore, approximately 58% of 10-11 year olds and 51% of 12-14 year olds participated in vigorous activity four or more times a week but this decreased substantially to 28% of 15-17 year olds. Adult females also typically engage in less physical activity of all types than males (Sallis, Hovell & Hofstetter, 1992). In the most recent SLÁN (National Health and Lifestyle) survey (Morgan et al., 2008) the disparity between males and females and across age groups in relation to exceeding minimum physical activity requirements was quite clear (*Table 3*).

Table 3

Physical Activity Levels of Irish Adults: SLÁN Survey (Morgan et al., 2008)

Population Sub Group	High Active (%)	
Males	32	
Females	16	
	Males	Females
18-29	48	20
30-44	34	22
45-64	25	17
65+	15	9

Fahey, Layte and Gannon (2004) in their study of participation in sport in Ireland by Irish adults, using data from a survey of sport and physical exercise carried out in 2003 (n = 3,080), noted that more females drop out from sport and a lower proportion switch to a new sport or stick to the same sport than males. Furthermore, Lunn (2007a), using this same data, reported that an Irish male (average age 44) was 2.64 times more likely to play sport than an Irish female of similar age.

Unfortunately, Ireland lacks longitudinal data to accurately identify variations in participation in physical activity across the lifespan, relying instead on the cross sectional SLÁN surveys. To overcome this, Lunn and Layte (2008) used retrospective data from the survey of sport and physical exercise in 2003 to create individual sporting histories for respondents and to elaborate on the above findings from Fahey et al. (2004) and Lunn (2007a). There are many limitations to this method including accuracy of and incomplete responses but the authors did address these and discussed the threat they posed to the validity of the findings produced. In any case, a gender gap and age related decline, which was termed a 'sport hill', in sport participation was observed and appeared most notable for team sports. Females took these up at a high rate in their youth but tended to drop out significantly from the age of 15 onwards. This may explain the similar age related decrease in physical activity observed in the aforementioned HBSC data (Nic Gabhainn et al., 2007). Also of note was that females actually played more individual sport than males until their late teenage years and the drop off in participation was considerably lower than in team sports and similar to the drop out rates in males. This suggests that females, if presented with sufficient opportunity, are likely to maintain participation in sport throughout the lifespan.

Unlike age, the HBSC (Nic Gabhainn et al., 2007) indicated little variation in physical activity across social class among girls of all ages, although the effect of educational attainment, an indicator of social class and socioeconomic status (SES), is often most apparent from early adulthood onwards. Results from the SLÁN survey (Morgan et al., 2008) indicated that inactivity was greatest in the lowest social classes among their sample of Irish adult females. This was also apparent in work undertaken by Fahey et al. (2004) which revealed that participation rates, excluding walking, among professional classes was twice as high as among the unskilled class. Similarly, Lunn and Layte (2008) reported that for Irish adult males and females, high educational attainment was associated with greater team sport participation, particularly in early adulthood but was more strongly related to individual sport participation across the lifespan. Despite lower uptake levels in individual sports among the less well educated, participation that was reported was quite consistent and was, as indicated previously, maintained throughout adulthood to a greater extent than team sport participation.

Lunn and Layte (2009) also observed that the odds of playing sport and engaging in physical activity increased as income increased irrespective of gender, age and educational attainment. Interestingly, in this report, a decrease in participation in sport was observed from its previous incarnate in 2007, which was partially attributed to a recent economic downturn in Ireland and an associated decreased income among the source population. Rather contrary to the above discussion on social class/SES and physical activity, it was also noted in this report that unemployment (a further indicator of social class/SES) was related to increased odds of playing sport. The authors hypothesised that this was perhaps due to a high proportion of newly employed individuals, as a result of the recession, who used their free time to engage in more sport and physical activity. This unexpected positive relationship between unemployment and physical activity is likely to lessen over time as more stable rates of unemployment return. Indeed, pre recession, in the 2007 Sports Monitor Report (Lunn, Layte and Watson, 2009) unemployed people were less likely to participate in sport than the employed.

3.1.2 Reasons for Insufficient Physical Activity Levels among Females

The causes of the measured declines in and insufficient levels of physical activity among populations are multiple and varied, and many countries, including Ireland, have recognised the need to tackle same; to identify populations at risk and reasons for non/limited participation, and to develop strategies to combat this. Indeed, Lunn (2007a) noted that research is often undertaken to identify social groups who participate in little physical activity as part of an overall strategy to increase participation rates. Subsequently, the author observed that income and educational attainment were deemed to have the strongest association with participation, irrespective of intensity. Furthermore, previous discussion highlighted the age related decline in physical activity apparent from childhood onwards, particularly among females. In order to promote physical activity among these 'at risk' groups (eg. females, older adults, less educated), it is important to further consider why and how people differ in relation to physical activity.

Many of the reasons why these population sub groups do not participate in sufficient physical activity were presented in the assessment of correlates of physical activity in chapter 2. These included, for women specifically, the incidence of significant events, such as getting married and having children, throughout the lifespan (Bellows-Riecken and Rhodes, 2008). Such events create barriers to physical activity, which can be more prominent among older adults and those from lower socio-economic backgrounds (Chinn et al., 1999). Variations in access to facilities and opportunities for physical activity (Bragg et al., 2009), and fluctuating levels of self efficacy (Kamphuis et al., 2008) and social support (Dowda et al., 2003) also predict the disparity in physical activity between these sub groups, as well as the inter-relationship of health behaviours across the lifespan such as physical activity (Agahi, Ahacic & Parker, 2006), dietary habits (Dutton et al., 2008) and smoking (Poortinga, 2007). These behaviours are linked and each is more common among populations from lower socioeconomic backgrounds in Ireland (Morgan et al., 2008). Lunn (2007a) noted that there was a higher proportion of females than males in lower SES groups in Ireland, which would suggest that these factors may be particularly prominent among Irish women. This may merit additional attention and resources targeted to women in this particular sub group in relation to physical activity promotion.

Fahey et al. (2004) and Morgan et al. (2008) investigated factors related to non participation in physical activity in their national survey. These included a lack of interest and time, and being physically unable to be active rather than a deficit in service provision. The latter was a greater barrier for older people, lack of time was cited in younger age groups and both genders, while lack of interest was more prominent as a barrier among females (49% v 37%, Fahey et al., 2004). Drop out was also further explored in this latter study and reasons presented for this by females were related to age and maturity, including leaving college or university, losing interest and work and family commitments. These explanations for non participation and drop out reflect the previously mentioned correlates of physical activity in women across the lifespan.

3.1.3 Efforts to Promote Physical Activity in Ireland

As well as the many national sporting bodies that exist in Ireland, there are several agencies that have a role in efforts to promote physical activity, including the Irish Sports Council (ISC), the Health Service Executive (HSE) and Government Departments. There are a multitude of other entities that have smaller roles in promoting participation, but the discussion here will be limited to those just identified. In the ISCs 2006 strategy, attracting more adult women into physical activity and sport, as well as the promotion of physical activity overall, was identified as a key priority. This has been supported and facilitated by their 'Women in Sport' programme, which is still in operation (The ISC, 2006). The ISC has also created Local Sports Partnerships (LSPs) throughout the country that are tasked with promoting physical activity in the community, in their respective regions. These entities, which are the most localised physical activity promoting agency in Ireland are reviewed in chapter 7. The ISC has also commenced a Go For Life programme for older people, a Buntús programme for primary schools and developed recreational activities such as walking and cycling trails.

At present, the Council is also generating a participation strategy, the first attempt by any organisation in Ireland to specifically target and promote participation in physical activity. Previously, the Department of Health and Children (1995) in the country's first Health Promotion Strategy targeted a 30% and 20% increase respectively in participation in light and moderate intensity activity over five years, which was possibly over ambitious. A subsidiary of the Department of Health, the HSE, is currently responsible for the development of policy and the design and delivery of services to promote healthy living, which includes an active lifestyle. The most recent development was the production of physical activity guidelines for Ireland (Department of Health and Children and HSE, 2009), which were largely based on those released recently in the US (USDHHS, 2008). These will be useful to those promoting physical activity, such as health professionals, teachers, coaches, LSPs and youth workers and include recommendations for physical activity for various population groups, including children, adults, older people, and people with disabilities on how to be active. The guidelines potentially can represent a renewed drive by national agencies to decrease physical inactivity among the Irish population.

There have also been positive developments in the transport sector in Ireland. The Department of Transport (2009a) in their plans for sustainable transport identified the importance of the promotion and adoption of active commuting modes of transport, such as walking and cycling. To achieve this, specific targets and timeframes to develop local and regional walking and cycling policies, to teach safe cycling in schools, and to retrofit and design urban areas and neighbourhoods that facilitate these modes of transport to make them a safe and pleasant option, were defined. Of note was that the policy did acknowledge the related health benefit of these actions; an illustration of cross departmental collaboration, which is required to achieve a co-ordinated national approach to tackling physical inactivity. A related National Cycle

Policy Framework has also been published to guide the development of a cycling culture in Ireland with a defined aim to increase the proportion of cycling trips to 10% by 2020 (Department of Transport, 2009b).

Finally, there is a national physical education (PE) curriculum, which is supported by the Department of Education and is administered at primary and post primary level. At the primary level, PE is not compulsory and while guidelines exist for its implementation, it is not assessed or regulated. At post primary, during the first three years only (junior cycle), there is a formal curriculum for the delivery of PE and its subsequent assessment but again it is not a compulsory subject and is not delivered in all schools. For the last two years at post primary (senior cycle), no PE subject is available for students (National Council for Curriculum and Assessment, 2010). It is not surprising that MacPhail et al. (2005) reported that PE in Ireland was in crisis and was being constrained by a lack of facilities, resources and time. Despite this, the large majority of principal teachers (88%) contacted in the study supported the inclusion of PE as a compulsory subject for the junior cycle at post primary level, while just over half advocated the same for the senior cycle.

The consideration of findings from research that has been undertaken in Ireland on sport and physical activity could also be worthwhile and may supplement efforts to promote physical activity at a population level. For example, Fahey et al. (2004) stated in their study that the most popular sports among adult females in Ireland included swimming, aerobics, cycling, golf and jogging; all individual sports, which offers evidence for the promotion of such options for physical activity. One concern remains; participation in individual sport is lower among populations with lower educational attainment. This presents a unique challenge to promote participation in individual sports, which appears to induce the greatest levels of adherence, among groups of women with low as well as high levels of educational attainment.

This latter finding about individual sports has further implications for national efforts to promote participation and is likely to be reflected in the ISCs new participation strategy. Specifically, it is now apparent, according to Lunn and Layte (2008) that policy is overly focused on team sports and the generation of new facilities and is not adapting to the changing demands and motivations of the Irish population. This latter point causes conflict in Ireland due to the dominance of team sports, particularly indigenous games, whose organisations typically receive the greatest funding and often record very high revenues, possibly at the expense of health enhancing community participation. The social-ecological framework for behaviour change incorporates changes at this policy level as well as at other levels, including the environment, in culture and in organisational structures as well as promoting interventions and programmes at the individual and community level.

The social-ecological model proposed by Sallis et al. (2006) includes four domains for active living; one refers specifically to active recreation, which entails the provision of programmes, the development and efficient operation of community organisations and the availability of sports and opportunities for physical activity. It is within this domain primarily that the development of physical activity events for individual sports, which includes the annual Women's Mini Marathon in Dublin and Cork, the focus of this research, could support the promotion of physical activity in Ireland, specifically among adult females.

3.1.4 Mass Events and Physical Activity

Worldwide, health events specific to or incorporating some element of physical activity, are regularly scheduled to promote and facilitate physical activity; mass community participation events are one of these event types. Given their popularity, it is important to investigate the evidence, if any, for the effectiveness of mass events and to explore the mechanism of this effect. Murphy and Bauman (2007) organised physical activity or sport events into three categories; large scale elite events with worldwide appeal, such as the Olympic Games and the World Cup in soccer; smaller, more localised community events which attract non elite, as well as elite participants, such as the Women's Mini Marathon in Ireland and other running/cycling events; and finally, health promotion events designed to increase activity among the general population such as walk to school/work days.

These events, both sport and health related have the potential to provide opportunities for activity across a variety of sectors, including the transport, occupation and recreation domains, which reflects the social-ecological model of behaviour change (Sallis et al., 2006). Recently, Bauman, Murphy and Lane (2009) specifically commented on the role of mass community events in promoting physical activity, calling for doctors (GPs) to recommend and advocate participation in these events and to take a more active role in physical activity promotion. Furthermore, Henderson (2009) and Lane et al. (2010) discussed the potential of these often 'sport' dominated events, specifically the fun and enjoyment they generate and the possibility of using this to stimulate increased participation in physical activity and develop a legacy of sorts.

Murphy and Bauman (2007) discussed the legacy of mass events, which can be quite tangible (facilities, infrastructural development) or psychosocial (positive perceptions of the event, social cohesion) in nature, and could potentially lead to physical activity behaviour change. In the literature however, much evaluation of these legacies is focused on economic or 'hard' outcomes from hosting a major event and often this focus is on impacts rather than legacies (Preuss, 2007). In a systematic review of the effects of major multi sport events on health and the socioeconomic determinants of health, McCartney et al. (2010) noted that some studies did undertake evaluation of these 'hard' impacts but they were of quite low quality. In contrast, little attempt has been made to measure the social outcomes, or behaviour change legacies that may be associated with mass events. Indeed, in the UK, Weed et al. (2009) noted that no evidence exists that any previous Olympics raised participation and also, that none have embarked on specific attempts to do so. Overall, in their review of events, McCartney et al. (2010) presented a rather bleak scenario, stating that there was little evidence that major multi sport events had any positive impacts on the population of the respective host cities.

3.1.5 Evidence of Effectiveness of Mass Elite Events

3.1.5.1 Economic and social effects.

As noted previously, legacy research has focused on economic outcomes as primary motives for holding a mass event. Despite this, Horne (2007) reported considerable overestimation of this particular benefit of hosting a mass event, with only Barcelona in 1992 presenting more positive than negative effects, particularly with respect to infrastructure and employment. Owen (2005) observed that economic windfalls post Olympics do not exist and predicted that China would not experience any related boom, following the Beijing Games.

The positive and negative social impacts of mass events have more recently been explored; these can include the provision and use of facilities, generation of community pride, and understanding of cultural diversity as well as crime, disruption to community life and unruly behaviour from supporters. Bull and Lovell (2007) documented the social impacts of the Tour de France when it started in Canterbury, in England, in 2007. Interviews were undertaken with people in the community and despite some negative offerings about road closures, 81% of respondents were happy the event was taking place. Furthermore, 11% noted the benefit to sport and health of the event and 35% intended to take part in some of the associated health/activity related activities organised in the community. Other social impacts such as increased tourism and community pride were also mentioned.

Ohmann, Jones and Wilkes (2006) assessed the social impacts of the 2006 soccer World Cup in Germany and found also that they were primarily positive although the behaviour of fans was cited as a negative outcome by 80% of respondents. Also, just over a third of respondents recognised the development of new leisure facilities after the World Cup. This is interesting considering that the International Olympic Committee have referred to legacy as the provision of sport facilities in a community and a fund to operate these facilities and venues (Preuss, 2007). Much rhetoric has been presented about the effect of new facilities, a common adjunct to any mass event, but little evidence is available on their subsequent effect on community participation. It was noted earlier that facilities are not a barrier to participation amongst Irish adults (Fahey et al., 2004), a finding which reinforced those produced by Giles-Corti and Donovan (2002) who in a study on healthy adults in Perth, Australia found that only about 10% of respondents used recreational facilities and the presence of facilities was ineffective in instigating sufficient levels of physical activity. More information on the role of facilities to be active in predicting physical activity was presented in chapter 2.

3.1.5.2 Effects of mass elite events on physical activity behaviour.

In relation to physical activity and participation effects, population surveys carried out after the Barcelona Olympics, Manchester Commonwealth Games and Sydney Olympics all failed to present conclusive evidence of increased participation due directly to these events (London East Research Institute, 2007; MORI, 2004; Bauman, Ford & Armstrong, 2001; McCartney et al., 2010), suggesting that the impact of hosting an event alone is not sufficient to induce population behaviour change. Horne (2007) cited these latter supposed effects of hosting a mass event as ‘known unknowns’, popular beliefs with little, or insufficient validation. McCartney et al. (2010) in their review of multi sports events noted that some impact on volunteers has been assessed, although no notable outcomes were apparent in relation to subsequent engagement in physical activity by these same individuals. It remains to be seen the difference, if any, that is apparent in the UK following the introduction of an integrated, participation focused strategy that will be assessed post event.

3.1.5.3 How to maximise the effect of mass events?

Chalip (2004, cited in Chalip, 2006) has advocated 'leveraging' the opportunities that mass events present before, during and after their operation rather than attempting to focus on the direct impacts they alone can generate. Similarly, Henderson (2009) called for sport managers and organisers to adopt a public health mandate and use their events and games to promote health and physical activity as well as generating entertainment and excitement for both sports participants and supporters. Chalip (2006) referred to the almost transcendental effect of mega events where something greater than the sport or event itself is observed and a heightened sense of community and energy, referred to as liminality or communitas, is apparent. To create the latter at events, Chalip (2006) recommended the adoption of five strategies: enabling sociability, creating event related social events, facilitating informal social opportunities, producing ancillary events and theming.

The organisers of the London 2012 Olympics are aiming, and indeed have already begun, to adopt a similarly framed, pro-active approach to maximising the health potential of this sporting event. A strategy to avail of the once in a lifetime promise of the London Olympic and Paralympic Games has been formulated; specifically to align physical activity with sport and thus leverage the effect of these events beyond elite sport and sport in general (UK Department of Health, 2009). This plan includes offering a greater choice of physical activities and informing the population of this, creating active environments, supporting those most of risk of inactivity and ill health and strengthening the delivery of the physical activity message at a local and national level. These efforts reflect recommendations made by McCartney et al. (2010) and Chalip (2006) to define a specific approach and a 'theory of change' for an event to optimise its effects, in light of the little evidence that currently exists to justify hosting such events. If the UK is successful in motivating a further two million British people to be active, as they aim to do, the public health potential of mass events would be enhanced and there would be considerable implications for organisers of future events.

At this juncture, it is worthwhile considering the possible spillover effect of the London Games to Ireland. In Australia, warm up events organised across Victoria prior to the Commonwealth Games in Melbourne in 2006 (Sport and Recreation Victoria, 2006) were reported to motivate people to be active and was cited as a good initiative by the London 2012 organisers. Given the proximity of Ireland to the UK, akin to the geographic disparity of the state of Victoria in Australia, there appears to be a possibility for the national agencies mentioned earlier to incorporate Olympic related projects into overall plans to promote physical activity. Indeed, Murphy and Bauman (2007) observed that co-ordinated, advanced planning between event organisers and relevant agencies in the health and sport sector is paramount to maximise the benefits associated with mass events. It is therefore positive to note that a task force was set up in the Department of Sport in Ireland to consider all opportunities that may be presented by the London Games. As well as economic and tourism related gains, the report produced by the task force (Department of Arts, Tourism and Sport, 2008) also referred to increased facility provision and greater participation rates and volunteerism during and post event and the value and impact of this on community health. The report also observed that it was imperative that decisions and actions are taken quickly to avail of the possible sporting legacy that the Games present.

3.1.6 Effectiveness of and Motives for Participation in Mass Community Events

Hitherto, only large scale elite events have been considered, but overall, Murphy and Bauman (2007) remarked that there is a lack of evaluative studies throughout this area, across all types of mass events. Community events such as city road races or cycle events are also typically not assessed in relation to their impact on physical activity, despite their large numbers and increasing popularity (Bauman, Murphy & Lane, 2009). The City to Surf in Sydney attracts 60,000 participants, the Bolder Boulder in the USA attracts 50,000 while the Women's Mini Marathon in Dublin and Cork has approximately 50,000 participants, each on an annual basis. These events are often over-subscribed, which presents further evidence of their popularity. They appeal to elite, already active participants but there is also some suggestion that non-elite, less active individuals also take part; for example, 40% of participants in the Honolulu Marathon walk the event.

A formal evaluation was undertaken by Bowles, Rissel and Bauman (2006) of the 20 and 50km annual Spring Cycle in Sydney, which has approximately 10,000 participants. A pre and post survey investigating cycling ability and physical activity levels, using the Active Australia protocol (Australian Institute of Health and Welfare

(AIHW, 2003) were administered. Results indicated that one month post event, almost 50% of people who self rated as ‘low’ active prior to the event were now confident they were ‘high’ active. Numbers of cycling trips and minutes being active also increased at follow up. This was undertaken one month post event, which offers little indication of long term impact; a common occurrence in the evaluation of events. Despite this, there appears to be a capacity for these events to foster low intensity participation in a relaxed, social setting, often with non health or fitness related goals or motives attached to taking part. Instead, fun, sometimes charity related objectives are evident. For example, the Bolder Boulder 10km event in the USA has entertainment scheduled throughout the race to support participants, while the City to Surf incorporates the Herald Hero concept to encourage participants to raise money for charity.

3.1.6.1 Charity as a motive for participation.

Filo, Funk and O’Brien (2008; 2009) addressed the increasing prominence of participatory events that are aligned with a charitable cause. Filo et al. (2008) using participants from two Lance Armstrong cycling events explored motives for participating in a charity sport event and uncovered fitness and social reasons, reciprocity (giving back to a charity that helped them), self worth, helping others, and raising awareness as key factors related to participation. More significantly, these factors were inter-related and led to a visibly enhanced connection between participants and the event. Filo et al. (2009) explored participants’ attachment to participation in an event, which they acknowledged from their previous research can be enhanced by having charitable as well as fitness related motives for participation.

In Filo’s study, semi structured interviews were undertaken with participants in the Lance Armstrong LIVESTRONG challenge in Texas, USA, where participants were required to reach minimum fundraising requirements. The first theme uncovered in relation to participation in the event concerned participants feeling that they were taking part in something significant with a large group of similar minded people and the friendship generated and experienced as a result. Secondly, participants rated the greater cause associated with the event more than fitness, activity related goals as a reason for participating. This adds meaning to the associated physical activity and can motivate otherwise un-interested, unwilling people to take part. Lastly, many participants did note the fitness and health related benefits of participation and the challenge of training prior to the event. Overall, the authors noted an emotional, symbolic and functional meaning to the event, which could offer a framework for the leveraging of charitable events to increase participation in physical activity.

3.1.7 Health Promotion Events

The last category of mass events incorporates single-day health promotion events. These events have historically targeted issues like smoking and sexual health but have since grown to embrace all facets of behaviour change and currently are thought to contribute to making nations healthier (Rose, Marfurt & Harbutt, 2003). These one off events are most effective when part of a broader programme. Unfortunately, few have been formally or rigorously evaluated, with the majority of money allotted to the organisation and running of the event (Rose et al., 2003). Some of the evaluations that have been undertaken are presented below.

Mellifont (2002, as cited in Rose et al., 2003) evaluated the Queensland Ride to Work day and found that only 8% of respondents took up cycling for the event; the majority were already regular cyclists. However, response rates were not defined and no follow up was undertaken, so it is difficult to assess the true effect of the event. Merom et al. (2005a) carried out a pre-post evaluation of an Australian Walk to Work Day campaign. Follow up data were collected immediately post event and indicated a significant increase in moderate intensity activity and walking, which led to an overall decrease in the proportion of employed people classified as inactive. This was possibly due to a significant reduction in car trips and a complementary increase in walking, cycling or combined trips (i.e.) more active commuting. Merom et al. (2005b) undertook a post event evaluation of a Walk Safely to School Day in New South Wales, in Australia. Parents were contacted following the event and there was a self reported increase in walking behaviour (6.8%).

The Ride to Work Day, held annually in Victoria, Australia is a once off event that is embedded in a larger community cycling campaign, which involves community breakfasts, workplace initiatives, promotional materials and post event follow ups. Following the 2004 event, Bicycle Victoria (2005) produced a summary report. It was noted that 23% of the participants were first time riders, and only 7% were habitual commuters, suggesting that the event was effective in instigating activity among more than those who were already active. Five months after the event, just under a quarter of the first time riders were still commuting to work, evidence of some lasting behaviour change.

In the UK and USA, there also are Walk and Cycle to Work and School days/weeks. In Ireland physical activity related events include Irish Heart Week and National Bike Week, being held for the first time in 2009. These events typically operate within greater campaigns such as Happy Heart at Work, Get a Life, Get Active, Go For Life and Smarter Travel. There is however, minimal published evaluation of any of these collective or individual physical activity related events, in Ireland. Recently, Priest et al. (2009) in a Cochrane review, assessed all promotion initiatives undertaken by sporting organisations, which can include one off activity days, media campaigns and information sessions; strategies that could be encompassed into the event framework described above. A thorough search of the literature and contact with relevant organisations revealed no controlled studies that assessed physical activity as a primary outcome; further evidence of the lack of evaluative studies in this paradigm of research.

3.1.8 Theoretical Framework for Mass Events

Murphy and Bauman (2007) observed that there is a lack of clarity or theoretical framework to explain the aforementioned legacy of mass events and the nature of the relationship between engagement in events and population physical activity. Some explanations were presented; the first proposal was that mass events may have a 'trickle down' or demonstration effect on participation where non participants are encouraged to become active, possibly due to the success of elite athletes, who are viewed as role models (Hindson, Gidlow & Peebles, 1994). Payne et al. (2002) however, found that there was minimal literature on the possible causal relationship between role models and physical activity but some support existed for the beneficial effects on health behaviours such as substance use and smoking. The authors reviewed several role model programmes in Australia and noted that few provided evidence of effectiveness in relation to participation in physical activity; rather they assessed the success of implementation and participant satisfaction with the programme. It was also noted that successful programmes involved long term mentoring, incorporated parents, teachers and peers as well as celebrities and elite athletes and were targeted to 'at risk' or socially disadvantaged population groups.

It is difficult at this stage to find evidence for a 'trickle down' effect, at least on to a general community or population (Hindson et al., 1994). Indeed Murphy and Bauman (2007) observed that most of the support for this hypothesis is anecdotal in nature; support is restricted to observations of children playing tennis around Wimbledon, or in Ireland, the soccer and rugby booms that followed success in the 1990 World Cup and in the Six Nations in the 2000s. Furthermore, Hogan and Norton (2000) noted that after the Australian government adopted this model of sport promotion by primarily funding elite sports, the general population actually became less active. Rather, as noted by the UK Department of Health (2009), any demonstration effect that is apparent may be restricted to people who are already active, and are merely increasing the frequency, intensity and diversity of their activity bouts. Thus, the use of top athletes and role models taking part in mass events to promote sports and physical activity, which has political acumen and subsequently is often a part of sports development policy can now be deemed somewhat unfounded particularly in a physical activity context (Horgan & Norton, 2000).

A second hypothesis was that events with new or different sports create interest and enthusiasm in people, particularly children to play these sports (UK Department of Health, 2009). Scientific evidence of this phenomenon is not forthcoming although Brown and Massey (2001) did note that the Commonwealth Games presented an opportunity for new sports to gain an audience and perhaps some participants for their sport, irrespective of success. The authors prepared a proposal to maximise the impact of these games prior to their operation in 2002 but noted that a pre-post evaluation over a five year period was imperative to assess the true impact on participation. This was a significant proposition that may be important in the future to further the evidence of the effectiveness of mass events on physical activity behaviour.

The last suggestion to explain the relationship between events and participation concerned a staged engagement with physical activity due to the event, which may provide a greater understanding of how events could be leveraged to promote increased levels of activity among participants, spectators and volunteers alike. Models such as the TTM and Psychological Continuum Model (PCM) have been used to explain this staged engagement. The UK Department of Health (2009) observed that behaviour change is a phased occurrence initiated by changes in attitudes, awareness and intention and thus deemed these models ideal in a mass event context. The PCM model has some similarities with the TTM model, which has been addressed earlier in chapter 2. It is, however, different to the TTM in that it focuses on the psychological processes and situational factors involved between an individual and an event and any subsequent change in participation.

The PCM model incorporates four stages; awareness, attraction, attachment and allegiance and was first applied to sport spectators (Funk & James, 2001) but has since been discussed in an event (elite/community based) context. Specifically, Filo et al. (2009) explained that awareness relates to being conscious of the event; attraction indicates displaying some preference for the event; attachment incorporates generating meaning for the event and allegiance, a commitment to the event. In relation to participation, the first two stages can reflect registration and intention to participate in the event but it is the latter stages that are important to induce significant behaviour change. Filo et al. (2008; 2009) noted that the development of attachment and meaning is possible among participants in events. Meaning is aligned with personal motives and values and these, particularly those that are non health/fitness related, could be targeted to advance participants to the pinnacle of the PCM model – allegiance. At this stage, individuals, in a physical activity context, would display persistent positive attitudes towards activity and sustained behaviour change.

3.1.9 Summary

The health and sport sector have not sufficiently or consistently engaged with event organisers to use the opportunity provided by mass events to promote the physical activity message. This is not surprising since most event promoters do not have a public health agenda. The onus must be on the health sector to initiate engagement with organisers. There are indications of new participants, positive changes in physical activity due to the event, and signs that many events attract more than the fittest segment of their target population to participate in the event or become more active as a result of it. Unfortunately, evaluation is limited and study designs are inconsistent, while others have simply failed to assess participation in physical activity. This is somewhat disappointing because if mass events do indeed impact upon previously inactive individuals within the population, they would be of public health interest.

The research in this thesis represents a partnership between event organisers and the health sector, and is supported by the ISC. The aim was to undertake a pre-post survey of physical activity of participants (elite and non-elite) in a mass event in Ireland. Dublin hosts the annual Women's Mini Marathon (10km) in early June, and the event has grown to be the largest women's only event worldwide and is heavily subscribed. While the participation figures and other anecdotal evidence exists to suggest that the Women's Mini Marathon may be an important national event in encouraging Irish women to be more active, the true impact of the event has hitherto not been quantified. A similar event is hosted annually in Cork and while participation rates are somewhat lower, the event is well attended and attracts a different cohort of women than its Dublin equivalent. This first study was undertaken to describe the physical activity habits of the Mini Marathon participants, in Dublin and Cork, prior to and after the event, in 2007 (Dublin only) and 2008 (Dublin and Cork).

3.2 Methods

3.2.1 Study Population and Design

All entrants to the Dublin Mini Marathon (10km events), in 2007 and 2008 were requested to complete a questionnaire, either online or by mail, in the weeks (1-4) prior to the event. Women who registered online were sent a link to the questionnaire by email. Not all women who registered online were contacted due to a lack of email addresses and single email addresses for multiple entrants. This group was also sent a reminder email to complete the questionnaire. All women who registered by post were mailed a questionnaire along with a stamped addressed envelope. In 2008, participants in the Cork Mini Marathon were also recruited. There is currently no online registration for this event and postal details were not available prior to the race; therefore, questionnaires were disseminated on the day of the event only. To maximise the response rate, all women who completed and returned the questionnaire were entered into a competition to win a holiday, courtesy of Sunway Holidays, in 2007 or into a draw for a cash voucher, in 2008. As shown in *Table 4*, over 80,000 women were targeted at these events[1].

Table 4

Total Target Group at Mini Marathon Events

	Dublin 2007	Dublin 2008	Cork 2008
Online target group (N)	18,912	27,159	n/a
Postal target group (N)	13,793	15,502	9,000
Total N	32,705	42,661	9,000

[1] This figure may include women who participated in all events, thus some may have been counted twice or more.

3.2.2 Procedures

In early 2006, a research proposal was submitted to the ISC to complete an evaluation of the Women's Mini Marathon. Ethical approval was acquired and a pilot study was undertaken in April 2006 (n = 1,179), using an online survey to assess the physical activity habits of Mini Marathon participants, why they participated in the event, their training and preparation for the event, and their beliefs about physical activity. Data were analysed and the survey instrument was refined in advance of the 2007 and 2008 events. As noted earlier, a web based survey was available to all who registered online and postal entrants were mailed a copy of the questionnaire; two methods were used to ensure all participants who registered were contacted and to maximise response rate. Furthermore, on the day of the Dublin event only (2007 and 2008), intercept interviews were carried out with a random sample of the race participants. This intercept interview survey provided a random sample of event participants to compare with postal/online survey respondents to assess their representativeness.

3.2.3 Questionnaire

The questionnaire (*Appendix E, p. 392*) used at all events was designed by the research team in Waterford Institute of Technology and incorporated a variety of tools, including the International Physical Activity Questionnaire (IPAQ), the ISCs Sports Monitor Questionnaire and the latest Irish National Health and Lifestyle Survey 2006 (SLÁN). The IPAQ was developed to accurately measure all domains of physical activity using a questionnaire. A long and short version of the instrument was developed and then evaluated in twelve countries (Craig et al., 2003). Participants completed the IPAQ questionnaire twice and also wore accelerometers between these time points. Test retest reliability measures were acceptable (.65) for the IPAQ questionnaire. Validity for continuous data of minutes spent being physically active was somewhat lower at approximately 0.3 but remained comparable to most other self report measures. Its validation in a number of different developed and developing countries is a considerable strength of this instrument and re-affirms its use in this context.

The Irish Sports Monitor is a new initiative funded by the Irish Sports Council that will provide an ongoing assessment of participation in sport and physical activity in Ireland. Demographic questions were also adapted from the 2006 SLÁN survey, which is a national survey of the lifestyles, attitudes and nutrition of people living in Ireland. It is undertaken every four years to provide an overview of the current health status, attitudes and needs of Irish people, while also indicating changes in these parameters over periods of time. The 2006 questionnaire included the IPAQ measure for the first time, which will facilitate comparisons with the physical activity data collected in the current study.

3.2.4 Measures

3.2.4.1 Physical activity.

Physical activity data were, as noted earlier, collected using the previously validated IPAQ tool. Respondents were asked to provide detail on the amount of vigorous and moderate activity, and walking, they undertook in the previous week. Data were then presented as MET-minutes per week, which represents the estimated energy cost associated with performing activities at different intensities, as multiples of resting metabolic rates. Using the IPAQ Scoring Protocol (2005), participants were categorised as ‘high’, ‘moderate’ or ‘low’ active. The ‘high’ activity category refers to participation in at least one hour per day of at least moderate intensity exercise, above basal participation rates. It also equates to three days of vigorous intensity activity achieveing at least a total of 1,500 MET-minutes/wk or seven days of any activity achieving a minimum total of 3,000 MET-minutes/wk. The ‘moderate’ category is defined as doing some activity, more than the ‘low’ active category. This level of activity corresponds to half an hour of moderate intensity activity on most (five) days of the week or five days of any combination of activity achieving a total physical activity of at least 600 MET-minutes/wk. The ‘low’ active category is defined as not meeting either of the previous two criteria and reflects an ‘inactive’ level.

These IPAQ categories, based on the frequency and intensity of participation in physical activity, were used to classify an individual as sufficiently or insufficiently active using current recommendations for minimum physical activity for health benefits. Individuals who are categorised as ‘moderately’ active theoretically meet these minimum physical activity guidelines; 30 minutes on most days of the week, which corresponds to the 150 minutes of at least moderate intensity activity per week guideline issued recently in the US (USDHHS, 2008). However, as the IPAQ assesses all domains (vigorous, moderate and walking) of physical activity and involves self report data collection, it is likely that this 30 minute goal will be achieved by the majority of adults in a population. Therefore, it may be acceptable to use a higher threshold of physical activity, specifically the 'high' IPAQ active category to indicate participants who participated in 'sufficient' physical activity for health benefits. This will be discussed in greater detail below. To conclude, in this chapter, sufficiently active will equate to being deemed 'high' or 'moderate' active as per IPAQ categrories *or* just being categorised as 'high' active.

3.2.4.2 Sedentary behaviour.

In the 2008 Dublin and Cork event, specific sedentary behaviour was also assessed; participants were asked to indicate how much time they spent sitting and watching television per day. The latter has been used as an indicator of sedentary behaviour while assessment of sitting has become more popular in recent years (Rosenberg et al., 2008). These measures indicate specifically the amount of time spent being sedentary to supplement indicators of insufficiently active that the IPAQ data will generate. Rosenberg et al. (2008) noted that it is important to distinguish between sedentary and inactive participants. They observed in a sample of 289 participants from four different sites that these are distinct behaviours and many participants who reported high sitting times also engaged in recommended amounts of physical activity.

3.2.4.3 Readiness to change.

Readiness to change was assessed using a tool developed by Marcus and Owen (1992) to measure exercise motivational stage. Respondents were asked to indicate their perceived physical activity status from a five point scale. The labels of each of these points corresponded to the different stages of physical activity adoption (pre-contemplation, contemplation, preparation, action, maintenance) as described in the TTM model of behaviour change.

3.2.4.4 Self efficacy.

Self efficacy was assessed using a modified version of Marcus and Owen's (1992) self efficacy scale. Respondents were asked to indicate their agreement with four different statements. A final self efficacy score was calculated by summing the answers from each of the four variables, with higher scores indicating lower self efficacy.

3.2.4.5 Body Mass Index (BMI)

BMI was self reported in the 2008 Dublin and Cork event. Participants were asked to submit detail on weight and height, which was then converted to the appropriate unit of measurement and manipulated to generate BMI. Dietz and Bellizzi (1999) noted that BMI is now a widely accepted measure of adiposity in adults although self report of body height and weight is prone to measurement error. Despite this, Kuczmarski, Kuczmarski and Najjar (2001) compared self report and measured weight and heights in a group of adults in the US and found that there was a strong, significant correlation between the two measures. Some differences were apparent and measured BMI was greater than self reported BMI, particularly among women and older age groups. BMI was therefore recommended as a valid and reliable measurement among younger populations. According to guidelines produced by Field, Aneja and Rosner (2007), BMI values less than 12 and greater than 60 were excluded from analysis.

3.2.4.6 Demographic data.

Demographic data were collected on age, education, marital status, medical card status, place of residence, as well as detail on the training habits, previous participation and intended mode of completion of each participant, specific to each individual event.

3.2.5 Meet and Train Groups Training for the Mini Marathon

Meet and Train groups were specifically targeted in the 2007 survey. Meet and Train groups are training clusters that have developed nationwide to facilitate collective training. A list of the registered Meet and Train groups nationwide was obtained from the Evening Herald newspaper (March 1st, 2007). The Athletics Association of Ireland (AAI) and the Local Sports Partnerships (n = 20) were also contacted to check their records of such groups. A sample (n = 30) of the charities represented in the 2007 Women's Mini Marathon were contacted but no charity was found to have an organised Meet and Train group. In total thirty-five groups were contacted and baseline questionnaires were posted to the leader of each group, who distributed the instrument to the group members (n = 250). This data were included in the overall baseline data.

3.2.6 Intercept Interviews of a Random Sample of Participants on Race Day

Interviews, n = 414 (2007) and n = 300 (2008), to assess the physical activity habits of the Mini Marathon participants and to record reasons for participating were undertaken on the day of both Dublin events. These interviews, conducted approximately two hours prior to race start, were designed to assess whether data collected in the postal and web based baseline survey were similar to a random sample of participants on race day. This examines the selection bias that is typically apparent when there is a low response of participants to a questionnaire. Approximately ten interviewers adhered to a set protocol, using IPAQ measures, and were assigned to separate sections of the pre-determined starting zones for runners and walkers. Interviewers were instructed to read the questions clearly and not to probe participant responses. They were required to ask every 5th participant to complete the questionnaire and to record their consent or lack thereof to participate and to note if they had previously completed the questionnaire online or by mail.

3.2.7 Data Analysis

As noted earlier, physical activity data were converted to MET-minutes, which indicates the energy expenditure associated with particular types of physical activity. The number of minutes of each activity (vigorous, moderate and walking) was multiplied by the MET score for that particular intensity (3.3 METS for walking, 4 METS for moderate and 8 METS for vigorous). These data were then used to compute activity categories for each participant (IPAQ, 2005). Descriptive analysis was summarised the activity levels of each event group and their demographic and training characteristics. Comparative analysis, using inferential statistics, was undertaken between the different modes of completion of the survey, age groups, marital status, level of education and activity category among others. Both frequency and duration measures of physical activity and MET-minute scores were used in this analysis. Crosstab analysis permitted the investigation of consistency between perceived and reported levels of physical activity.

3.2.8 Research Questions

1. What were the characteristics (demographic, training habits, knowledge etc) of Mini Marathon participants?
2. How active were Mini Marathon participants?
3. Were participants confident in their ability to be active?
4. Were participants consistent in their global self ratings of physical activity?

3.3 Results

Research Question 1: What were the characteristics (demographic, training habits etc.) of Mini Marathon participants?

3.3.1 Characteristics of Respondents

Of a total sample size of 11,205 in the 2007 Dublin Mini Marathon, 61% were online returns and 39% were postal replies. There was a lower sample size in the 2008 equivalent; 9,523, with a similar breakdown of online and postal responses. Overall this represented a total response rate of 35%, in 2007 and 23% in 2008, as indicated in *Table 5.* The response rate in Cork was considerably lower at 11% possibly due to collection of data on the day of the event only. Not all participants in the event were contacted; as indicated earlier, lack of email addresses and undelivered mail and emails led to a decrease in women reached by the survey instrument. The data in *Table 5* illustrates the number of participants who were successfully targeted with an online or postal survey.

Table 5

Baseline Surveys Response Rate

	Target Population (N)	Total Responses (n)	Online Reponses (n)	Postal Responses (n)	Response Rate (%)
2007 Dublin	31,986	11,205	6,804	4,401	35
2008 Dublin	41,969	9,523	6,497	3,026	23
2008 Cork	9,000	1,029	n/a	1,029	11

Table 6 shows that half of the respondents, in the Dublin Mini Marathon were from Dublin, which was understandable given that the event was held in the city. In the 2007 event 51% of the sample was aged between 30 and 49 years, with 33% aged less than 30 and 16% older than 50 years. A similar breakdown was apparent for the 2008 event. In both Dublin cohorts, approximately half of the group had no children, with the remaining either married or single with children. Sixty six per cent of the total sample lived in a city or town, 33% lived in a village or isolated location and the remainder were people who did not reside in Ireland.

To attempt some measure of social class, participants were asked about their level of schooling and medical card status. Medical cards are issued by the government in Ireland to individuals whose income falls below a certain figure. Only 16% of respondents indicated they had a medical card; this was similar (18%) in 2008 and considerably lower than the Irish female population at large (37% of whom owned a medical card). Approximately two thirds of the group had undertaken at least tertiary level education, which is considerably higher than the general Irish adult female population. Just over 95% of respondents to the 2007 survey stated that they were white Irish. In the Cork event, a similar proportion of participants had some or complete tertiary education and held medical cards. As expected, a much lower proportion were from Dublin and interestingly, the age and parenthood profile was more like general Irish population. *Table 6* underneath illustrates some key characteristics of the respondents to the surveys, compared to statistics from the Irish population.

Table 6

Characteristics of Respondents to Baseline Surveys

	National Statistics for Irish Adult Females n=1,697,272 (%)	Dublin Mini Marathon Population 2007 n=11,205 (%)	Dublin Mini Marathon Population 2008 n=9,523 (%)	Cork Mini Marathon Population 2008 n=1,029 (%)
Tertiary Education	27	63	62	62
White Irish	87	96	n/a	n/a
Medical Card Holder	37	16	18	18
Aged 20-29	21	27	33	19
Live in Dublin	36	50	49	2
No Children	50	52	51	42
Married	46	57	58	63

Responses were collected using online and postal questionnaires. *Table 7* indicates some demographic disparity between respondents using these different data collection tools. Online respondents had higher levels of education, were younger and were less likely to have a medical card or children than those who completed postal questionnaires.

Table 7

Characteristics of Online v Postal Respondents to Baseline Surveys

	Dublin Mini Marathon 2007		Dublin Mini Marathon 2008	
	Online n=6,804 (%)	Postal n=4,401 (%)	Online n=6,497 (%)	Postal n=3,026 (%)
Tertiary Education	78	40.9	75.3	39
Medical Card Holder	10.7	23.9	13	27.3
Aged 20-29	36.9	13.7	36.9	12.4
No Children	61.3	38	60.2	33.5

3.3.2 Previous Participation in the Mini Marathon

Just over a third (38%) of respondents were participating in the 2007 Mini Marathon for the first time, while approximately 62% were taking part in the event for the second time, or more, as illustrated in *Figure 2*. A slightly greater proportion of 2008 Dublin participants and Cork 2008 participants were participating in the event for the first time.

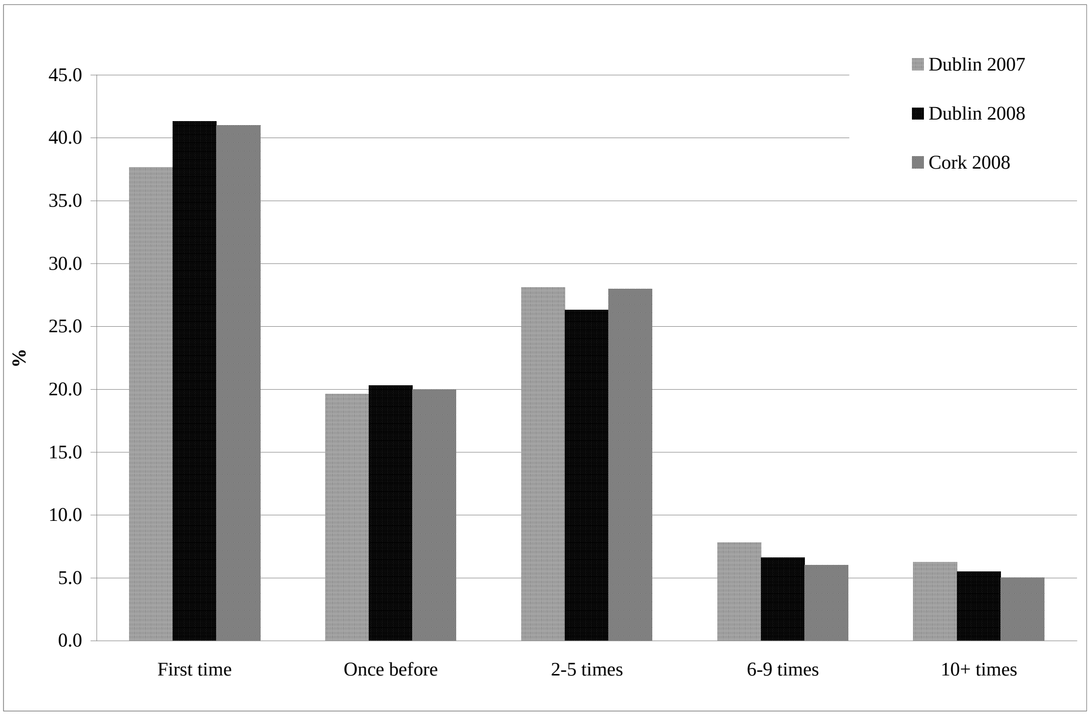


Figure 2. Previous participation in the Mini Marathon: Baseline surveys.

3.3.3 Reasons for Participation in the Mini Marathon

The Mini Marathon in Dublin has historically attracted women raising money for charity, and, in 2007, approximately 70% of women cited this as their main reason for participating in the event. The rate was similar in 2008 and higher for the Cork event (76%). Other reasons for participating across all events included as a motivator for activity (30%), as a personal challenge (33%), and due to a request from friends (20%). Analysis of the intercept interviews undertaken on the day of the 2007 Dublin event indicated that 93% had raised money for charity to coincide with their participation in the Mini Marathon; 47% reported that they raised more than €250 for their chosen charity. This estimate of €250 was likely to be representative of all participants because organising committee data indicated that the Mini Marathon in 2007 and 2008 raised about €10 million (Women's Mini Marathon, 2009), which equates to about €200-250 per participant.

3.3.4 Mode of Participation in the Mini Marathon

Of the total respondents to the Dublin events, approximately 48% indicated that they would walk or mostly walk the 10km route, 30% hoped to walk and jog, while 22% forecast that they would jog or run the event (see *Figure 3)*. Twice as many of the Cork participants reported that they would run the event.

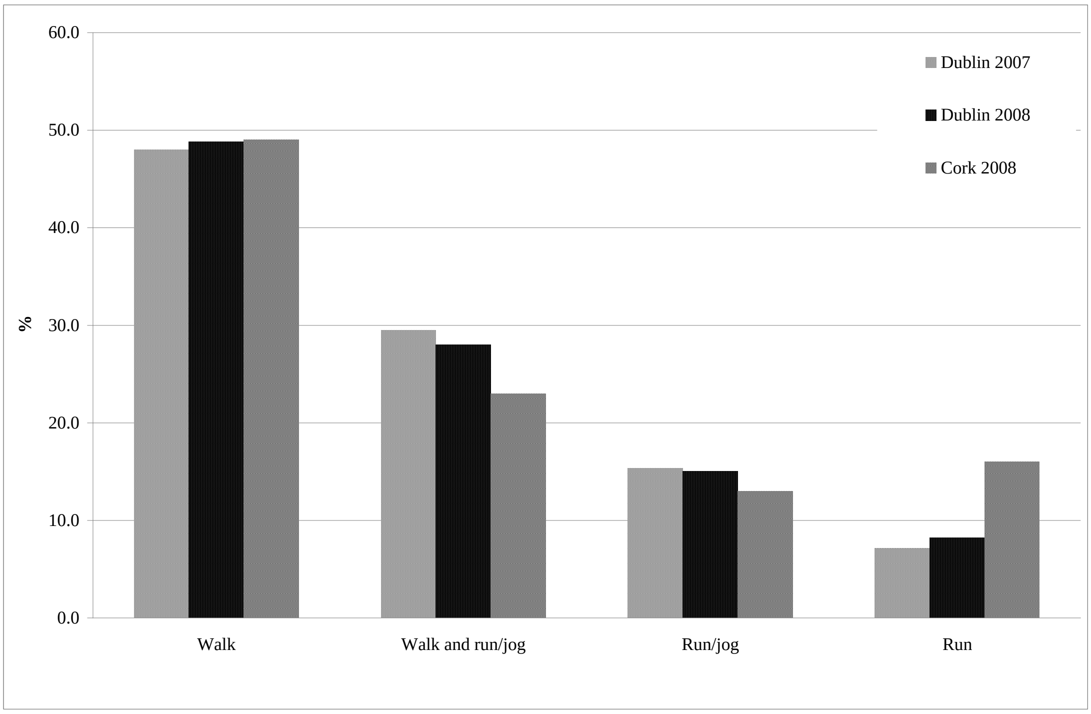


Figure 3. Mode of participation in the Mini Marathon: Baseline surveys.

In all events, the majority of participants intending to walk were first time participants (approximately 41%) and intention to run was highest in those who participated in the Mini Marathon between two and five times previously.

3.3.5 Training for the Mini Marathon

in 2007, just over 34% of the respondents indicated that they trained continuously most of the time; only 10% stated that they did not train at all (*Figure 4).* A much greater proportion (33%) of Cork participants indicated that they did not train prior to the event.

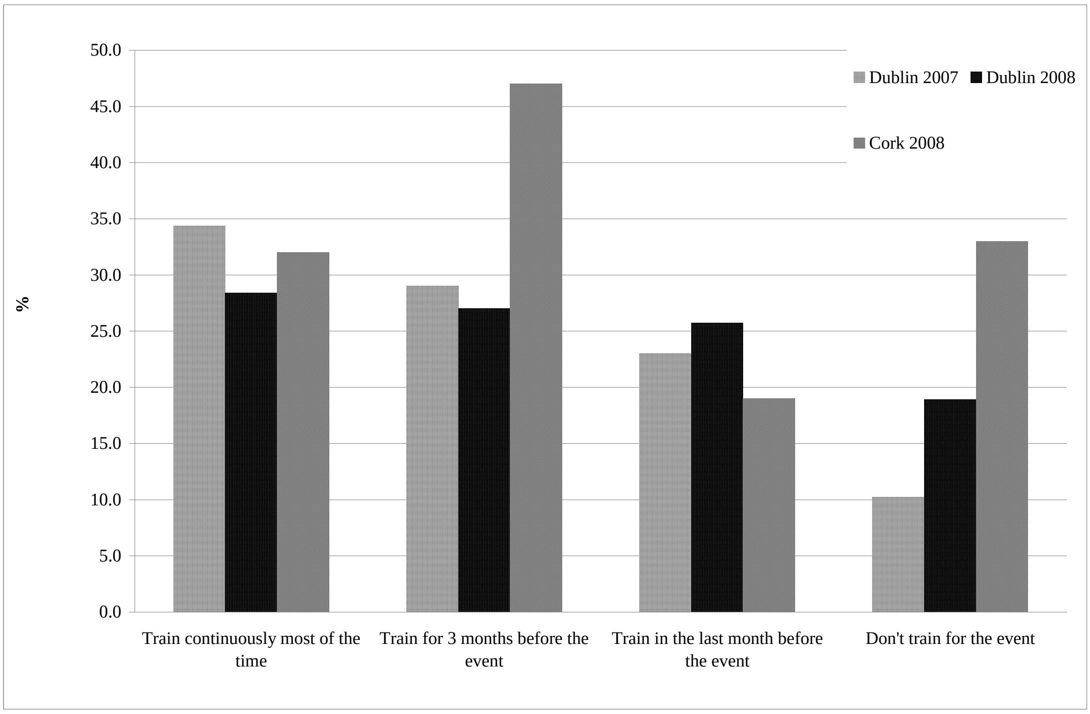


*Figure 4.*Training for the Mini Marathon: Baseline surveys.

The majority (70-80%) of those who did not train indicated that they intended to mainly walk the event; this was apparent in all three events. Intentions to jog/mostly jog or run the event did increase as training levels increased. Also, greater previous participation was associated with higher levels of training.

In the 2007 event, 53% trained on their own for the event, with a further 46% training with a friend. Only 13% of the total respondents reported participating in a Meet and Train group as part of their preparation for the event. As noted in the method section, Meet and Train groups were specifically targeted as part of this survey. The response rate was quite low (20%) so this may explain why, overall, there appeared to be limited participation in these training groups. It was apparent that those who did train with a group of people were less likely to walk the Mini Marathon and also reported greater levels of training, suggesting people who train in groups may participate in more physical activity, at a greater intensity.

A large majority of respondents trained in the streets and roads around where they lived (75%) with some mixing this with training in a local green area near where they worked and, to a lesser extent, with a local gym/leisure centre. Indeed, only 11% cited the latter as a training location. Interestingly, training in streets and roads around where respondents lived was the most popular training location irrespective of where the respondent resided (city, town, village etc). Training in local green areas and in gym/leisure centres was approximately twice as common among people residing in cities compared to those living in villages and isolated locations. These data were collected in the 2007 survey only.

Research Question 2: How active were Mini Marathon participants?

3.3.6 Physical Activity Levels of the Mini Marathon Participants

Analysis of the physical activity data from the 2007 event indicated that 32% of the respondents were in the 'high' activity category, 45% in the 'moderate' and 24% in the 'low' active category. As discussed earlier, individuals who are categorised as 'high' or 'moderately' active technically meet minimum physical activity guidelines; 150 minutes of at least moderate intensity activity on most days of the week (USDHHS, 2008). *Figure 5* indicates that approximately 76% of the 2007 Dublin Mini Marathon participants met these minimum physical activity requirements. This was 81% for both 2008 events.

The IPAQ Scoring Protocol (2005) and Bauman et al. (2009) presented an alternative interpretation of IPAQ data, proposing that only participants categorised as 'high' active meet minimum physical activity requirements. The commonly used '30 minute per day' guideline refers to generic leisure time physical activity but IPAQ assesses multiple domains of physical activity. Although, high active reflects physical activity levels greater than those recommended as standard or minimum it provides more accurate estimates of sufficiently active for participants who detail the specific nature and extent of their engagement in physical activity, as per the IPAQ instrument. The IPAQ (2005) also noted that 'high' active is more suitable and appropriate as a unit of comparison for assessments of physical activity levels across various population groups and sub groups. This interpretation of IPAQ data presents an alternative analysis of the physical activity levels of event participants; *Figure 5* suggests that approximately one third of participants over the three events could be deemed sufficiently active.

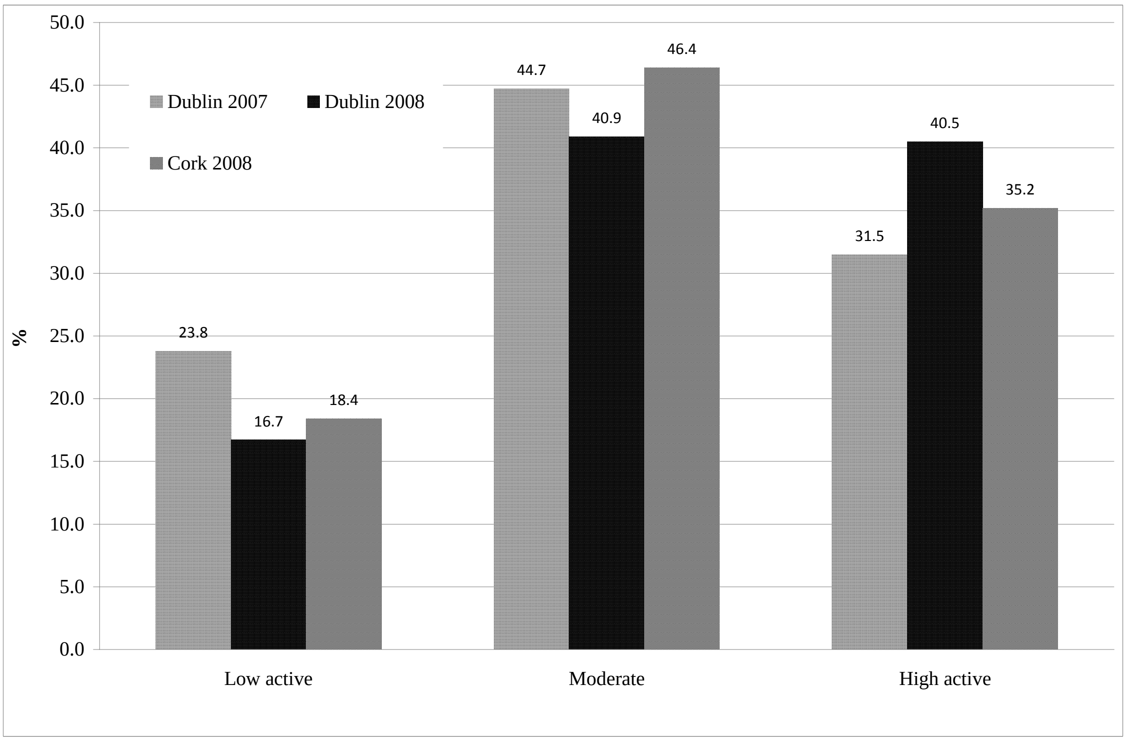


Figure 5. IPAQ activity categories of Mini Marathon participants (n = 11,205: Dublin 2007).

There was no apparent difference in physical activity habits between online and postal respondents in 2007; however, in 2008 there was a greater proportion (p<.05) of 'low' active among online respondents. Further analysis of activity patterns indicated that approximately half of the women surveyed, in 2007, participated in vigorous and moderate activities in the last seven days, while 96% participated in any walking in the same period (*Appendix A, Table 1)*. A greater percentage of respondents in both 2008 surveys reported participating in vigorous activity than the 2007 event, which may explain the higher proportion of high active participants in these events.

In the 2007 event, participation in vigorous activity (mean (SD)) in the total group occurred, on average on 1.6(2) days, for approximately 39 minutes per day. There was considerable variation in this result with a standard deviation of 49 minutes. Walking was the most common form of activity, being undertaken on an average of 5(2) days per week for just under one hour(42) minutes in duration. Participation in vigorous activity was more frequent and of longer duration in the Dublin 2008 event than its 2007 or Cork equivalent. This was also apparent for moderate intensity activity and walking (*Table 8*).

Table 8

Frequency and Duration of Participation in Physical Activity in Previous Seven Days: Baseline Surveys

	Dublin 2007 n=11,205 (M, SD)	Dublin 2008 n=9,523 (M, SD)	Cork 2008 n=1,029 (M, SD)
Vigorous Activity Days/wk	1.6(2)	2.2(2.3)	1.9(2)
Vigorous Activity Minutes/wk	39(49)	59.1(52)	41.5(48)
Moderate Activity Days /wk	1.5(2)	2.2(2)	1.7(2)
Moderate Activity Minutes/wk	31(48)	55.6(56)	33(49)
Walking Days /wk	5(2)	5.5(2)	5.2(2)
Walking Minutes/wk	60(42)	67.3(45)	57.1(45)

As expected, respondents in the high activity category participated in the greatest amount of vigorous activity, on an average of three days per week for over an hour on each occasion. Indeed, women in this category participated in the greatest amount of all types of physical activity. Individuals in the low activity category had the lowest amount of participation in all forms of activity (*Appendix A, Table 2-4*).

The greatest proportion of high active women were in the oldest age group in both Dublin events; and in the youngest age group in the Cork event (*Appendix A, Table 5-7*). Moderate levels of activity remained relatively stable throughout all ages, in the Dublin events, but increased with age in the Cork event.

Upon further analysis (*Table 9*), significant differences were found in total MET minutes per week of physical activity ($p<.05$) between the age groups, in both Dublin events, with total participation greatest among the oldest age group. This was primarily due to greater reported amounts of moderate intensity and walking among this group.

Table 9

Duration and Intensity of Physical Activity by Age: Baseline Surveys

	<30 years (M,SD)	30-50 years (M,SD)	>50 years (M,SD)
Total MET-minutes/wk (n=11,205: Dublin 2007)	2254.3 (2130.7)	2397.4 (2228.3)	2835.6 (2801.9)*† ‡
Total MET-minutes/wk (n=9,523: Dublin 2008)	3060 (2492)	3099.9 (2662.7)	3425.5 (3099.6)† ‡
Total MET-minutes/wk (n=1,029: Cork 2008)	2784.9 (2731.8)	2562.1 (2379.5)	2943.8 (2901.7)

* $p < 0.05$ <30 years v 30-50 years, † $p < 0.05$ <30 years v >50 years ‡ $p < 0.05$ 30-50 years v >50 years

Women with children reported significantly higher amounts of total physical activity in both Dublin events[2] (*Appendix A, Table 8-9*) than women who did not have children; this was primarily due to higher participation in moderate intensity activity and walking. In the Cork event women without children participated in significantly greater amounts of vigorous activity (*Table 10*).

Table 10

Duration and Intensity of Physical Activity by Parenthood (n = 1,029: Cork 2008)

	No Children n=431 (M,SD)	Children n=588 (M,SD)
Vigorous MET-minutes/wk	1323.7 (1733.4)	1048.1 (1611.8)*
Moderate MET-minutes/wk	445.1 (761.7)	557 (1065.3)
Walking MET-minutes/wk	1031.6 (1007.1)	1169.3 (1035.3)*
Total MET-minutes/wk	2720.7 (2472.5)	2679.7 (2662.7)

* $p < 0.05$ No Children v Children

Moderate levels of activity were consistently higher among those who were tertiary educated in all events, and slightly greater proportions of non tertiary educated respondents were categorised as low active and thus engaging in minimal amounts of physical activity (*Table 11*).

[2] Some tables were moved to the *Appendices* to reduce the content in the main chapters

Table 11

Meeting Minimum Guidelines for Physical Activity by Education: Baseline Surveys

	No Tertiary Education			Tertiary Education		
	Dub 07 n=3,887 (%)	Dub 08 n=3,099 (%)	Cork 08 n=327 (%)	Dub 07 n=6,600 (%)	Dub 08 n=5,129 (%)	Cork 08 n=624 (%)
High Active	32.4	43.4	38.2	31.5	41.1	33.2
Moderate	44.4	42.4	41.6	46.6	46.1	49
Low Active	23.2	14.2	20.2	21.9	12.8	17.8

* p < 0.05 No Tertiary v Tertiary

In both 2008 events, an average BMI of 24.4 was computed. BMI was lowest (p<.05) among the most active respondents (*Table 12*). Sedentary behaviour, particularly sitting, was also significantly (p<.05) lower among high active women compared to low active women.

Table 12

BMI, Sitting and TV Viewing among IPAQ Categories (n=9523: Dublin 2008, n=346: Cork 2008)

		BMI (M,SD)	Sitting Minutes/day (M,SD)	TV Minutes/day (M,SD)
High Active	Dub 08 (n=3,854)	24.2 (4.1)†	265.3 (163.1)† ‡	102.9 (73.8)†
	Cork 08 (n=361)	23.6 (3.6) †‡	226.8 (136.8)† ‡	102.2 (70.5)
Moderate	Dub 08 (n=3,894)	24.4 (4.1)*	302.6 (169.3)	105.9 (67.3)*
	Cork 08 (n=477)	24.4 (4.1)	273.3 (162.5)	104.3 (75.4)
Low Active	Dub 08 (n=1,594)	25.2 (4.8)	311.3 (190.7)	114.6 (91.3)
	Cork 08 (n=189)	24.6 (3.7)	279.4 (176.7)	108.2 (66.6)

* p < 0.05 Low v Moderate, † p < 0.05 Low v High, ‡ p < 0.05 Moderate v High

In both events, women with children spent significantly less time (p<.05) sitting than non parents. Women with tertiary education and the youngest women spent significantly more time sitting, less time watching television and had lower BMI values (p<.05). Data are presented in *Appendix A, Table 10-12*.

Research Question 3: Were participants confident in their ability to be active?

3.3.7 Self Efficacy of Mini Marathon Participants

Approximately 70% of participants in all events felt they could still be active when the weather was bad; there was a trend across IPAQ categories with a greater proportion of high active participants agreeing with this statement compared to low active participants. This trend was apparent for all questions related to self efficacy (*Table 13-14* and *Appendix A, Table 13-14).* An age trend was also apparent, with confidence in ability to exercise when tired or when family demands a lot of time consistently higher, across all events, among older participants.

Table 13

Confidence in Ability to be Active when Weather is bad - % Agree: Baseline Surveys

	Dublin 2007 n = 11,205 (%)	Dublin 2008 n = 9,523 (%)	Cork 2008 n = 1,029 (%)
High Active	78	78	81
Moderate	75	66	73
Low Active	64	49	55

Table 14

Confidence in Ability to be Active when stressed - % Agree: Baseline Surveys

	Dublin 2007 n = 11,205 (%)	Dublin 2008 n = 9,523 (%)	Cork 2008 n = 1,029 (%)
High Active	78	88	89
Moderate	75	80	83
Low Active	64	69	70

Self efficacy scores were computed and as indicated in *Table 15*, self efficacy was highest in the high active participants (lower scores represent higher self efficacy).

Table 15

Self Efficacy of Participants in IPAQ Categories: Baseline Surveys

	Dublin 2007 n = 11,205 (M,SD)	Dublin 2008 n = 9,523 (M,SD)	Cork 2008 n = 1,029 (M,SD)
High Active	4.5 (9)	9.1 (17.1)	8.2 (3.4)
Moderate	4.7 (9.4)	10.4 (16.6)	13.7 (64.4)
Low Active	5.1 (10.2)*† ‡	12.4 (29.8)*† ‡	11.7 (3.8)

Note: Only two items were used to calculate self-efficacy in 2007 surveys.

* $p < 0.05$ Low v Moderate, † $p < 0.05$ Low v High, ‡ $p < 0.05$ Moderate v High

Research Question 4: Were participants consistent in their self ratings of physical activity?

3.3.8 Self Reported and Self Perceived Levels of Physical Activity

Results indicated that self reported levels of physical activity were significantly correlated ($p<.05$) with self perceived physical activity levels; however, the relationship was modest ($r=.208$). Participants who stated they were regularly physically active and had been so for longer than six months were likely to be categorised as high active. Despite this positive correlation, there was inconsistency between self reported and perceived levels of physical activity. In the 2007 Dublin event (*Table 16*), a third (33%) of women in the low activity category believed they were sufficiently physically active and had been for more than the last six months, a further 14% claimed they were sufficiently active but only began to be so within the last six months. Well over half of those in the high (73%) and moderate (69%) category had a similar perception in relation to their physical activity levels. This discrepancy between self reported and perceived physical activity was also apparent in the 2008 events (*Appendix A*, *Table 15-16*).

Table 16

Self Reported v Self Perceived Levels of Physical Activity (n = 11,205: Dublin 2007)

	I am not regularly physically active and do not intend to be so in the next 6 months (%)	I am not regularly physically active but am thinking about starting to do so in the next 6 months (%)	I do some physical activity but not enough to meet the description of regular physical activity (%)	I am regularly physically active but only began in the last 6 months (%)	I am regularly physically active and have been so for longer than 6 months (%)
High Active (n=3,508)	0.9	3.7	22.2	13.3	59.9
Moderate (n=4,984)	0.8	4.5	26.1	16.8	51.8
Low Active (n=2,650)	2.3	13.4	37.1	14	33.1

Analysis of previous participation in the Mini Marathon showed that high active participants were more likely to have participated on numerous occasions, to run the event and to have trained longer prior to the event. Significant differences were noted between the low and high active groups in all of these instances. Interestingly, in the 2007 event, 21% of the low active group intended to run the event and 28% of this same group reported that they trained continuously most of the time. This observation was replicated in the 2008 Dublin and Cork event and further suggests that there may be over-reporting of physical activity levels in this sample.

3.3.9 Intercept Interview Results

3.3.9.1 Physical activity levels of the Mini Marathon participants.

Intercept interview data was compared to total baseline data and analysis revealed fewer women categorised as high and moderately active in the interview sample compared to the total baseline sample, in the 2007 and 2008 Dublin events (*Figure 6*). There were twice as many women in the low active category, in both events, in the intercept interview sample compared to the overall group.

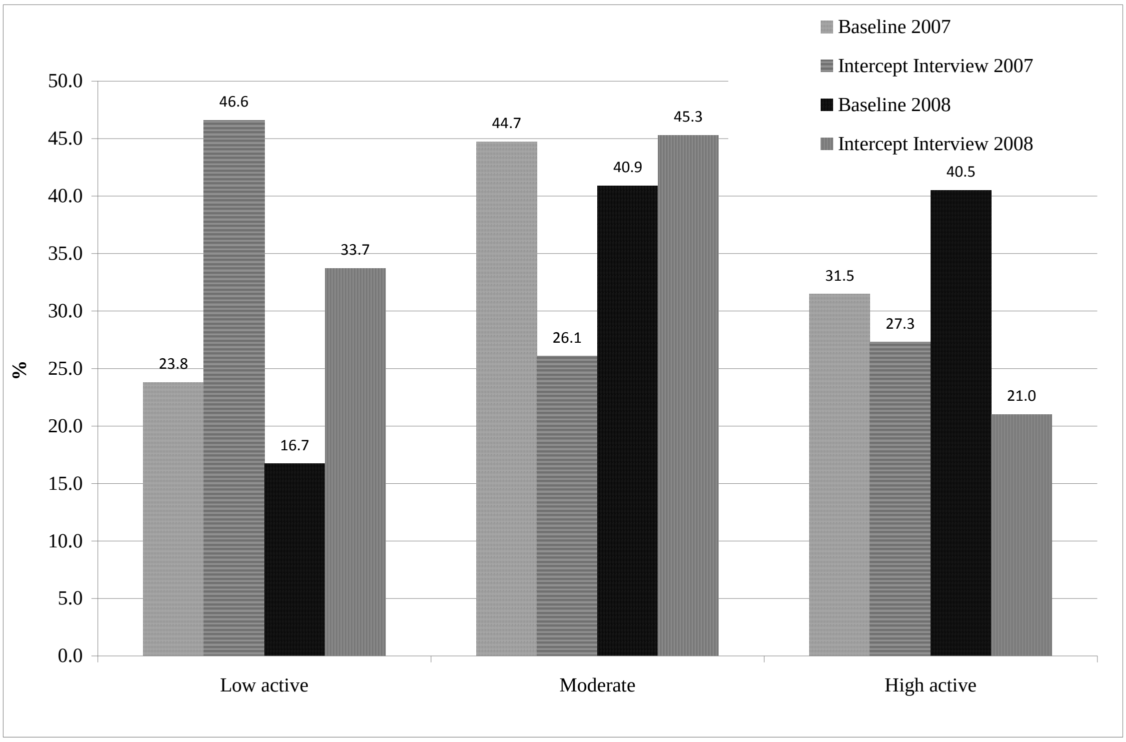


Figure 6. IPAQ activity categories of Mini Marathon participants: intercept interview on race day (n = 414, n = 300: Dublin 2007, 2008) compared with baseline survey (n = 11,205, n = 9,523: Dublin 2007, 2008)

Reported participation in and frequency and duration of vigorous physical activity was considerably lower in the interview survey that was undertaken on the day of the Mini Marathon. Approximately 50% of the overall baseline sample, in both events, reported that they participated in vigorous physical activity in the previous seven days. In contrast, *Appendix A (Table 17-18)* indicates a much lower participation rate in this type of activity in the intercept interview data. Participation in moderate intensity activity and walking was relatively consistent in both samples.

In an age comparison of activity there was a decrease in those categorised as low active with increasing age, overall, in both events; no other consistent trends were apparent (*Table 17*).

Table 17

Age Comparison of IPAQ Activity Categories in Intercept Interview Sample (n = 414: Dublin 2007) compared with Total Baseline Sample (n = 11,205: Dublin 2007)

	High Active		Moderate		Low Active	
	Interview n=63 (%)	Baseline n=3,508 (%)	Interview n=151 (%)	Baseline n=4,984 (%)	Interview n=200 (%)	Baseline n=2,650 (%)
<30 years	18.5	30.3	54.3	45	27.2	24.7
30-50 years old	22.6	31.6	51	46.3	26.5	22.1
>50 years old	23.1	35.3*	53.8	46*	23.1	18.7*

* $p < 0.05$ Difference in Physical Activity between Age Groups in Baseline Sample

† $p < 0.05$ Difference in Physical Activity between Age Groups in Interview Sample

Table 18

Age Comparison of IPAQ Activity Categories in Intercept Interview Sample (n = 300: Dublin 2008) compared with Total Baseline Sample (n = 9,523: Dublin 2008)

	High Active		Moderate		Low Active	
	Interview n=56 (%)	Baseline n=3,854 (%)	Interview n=121 (%)	Baseline n=3,894 (%)	Interview n=90 (%)	Baseline n=1,594 (%)
< 30 years	19.6	41.7	46.4	45.1	34	13.2
30-50 years old	23.5	41.5	42.4	44.9	34.1	13.6
>50 years old	16.7	43.4	52.8	43.6	30.6	13

* $p < 0.05$ Difference in Physical Activity between Age Groups in Baseline Sample

† $p < 0.05$ Difference in Physical Activity between Age Groups in Interview Sample

3.4 Discussion

This cross sectional analysis described participants in three separate mass community physical activity events with a total target population of over 84,000 women. This total number demonstrates the potential for initiatives to attract women to be active at least on the day of the event. While this group of women were not wholly representative of the Irish female population this should not negate the potential public health impact of mass events. These women were not only active on the day of the event but the majority also trained in the lead up to race day and approximately three quarters met minimum guidelines for physical activity just prior to their participation in the respective event. These and other findings from the analysis of event participants will be addressed further below.

3.4.1 The Role of Charity as a Motive for Participation

The Mini Marathon, while not formally recognised as a charity event like the Bolder Boulder in the US for example, is becoming an increasingly charity orientated event. Over 70% of women raised money for charity to coincide with their participation in the event, and cited this as their main reason for participating. In an investigation of charity cycling events in the US, Filo et al. (2008; 2009) described the role 'charity giving' plays in event participation. Charity motives were related to increasing awareness for a condition and helping others and reflected a greater reason for involvement than simply to be physically active. This latter health and fitness related motive was apparent for a third of Mini Marathon participants but was considerably less than the charity motive. Overall, it appears that in this population, the overwhelming spur to participate was to raise money. This was not related to activity status, which presents possiblities and an associated challenge for those trying to encourage Irish people to be active.

According to the previously discussed PCM model (Funk & James, 2001) participants in an event have demonstrated awareness and attraction by registering for the event; the next challenge for event organisers and physical activity promoters is to create meaning about the event, which is expressed in the reasons for participating; charity and fitness reasons among others. Irish people have long been recognised as generous and considerable aid and charity donations are made when required, particularly during natural disasters. Indeed, per capita charity donations in Ireland compare favourably to other countries. The UK Charities Aid Foundation (2006) reported that Ireland is among the top six charity giving countries in the world. Also, the staging of the Special Olympics was a good example of national unity around a shared purpose and the volunteer ethos in sporting clubs is particularly strong in Ireland. Perhaps, health, sport and charity agencies, in all their manifestations, could build on this relatively robust link between participation and the benevolent nature and altruism of Irish communities to generate greater allegiance to physical activity and population level behaviour change.

3.4.2 Effectiveness of Mass Events

Primarily anecdotal evidence about the effectiveness of events on physical activity was presented earlier; little formal evaluation has been undertaken, therefore the finding that the Mini Marathon event did motivate participants to be active prior to and on the day of the event is relatively unique. Approximately two thirds of Cork participants and 85% of Dublin participants reported some degree of training in the lead up to the event. More notable is that over two thirds intended to walk and/or jog the event and that many of these women were not sufficiently active and thus not habitual exercisers. This proportion of walkers/joggers is considerably greater than the Honolulu and Los Angeles Marathons where 40% are walkers (although these are longer events), and similar to the City to Surf in Sydney where approximately 70% walk or jog the 14 km route.

Furthermore, almost one quarter of the 2007 participants and approximately 17% of the 2008 participants were classified as low active and not meeting minimum physical activity requirements, as defined by USDHHS (2008). This is less than the latest population data where 31% of the Irish female population were low active (Morgan et al., 2008). One reason for the higher physical activity levels among event participants may be that pre event data were collected in the weeks before the event when physical activity levels were likely to be at their highest. Despite this, overall analysis indicates that while the Mini Marathon engages far more than just the already converted active women within the population, which is highly positive from a public health perspective, participants in the event did report greater activity levels than population norms.

This discussion may not be entirely accurate for two reasons. Firstly, analysis of intercept interview data indicated that just under half of the Dublin 2007 participants and a third of 2008 participants in the same event were low active; both considerably greater than overall baseline statistics (24% in 2007 and 16% in 2008) and similar to the equivalent statistic (31%) in the national SLÁN survey (Morgan et al., 2008). Consequently, it could be assumed that least active participants in this particular event were less likely to respond to the mailed/emailed surveys and also, they may have displayed a tendency to rate their activity at a higher intensity on these questionnaires. It may then be assumed that the effectiveness of the event in attracting more than the elite exerciser was substantially underestimated as these participants were less likely to return questionnaires and may have over reported their participation levels.

Also, there was disagreement between self reported and perceived levels of physical activity in this research; well over half of the low active respondents perceived that they were sufficiently active, suggesting a lack of awareness or understanding of physical activity and perhaps, of the questions posed in the questionnaire, and evidence of further overestimation of physical activity levels. In contrast, the majority of sufficiently active respondents were accurate in their self rated physical activity. Of note is that Moore et al. (2010) reported that regularly active respondents in their study of US adults were twice as likely to be able to correctly identify minimum guidelines for physical activity suggesting that there is a relationship between knowledge and activity status.

Secondly, it was noted in the results section that an alternative interpretation of IPAQ (using high active to indicate sufficiently active) would result in substantially higher numbers of participants not meeting minimum physical activity requirements. Specifically, approximately 60-70% of participants in the baseline samples were moderate or low active and thus insufficiently active, compared to 17-25% if low active alone was used. This is still less than equivalent statistics from the SLÁN data (Morgan et al., 2008), which suggest that 84% of adult women in Ireland are insufficiently active according to the same criterion. This means that the prevalence of inactivity is underestimated compared to overall population data when using either definition of sufficiently active for Mini Marathon participants. In other words, a disparity existed between survey and overall population data and the Mini Marathon population were more active than the general Irish female population. Of note is that the more stringent analysis of baseline IPAQ data is more reflective of equivalent intercept interview data. The latter suggests that 75-80% were not meeting physical activity recommendations similar to proportions from total baseline data (60-70%). Adopting this criterion of sufficiently/insufficiently active may offer a more accurate assessment of physical activity in this research.

3.4.3 Inaccurate Assessment of Physical Activity

Response rates in this research varied between 11 and 35%, which presents considerable opportunity for non-response bias. This was part of the rationale for undertaking intercept interviews on the day of the Dublin events, to target a representative sample of participants who had not responded to mailed or emailed questionnaires. Hill et al. (1997) conducted short telephone interviews with a sample of non-respondents to a health survey and results indicated considerable difference in smoking and participation in moderate and vigorous activity between respondents and non-respondents. Indeed, it is a common observation in public health research that volunteers to trials and respondents to questionnaires are often healthier and more interested and enthusiastic about their health than those who do not volunteer or respond presenting a degree of bias in the subsequent data collected. Intercept interview results suggested that this was also apparent in this research.

Overestimation of physical activity is common when self report questionnaires are used to collect physical activity data. Duncan et al. (2001) asked sedentary middle-aged adults to complete a seven day physical activity recall questionnaire, an activity log and also monitored heart rate over the same period to give an objective measure of activity. Results indicated that the sample overestimated the intensity and frequency of their activity, specifically moderate intensity activity, and this was more apparent among less fit subjects compared to their fitter counterparts. There may be several reasons for this, which include using an instrument that has not been previously validated, failing to provide sufficient detail on the various intensities of activity, using a large reporting interval and respondents being influenced by a perceived social desirability to be more active; which may be particularly relevant in this study.

Rzewnicki, Auweele and de Bourdeaudhuij (2003) compared physical activity data collected using two different administration methods of the IPAQ survey to investigate overestimation of self report data from this instrument. A sample of Belgian adults completed the questionnaire via phone interviews, one with and the other without probing. In the latter, participants were asked to explain their answers and it became apparent that physical activity was substantially overestimated when the standard protocol was used. In contrast, probing revealed significantly lower and more realistic estimates of physical activity and a subsequent 50% lower proportion of participants meeting minimum physical activity guidelines. In this research, the different modes of administration of the IPAQ revealed similar discrepancies in physical activity even without any specific probing of answers in the intercept interviews. However, as noted earlier, using high active alone to indicate sufficiently active eliminated much of the inconsistencies between the two different modes of data collection.

Shephard (2003) reviewed many of the limitations attached to using questionnaires, and concluded that a large sample size can reduce problems associated with the misclassification of participants in a study. Furthermore, Reiff (1969, as cited in Shephard, 2003) noted that self report data were unsatisfactory unless combined with an interview. Vuillemin et al. (2003) thus assessed self administered and interview results from the Modifiable Activity Questionnaire (MAQ) to detect if comparable data could be achieved from both modes of collection. High agreement was found between resultant physical activity data, which suggested that both methods were viable options as methods of data collection although it was observed that interviewers provided an individual with more detailed information and a more structured framework for their response. The authors noted that little research has examined this issue; none was located on the IPAQ, for example, which was the instrument used in this research. As noted above, results from the Mini Marathon surveys and intercept interviews in this study revealed a lack of conformity between the modes of administration of this instrument in relation to the data collected. Overall, this analysis and discussion would suggest that the Mini Marathon's ability to attract women most at risk was not fully expressed in survey data. However, using a validated questionnaire was the most cost-effective and practical option for a population based study such as this.

3.4.4 Self Reported Body Mass Index (BMI) and Sedentary Behaviour

BMI was assessed in the 2008 events and results illustrated that the majority of women, irrespective of activity status and demographic characteristics, were in the normal weight range. As noted earlier in the measures section, this self report assessment of BMI is lower than an objective measurement but has demonstrated sufficient correlation with the latter and is acceptable for use. Sedentary behaviour was also investigated in this research and women in the least active category had correspondingly higher rates of sitting and television viewing; overall, women reported an average of approximately six hours of total sedentary behaviour per day. As noted in chapter 2, sitting and TV viewing have both been identified as potential independent risk factors for mortality (Katzmarzyk et al., 2009; Owen et al., 2009), emphasising their importance in related discussions of physical activity.

Sitting was highest, in this research, among those with tertiary education and women aged less than 30, which could be related to the professional desk jobs that these participants could be employed in. Indeed, television viewing time and BMI was lowest in these same sub groups, but as noted earlier sitting time itself may still present a significant risk factor for disease and mortality. Overall, the average reported sitting time was approximately 4.5 hours, and average television viewing time was 1.5 hours in the total sample. Manson et al. (2002) observed over 70,000 post menopausal women in a Women's Health Initiative and reported that sitting for more than 16 hours was associated with a 1.68 (RR) greater risk of mortality from CVD than women who sat for approximately four hours. Women in this cohort have considerably lower reported sitting times than those deemed perilous for health by Manson et al. (2002).

Mathews et al. (2008) found that adults in the US spent approximately 7.4 hours a day in sedentary pursuits, higher than reported sedentary time in Irish women in this research. It must be noted that an objective measure (an actigraph) was used in the American study, compared to self report data among Mini Marathon participants that only addressed sitting and TV viewing time as sedentary behaviour. Indeed, Mathews et al. (2008) noted that their measurement produced higher sedentary times than those produced by self report. Furthermore, Rosenberg et al. (2008) reported relatively low to moderate correlations between self report sitting time and accelerometry data, akin to those observed for similar assessments of physical activity. This suggests that data provided from Mini Marathon participants underestimates sedentary behaviour. There are no other published data on the sedentary behaviour of Irish men or women.

3.4.5 Physical Activity in Demographic Sub Groups

Demographically, the most consistent observation in relation to activity status was that women were marginally less likely to fall into the low active category if they had some or complete tertiary education. Also, the oldest participants (older than 50) reported the highest activity levels in Dublin and in Cork. This is somewhat unusual, considering inactivity increased as age increased in Irish women in the SLÁN survey (Morgan et al., 2008) and will be discussed further in this section along with other demographic comparisons.

3.4.5.1 Education and physical activity

The correlate of physical activity in this research that was most consistent with literature appeared to be level of educational attainment; women with higher educational attainment were more active, in accordance with previously noted Irish data on social class/SES and physical activity (Morgan et al., 2008; Lunn & Layte, 2008). Educational attainment, along with medical card ownership, was used as an indicator of social class/SES in this study. At this point, it must be noted that participants in all three events reported higher levels of education and lower ownership of medical cards than the general Irish female population suggesting that these events attracted more affluent Irish females. This disparity may be in part due to the registration fee attached to participating in these events, which was approximately €20, although concessions were available for those who did not want a timing chip and perhaps due to the charity giving aspect of the evens, which is more common among the more affluent.   Overall, though it is not unusual that lower social class/SES groups were under represented and that activity levels were higher among the tertiary educated.

The discrepancy in proportions that were tertiary educated between the general Irish and Mini Marathon populations offers some explanation for the greater numbers classified as high or sufficiently in the Mini Marathon population (approximately 33%) compared to national data on Irish females (16%). It is recognised that there is a significant social class gradient in physical activity and sports participation in Ireland (Lunn, 2007b). Lunn (2007a) reported that social disadvantage, measured by low educational attainment or low income, has at least as strong an impact as gender and age on the active participation in sport by adults, and low education appears to have a lasting effect on people's participation levels. Similar conclusions were observed in the Irish Sport Monitor results in 2008 (Lunn and Layte, 2009) with both income and employment related to participation in sport. A one-off sporting event is unlikely, and did not prove, to be a significant stimulus to action for these hard to reach groups. It suggests that further efforts need to be undertaken by event organisers to target this priority group.

3.4.5.2 Older participants and physical activity

As noted earlier, older participants (aged 50+) in both Dublin events were the most active participants, according to overall survey and intercept interview data. Approximately 83% of Dublin 2007 participants in this age category were moderate or high active compared to 75% of those aged less than 30. These findings do conflict with those that have been reported worldwide; Guthold et al. (2008), in a 51-country survey of physical activity found that inactivity was greatest among oldest respondents in almost all countries, and specifically in the US, rates of insufficiently active increased with age from 41% of 18-24 age group to 53% of the 45-64 age group (CDC, 2007). Furthermore, the EU Barometer Survey (European Opinion Research Group, 2003) reported that 60-80% of people aged 45 plus did no vigorous intensity physical activity and 40-60% of this same age group participated in no moderate intensity activity, which would result in lower estimates of sufficiently active than this research. This latter study did not generate activity categories from the IPAQ data they collected thus the latter comparison was not possible.

There may be several explanations for the discrepancy between findings on the relationship between age and physical activity; one may be the interpretation of sufficiently active used above. If high active only equated to sufficiently active then 35-45% of all event participants aged 50+ would fit this criterion, substantially less than the 75-85% if high and moderate were used. This participation in high intensity activity would be similar to that cited in the EU Barometer Survey and sufficiently active rates among older individuals in the US (CDC, 2007). However, in all events, approximately 16% of participants aged 50+ were low active, which is less than 20% worldwide inactivity rates in 50-59 year olds, cited by Guthold et al. (2008).

To offer some explanation, it is possible that older women who participate in charity events are the most active individuals within this age cohort overall. In addition, older participants are more likely to be habitually active if they participate in mass events, compared to younger adults. As well as high physical activity levels, older people (older than 50) in this study reported the greatest amount of sedentary behaviour (6-7 hours), similar to findings from Mathews et al. (2008) in the US where approximately eight plus hours were spent being sedentary among this same age cohort. As noted earlier, Owen et al. (2009) noted that sedentary time was viewed as an independent risk factor for ill health even when participants engaged in sufficient physical activity, and thus is a concern among older respondents in this study despite their apparent high physical activity participation rates.

3.4.5.3 Parenthood, marriage and physical activity

Non parents in Cork reported significantly greater amounts of vigorous activity than parents, a trend, which was also apparent in Dublin, although to a lesser extent. This trend to engage in more health enhancing physical activity corroborates with findings from other studies (Verhoef, Love & Rose, 1992; Brown et al., 2000; Bellows-Riecken & Rhodes, 2008). Despite this, women with children participated in significantly greater amounts of walking, in all events, and in total physical activity in both Dublin events. Parents in the 2008 event also reported significantly less sitting than their counterparts who did not have children. This engagement in less sedentary behaviour may have contributed to total time spent being active. These results conflict with general conclusions in this field of research; for example, in a study on the effect of women's social roles on exercise participation, Verhoef, Love and Rose (1993) analysed data from the Women's Health Study in Canada and found that parenthood was strongly related to physical activity and women with children exercised less.

Brown et al. (2000) assessed a group of women in Australia and found that physical activity was lower among specific sub groups of women, among wives, mothers, workers and non English speakers. Further assessment of this cohort of women from the ALSWH (Brown, Heesch & Miller, 2009) has revealed that marriage and child birth were associated with increased odds of decreasing physical activity levels. Having children and other gender specific roles and responsibilities (Segar et al., 2002) present barriers to being physically active and thus mothers are frequently recruited to physical activity interventions (Clarke et al., 2007; Miller et al., 2002). This does not appear necessary in this research and could possibly be due to the finding that over two thirds of women with children, in all events, were confident that they could be active when their family demanded a lot of their time. Also, relatively similar, low proportions (22%) of women with and without children cited a lack of time as a barrier to physical activity, in the Dublin 2007 event.

Although not investigated directly at this stage, it is also likely that women with children in this research have support from their family and friends to be active, particularly given the high levels of education and predominantly white Irish ethnicity of the cohort. Segar et al. (2002) noted that women from lower SES and minority ethnic groups have many different and more pronounced barriers to physical activity. Indeed, twice as many women with lower levels of education cited a lack of time as a barrier to activity than their better educated counterparts. Furthermore, over 85% of women in this research who reported having children were married, which might suggests a high presence of partner support to be active; itself a predictor of physical activity in women (Miller et al., 2002). Also, a greater engagement in moderate intensity activity and walking among women with children may be related to them finding opportunities to spend time on their own or with friends, away from their children.

There may be further explanations for the disparity between this and other research in relation to parenthood and physical activity. Collins, Marshall and Miller (2007) suggested that variation in reported levels of physical activity among women with children may actually be due to inaccurate measurement of physical activity in this sub group and a lack of knowledge among these women about how to correctly identify their daily housework etc as types of physical activity. Consequently, the authors used focus groups to assess women's perceptions of physical activity and how they categorised their daily activities. Participants, who were married and had children, were permitted to refer to a commonly used questionnaire when commenting on types of physical activity. It was apparent that most of the activities noted by this group were categorised as household, occupational and childcare related and that it was difficult to estimate the frequency and duration of the many activities they undertook daily, as the reference questionnaire demanded. Participants engaged in multiple tasks and found it challenging to break these into discrete bouts, which led to some over-reporting in subsequent physical activity data.

In this research, there was a discrepancy between IPAQ data and perceived activity status and between survey and intercept interview data. There is no definitive evidence, however to indicate that parents had less knowledge or were more likely to over report, as per findings by Collins et al. (2007). It is likely that rather than decreasing during motherhood, the nature of physical activity changes, with a decrease in strenuous activities, which was apparent among Mini Marathon mothers and an increase in household and related activities, as noted previously. Indeed, Scharff et al. (1999) found that such physical activities for daily living were most apparent among women (aged 18-49) with children. These were not assessed specifically in the IPAQ based questionnaire but could be inherent in the higher levels of reported moderate intensity activity by those participants with children. This suggests that self report questionnaires, not only would be better served by being administered face to face, but should also include some assessment of daily physical activities and other domains of physical activity that are particularly relevant to mothers (egs. IPAQ long or GPAQ instruments).

3.4.6 Online v Postal Respondents

Further investigation of respondents indicated demographic variation between online and postal submissions, with the latter showing greater conformity with the general Irish female population. For example, in the 2007 Dublin event 40.9% of postal respondents reported some tertiary education compared to 78% of online respondents and 21% of the general population. Adams and White (2007) investigated the health behaviours of people, in the UK, who responded to web-based surveys. It was noted that younger, more affluent people have access to the internet and consequently demographic differences between online respondents and the general population were apparent.

Internet usage statistics in Ireland support this claim with eight out of ten people aged 15-24, and 90% of the highest social class using the internet, compared to 25% of those aged over 65 and 20% of the lowest social class (Amárach Research, 2008); hence, over twice as many online respondents in this research were aged 20-29 than the general population. Furthermore, the age profile from the Cork event, which did not incorporate a web survey, and from postal respondents to the Dublin surveys is quite similar to overall national statistics. Overall, this analysis could indicate that the use of an online survey collection tools may generate responses primarily from younger individuals with greater educational attainment, who may subsequently be more active. This perhaps offers further explanation for the disparity between survey responses and intercept interview data and exacerbates the limitations of self report data.

Dillman (2007) noted that while mixed mode surveys are often conducted to increase response rates and reduce costs, each mode of data collection can produce different results. Adams and White (2007) compared results from an online health survey to regional results from a national health and lifestyle survey where data were collected using face to face interviews. Differences in health behaviours, including physical activity, between the two sources were detected. It was observed that this could be due to the demographic differences between the groups and a response bias that those who completed the web based survey may have a greater interest and knowledge in health related issues. In this research, surveys were administered by post and online, in an attempt to maximise reach. Based on Dillman's observations it could be assumed that the variation in the design of these different modes could lead to a lack of compatibilty between survey responses.

While demographic differences between the different cohorts of respondents were noted, there was no difference in IPAQ category between postal and online respondents in 2007, while in 2008; there was a marginally, albeit significantly, greater proportion ($p<.05$; 43.4% v 40.2%) of high active among postal respondents. This is in direct contrast to findings from Adams and White (2007) where physical activity was higher among web survey participants. This is quite surprising given the socio-demographic variation between online and postal respondents discussed previously and the considerable research evidence to support the claim that physical activity levels are higher among more affluent populations. Consequently, the demographic disparity noted between online and postal participants may be due simply to self report bias; the main explanation also for the lack of consisteny between intercept interview and survey data.

One of the main reasons for using mixed mode data collection was to improve the reach of data collection. This was successful as postal respondents were more similar to the general Irish adult female population than online respondents. Despite this, there was considerable disparity between the latter, the overall survey population and intercept interview data, mostly in relation to social class indicators and activity status and thus reach was somewhat limited. This is not an unusual finding as many physical activity research efforts fail to successfully target, recruit or retain typically ‘hard to reach’ groups of the population to their studies unless they make specific attempts to do so. For example, Jenum, Lorentzen and Ommundsen (2009) delivered an intervention to promote physical activity to participants from a low income district while Finkelstein et al. (2008) recruited sedentary individuals to a similar study.

Dillman (2007) recommended the adoption of a tailored design method where consideration of specific features of the survey population is incorporated into the development of an instrument and study procedures. This could involve personalising questionnaires and cover letters, generating publicity about and emphasising the importance of the survey, using a financial incentive, expressing gratitude and minimising personal questions. Some of these factors were considered in this research; a reward for participating was included (holiday draw), questions were not invasive and gratitude was expressed at all times. Despite this, a greater effort to tailor instruments and study methods may have increased response rates among the less affluent, least active members of the target population.

3.4.7 Event Participation Characteristics, Self Efficacy and Physical Activity

Analysis of event participation indicated that repeat participation was associated with greater levels of training, higher intentions to run the event, and sufficient activity status. Approximately two thirds of Mini Marathon participants were taking part for the second or more time, which is a legacy of sorts for this particular event and presents another opportunity to leverage the repeated appeal the event possesses. Also, those who trained with a group of people were more likely to be jogging/running rather than walking the event and also reported greater levels of training; 96% of those in groups trained continuously most of the time for at least three months before the event. Despite this, only 13% of the total respondents participated in a Meet and Train group as part of their preparation for the event. These gatherings of participants have developed nationwide and have grown organically around the event. Recent developments as part of the ISCs Women in Sport initiative and through the AAI have begun to increase the capacity building process in this regard and it is recommended that support for these efforts be continued and if possible enhanced.

The main premise behind training in groups is that it fosters social support and greater self efficacy for physical activity; both predictors of physical activity as noted in chapter 2 (Lewis et al., 2002). Consequently, group based activities and programmes are widely used in interventions to increase physical activity in women. In an intervention to increase activity specifically among women with young children (Miller et al., 2002), participants developed group based activities to help them become more active and subsequent increases in self efficacy and physical activity were detected. A similar outcome was reported by Clarke et al. (2007) in women who took part in classes that aimed to alter barriers to physical activity and social support. In this research, Meet and Train group respondents were more confident than individual respondents in their ability to be active when stressed, when the weather was bad and when family demanded a lot of time; an indication that self efficacy was greatest amongst women who trained in groups. Indeed, overall, self efficacy was associated with higher physical activity levels, with those categorised as high active achieving the greatest levels of self efficacy.

3.5 Limitations

Response rates varied from 11% to 35% in the baseline study. The 11% rate in Cork was particularly low and was likely due to the dissemination of questionnaires on the day of the event only. Any future evaluation of events should endeavour to mail or email questionnaires prior to the event to increase overall response rates and facilitate the delivery of reminders emails etc. A greater effort should also be taken to tailor questionnaires to distinct groups of people in the target population.

The collection of self report data also presents limitations to this research. Firstly, analysis of intercept interviews undertaken on the day of the event suggests that low or insufficiently active participants were under-represented in the overall baseline surveys, in both 2007 and 2008. It appears that these women were less likely to respond to the questionnaire, a notion discussed in detail earlier. Furthermore, among those who did respond, there was a discrepancy between self reported and perceived levels of physical activity and a likely over estimation of participation in physical activity. The recruitment of a large sample size and use of a validated assessment tool for population level measurement of physical activity were attempts to minimise this non response and recall bias, which can only be eliminated through the use of objective measurement tools. The latter were not viable due to resource constraints.

3.6 Implications for Health Promotion

Individual sports have become increasingly popular in Irish society and present a more sustainable option in relation to lifetime participation in physical activity. The one off events in this research are typically over-subscribed and do encourage largely inactive people to train prior to and become active on the day of the event. There exists an opportunity to use these events as a catalyst to motivate more people to become involved in individual sports, irrespective of gender, age and SES. Indeed, Lunn and Layte (2008) found that Irish women are as likely to take up new sports after the age of 20 as their male counterparts and these are most likely to be individual sports, considering that this represents 90% of all adult sport in Ireland. The last challenge remains to ensure that this promotion is equitable across all classes. Evidence was also offered for the provision of more events at a regional level and the leveraging of the observed impact on physical activity; a task that may be undertaken by local and national bodies such as LSPs and the AAI. Indeed, Lunn and Layte (2008) called for greater consideration of research findings in future policy and strategic initiatives to increase physical activity.

Lastly, the well established charity and fun link with this and many other events and the consequent potential development of attachment to and maintained participation in physical activity, among not just event participants, may benefit from the adoption of a ‘trojan horse’ approach where physical activity is packaged as something more than a health requirement and a difficult, unpleasant experience but rather an enjoyable, worthy venture (Sport England, 2009). Participants in this research were aware of the benefits of physical activity but not all translated this knowledge to actual consistent behaviour change. It appears that associating activity with fitness and health related goals is not the most suitable message for the least active. It was also apparent that the least active women were ill-informed about what constitutes sufficiently active; there was a notable disconnect between self reported and self perceived physical activity levels. This would suggest a need to communicate to these participants the specific requirements for achieving a sufficiently active status.

3.7 Conclusion

The mass events included in this research were successful in motivating the large majority of participants to become active in the lead up to race day. Approximately 78% of participants were either high or moderately active and did meet minimum physical activity requirements prior to their participation in the event. As noted earlier, it is likely that is an over-estimation but remains an indicator of the impact of these mass events. Even more significant is that the events attracted more than the habitual exerciser with just under half indicating their intention to walk or mostly walk the 10km route. Notwithstanding the presence of non response and selection bias alluded to earlier, evaluation of these mass women-only community physical activity events has provided formal support for their effectiveness. This will enhance the primarily anecdotal evidence that existed previously and should serve to validate continued and perhaps increased investment in the provision of such initiatives.

Chapter 4: The Long Term Impact of Mass Community Physical Activity Events

4.1 Background

4.1.1 The Legacy of Mass Events

It was noted in the previous chapter that although much rhetoric has been expounded about the effectiveness of mass events, little evidence exists to support any long term legacy effects, particularly with respect to participation in physical activity and sustained behaviour change (Murphy and Bauman, 2007). Community events, such as the Dublin and Cork Women's Mini Marathon all attract many participants and subsequently generate considerable participation in physical activity on the day of the event (Bauman, Murphy & Lane, 2009). However, assessment is warranted of any long term impact on activity levels following these events.

Data presented in the previous chapter provided an insight into the immediate public health impact of three women's only Mini Marathon events and indicated that they do motivate people, including those deemed insufficiently active, to train and be active prior to and on the day of the event. It is necessary to carry out further investigation to assess the physical activity habits of participants post event. Bowles et al. (2006) undertook a pre and post assessment of the Spring Cycle, a fun cycling event that is held annually in Sydney, Australia and attracts up to 10,000 participants. Follow up was carried out one month post event, and despite presenting favourable outcomes in relation to physical activity, the investigation failed to provide support for the long term legacy of this event. Overall, it appears that little formal evidence of the long term public health impact of mass events exists (Murphy and Bauman, 2007). Indeed, as noted in chapter 3, few of the proposed effects of mass events, including social and economic impacts, have been demonstrated consistently.

4.1.2 Summary

National health and sport agencies are interested in instigating and developing long term population changes in physical activity as these can produce significant health gains. Evidence based strategies must be produced before policy makers react. In Ireland, The Irish Sports Council, for the past five years, has funded research into sport and physical activity that has led to the identification of several policy directions, including the current development of a participation strategy for Ireland. Further recommendations in the previous chapter included adopting a 'trojan horse' approach to physical activity promotion and adapting to the changing physical activity preferences and habits of Irish people, specifically the surge of interest in individual sports. Discussion in the previous chapter indicated that these strategies are effective and encourage and motivate people to be active in the short term.

This assessment of physical activity following three women-only Mini Marathon events presents an opportunity to assess the longer term legacy, if any, of these events. Consequently, follow up assessment was undertaken three and six months following the 2007 Dublin Mini Marathon and three months after the Dublin and Cork 2008 equivalents. Six month follow up was omitted in 2008 as physical activity levels were judged to have altered due to the event at three months but may have been distorted by a winter seasonal effect. Furthermore, members of the follow up group in 2008 were recruited to interventions to promote physical activity (see chapters 6 and 7) and commencement of these trials was most convenient at three months post event in Dublin and Cork. The purpose of this section was to investigate the change, if any, in physical activity among participants who submitted data at baseline, two/three months and six months post event.

4.2 Methods

4.2.1 Study Population and Design

All respondents to the baseline surveys, in 2007 and 2008, were invited to enter their name, address and/or email on the baseline questionnaire if they were prepared to continue their involvement in the study. Two months after the 2007 Dublin event, follow up questionnaires were disseminated; a similar procedure was undertaken three months post the 2008 Dublin and Cork events. Details of the target population, i.e. those who provided follow up contact details, for each event are in *Table 19* (p.103). This follow up will be known as *short term follow up* in the remainder of this chapter.

A link to an online version of the survey was forwarded to participants who had submitted email addresses and a print questionnaire was mailed to all postal contacts (*Appendix B, Table 1-2*). A reminder email was sent to relevant participants and subsequent increases in response rate were apparent. To maximise the response rate, all women who completed and returned the questionnaire were entered into a competition to win a cash voucher. A number of emails and postal questionnaires were not delivered successfully, as indicated in *Appendix B*; target populations were adjusted to reflect this. A further follow up (*long term follow up*) was undertaken six months following the 2007 event. As per the previous follow up, web and postal surveys were distributed according to relevant contact details.

4.2.2 Procedures

Analysis of baseline data highlighted those Mini Marathon participants who were willing to complete follow up questionnaires on their current physical activity levels. A web based survey was available to all who provided email addresses and a postal survey was mailed to all who submitted such detail two/three (short term follow up) and six (long term follow up – Dublin 2007 only) months post event.

4.2.3 Follow Up Questionnaire

The short and long term follow up questionnaires included the IPAQ questions on physical activity, an assessment of readiness to change and questions compiled by the research team (*Appendix E, p.396*).

4.2.4 Measures

4.2.4.1 Physical activity and readiness to change.

Physical Activity and readiness to change data were collected using methods previously outlined in chapter 3, page 65-66.

4.2.4.2 Other.

Other data were collected on perceptions of current physical activity levels and how they compared to physical activity levels prior to the Mini Marathon and on possible tips/strategies that may help participants become more active.

4.2.5 Data Analysis

Data analysis at this phase incorporated matching, specifically matching baseline, short and long term follow up data from participants who had responded at all stages. It was undertaken using answers to identifier questions provided at baseline and follow up. Subsequent descriptive analysis of participants at follow up, similar to that undertaken in the previous chapter, was carried out using this matched data. As per chapter 3, physical activity data were presented as frequency and duration of participation in physical activity or a combination of these and the energy expenditure associated with various intensities of physical activity, as MET-minutes per week.

Finally, following the discussion in the previous chapter, only those participants categorised as high active were deemed sufficiently active.

4.2.6 Research Questions

1. Were matched data similar to baseline only data across demographic characteristics?
2. Between baseline and short and long term follow up (2007 only), what were the changes in the following:
    a. Reported frequency and duration of participation in physical activity?
    b. Proportions categorised as sufficient or insufficiently active?
    c. Sedentary behaviour?
    d. Proportion that increased or decreased their participation in physical activity between baseline and short and long term follow up (2007 only) by ± at least 60 minutes of moderate intensity activity; and those that remained within these limits at all time points?

4.3 Results

4.3.1 Response Rates and Matching Rates

Short term response rates were relatively high and consistent across all three events. There was a higher proportion of online responses in all events; highlighting the value and potential of the web as a vehicle to collect data. As noted earlier, a six month follow up was undertaken in the 2007 Dublin event and response detail for this is also indicated in *Table 19*.

Table 19

Follow Up Target Population and Response Rates

		Dublin 2007	Dublin 2008	Cork 2008
Total Target Group (N)		31,986	41,969	9,000
Baseline	Online	6,804	6,497	
Sample (n)	Postal	4,401	3,026	1,029
	Total	11,205	9,523	1,029
Baseline Response Rate (%)		35	23	11
Total Short Term Follow Up Target Group (N)		8,935	8,618	955
Short Term % of Baseline (%)		80	90	93
Short Term	Online	3,494	3,148	297
Follow Up	Postal	1,292	616	121
Sample (n)	Total	4,786	3,764	418
Short Term Follow Up Response Rate (%)		54	44	44
Total Long Term Follow Up Target Group (N)		6,953	n/a	n/a
Long Term % of Baseline (%)		62	n/a	n/a
Long Term	Online	1,926	n/a	n/a
Follow Up	Postal	169		
Sample (n)	Total	2,095		
Long Term Follow Up Response Rate (%)		30	n/a	n/a

Matching baseline and follow up data permitted the analysis of changes in physical activity within participants' pre and post event (*Table 20*). Any possible over-reporting of activity levels was likely to have been consistent throughout the measurement period. Also, given the size of the matched sample it is reasonable to assume that changes in reported activity levels accurately mirror the entire Mini Marathon population. *Table 20* highlights the matching rate from each cohort; this reflects the proportion of follow up data that was matched to the original baseline sample. Matching was not possible when participants failed to provide identifier data (mothers maiden surname and day of birthday) at both time points. These data were used for 'de-identified' matching by an independent statistician, using a maximal probability matching algorithm (Winchester et al., 1996). There was no difference in the physical activity status at follow up of matched and unmatched participants.

Table 20

Matched Analysis

	Matched Data (n)	Matching Rate (%)
Dublin 2007 (Baseline and Short Term)	3,803	79
Dublin 2007 (Baseline, Short and Long Term)	2,020	96
Dublin 2008	3,505	93
Cork 2008	348	83

Research Question 1: Was matched data similar to baseline only data across demographic characteristics?

4.3.2 Characteristics of Matched Participants

4.3.2.1 Baseline, short and long term follow up

Table 21 illustrates the characteristics of participants recruited at each stage of the 2007 survey – baseline, matched baseline and short term follow up and matched baseline, short and long term follow up, compared to Census statistics for all of Ireland (CSO, 2006). The proportion of tertiary educated increased and medical card users decreased across the different stages suggesting that more affluent people may have been more likely to respond to the surveys. It is also notable that the proportion of women aged 20-29 and women without children also increased at the different time points.

Table 21

Characteristics of Long Term Follow Up Matched Participants v National Statistics

	National Statistics for Irish Adult Females n=1,697,272 (%)	Dublin Mini Marathon 2007 Baseline n=11,205 (%)	Dublin Mini 2007 Matched Short Term Follow Up n=3,803 (%)	Dublin Mini 2007 Matched Short & Long Term Follow Up n=2,020 (%)
Tertiary Education	27	63	70	77
White Irish	87	96	95	94
Medical Card Holder	37	16	14	11
Aged 20-29	21	27	29	32
Live in Dublin	36	50	52	56
No Children	50	52	53	58

4.3.2.2 Baseline and short term follow up

Matched participants at short term follow up were largely similar to the total baseline group, in all events. The only consistent difference between groups was apparent in education level; there was a higher proportion of tertiary educated respondents in the matched group.

Table 22

Characteristics of Short Term Follow Up Matched Participants v Baseline Participants

	Dublin Mini Marathon Population 2007		Dublin Mini Marathon Population 2008		Cork Mini Marathon Population 2008	
	Baseline n=11,205 (%)	Matched n=3,803 (%)	Baseline n=9,523 (%)	Matched n=3,505 (%)	Baseline n=1,029 (%)	Matched n=348 (%)
Tertiary Education	63	70	62	67	62	73
Medical Card Holder	16	14	18	16	18	18
Aged 20-29	27	29	33	28	19	21
Live in Dublin	50	52	49	51	2	1.4
No Children	52	53	51	51	42	43

A similar comparison with national data (*Table 23*) for Irish females indicated that respondents to this population survey reported much higher levels of education. It is not surprising that there were also lower numbers of medical card holders among the matched group. Almost twice as many of the Dublin survey population were from Dublin, compared to national statistics, while a very small proportion of participants in the Cork event were from Dublin. Evidently, both events attract participants primarily from within their immediate geographic region. Similar proportions of women reported not having children, and data from the 2007 Dublin event indicated that participants were predominantly white Irish.

Table 23

Characteristics of Short Term Follow Up Matched Participants v National Statistics

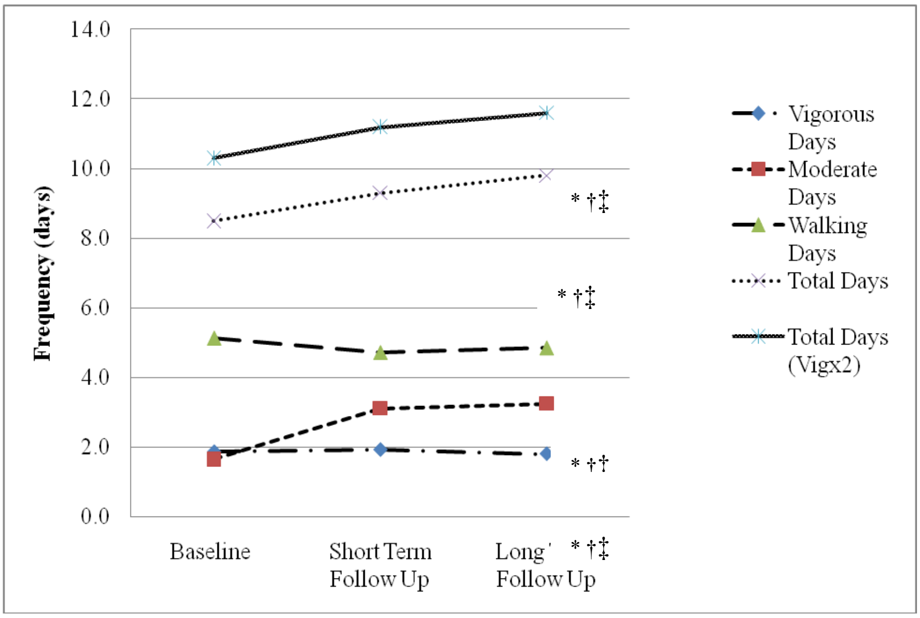
	National Statistics for Irish Adult Females n=1,697,272 (%)	Dublin Mini Marathon Matched Sample 2007 n=3,803 (%)	Dublin Mini Marathon Matched Sample 2008 n=3,505 (%)	Cork Mini Marathon Matched Sample 2008 n=348 (%)
Tertiary Education	27	70	67	73
White Irish	87	95	n/a	n/a
Medical Card Holder	37	14	16	18
Aged 20-29	21	29	28	21
Live in Dublin	36	52	51	1.4
No Children	50	53	51	43

Research Question 2a: What were the changes in frequency and duration of particiaption in physical activity between baseline, short and long term follow up (2007 only)?

4.3.3 Changes in Participation in Physical Activity

4.3.3.1 Baseline, short and long term follow up (Dublin 2007 only)

Participation in vigorous activity and walking (*Appendix B, Table 3*) decreased overall between baseline and long term follow up among this matched cohort. Analysis of frequency and duration of participation in physical activity at the different stages reflects these overall participation rates; frequency of total, vigorous and walking days decreased overall, while moderate and total days increased (*Figure 7*).

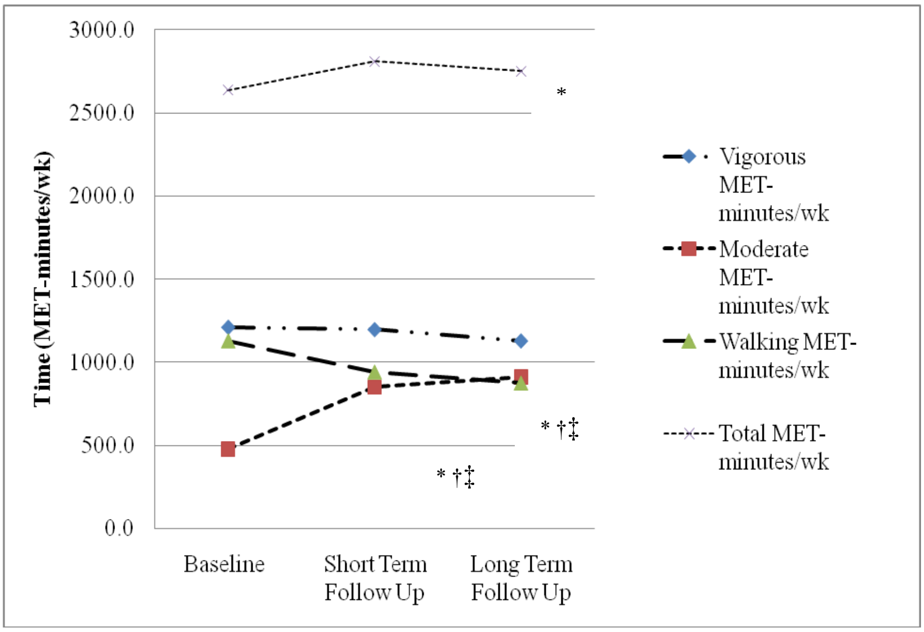


* $p < 0.05$ Baseline v Short Term, † $p < 0.05$ Short v Long Term p, ‡ $p < 0.05$ Baseline v Long Term

Figure 7

Baseline, short and long term frequency of participation: matched analysis (n = 2,020: Dublin 2007)

Vigorous and walking MET-minutes/wk decreased between baseline and long term follow up, while there was an initial increase only in total MET-minutes/wk (*Figure 8*).



* $p < 0.05$ Baseline v Short Term, † $p < 0.05$ Short v Long, ‡ $p < 0.05$ Baseline v Long Term

Figure 8

Baseline, short and long term duration and intensity of participation: matched analysis (n = 2,020: Dublin 2007)

Specific analysis of the change in duration and intensity of participation in physical activity (*Table 24*) between baseline and six months revealed little difference between the youngest and middle age groups but an increased in moderate and total activity in both groups. In the previous chapter it was noted that older women in this study were quite active and age related trends in physical activity were consequently highly conflicting with well established research findings in this area. This, as well as the small sample size of participants aged 50+, was a rationale for omitting these participants from the analysis below.

Table 24

Change in Duration and Intensity of Physical Activity by Age: Matched Analysis (n = 2,020)

	<30 years n=520 (M,SD)			30-50 years n=789 (M,SD)			
	Baseline	Long Term	Change in PA	Baseline	Long Term	Change in PA	p-value
Vigorous MET-minutes/wk	1153.6 (1681.7)	1104.8 (1597.9)	-66.2 (2200.5)	1208.1 (1916.9)	1132.7 (1770.4)	-108.9 (2456.9)	.755
Moderate MET-minutes/wk	413.1 (857.8)	892.2 (1026.5)	461.6 (1182)	458.3 (1012.2)	853.9 (1011.2)	364.4 (1238.5)	.191
Walking MET-minutes/wk	1068.1 (1491.7)	844.9 (825.6)	-198.5 (1311)	1064.9 (1307)	827.2 (887)	-243.8 (1328.9)	.577
Total MET-minutes/wk	2484.9 (2560.6)	2731.7 (2462.2)	215 (3167.5)	2579.6 (2764.4)	2658.7 (2747.2)	60.4 (3357.1)	.408

* $p < 0.05$ Change in MET-minutes/wk <30 years v 30-50 years

Total participation in physical activity at both time points was relatively similar between women with and without children. However, it is evident in *Table 25* that parents reported a decrease in overall participation in physical activity compared to an increase among non parents (p>.05), likely due to a significant (p<.05) decrease in vigorous MET-minutes/wk between baseline and long term follow up in women with children.

Table 25

Change in Duration and Intensity of Physical Activity by Parenthood: Matched Analysis (n = 2,020)

	No Children n=875 (M,SD)			Children n=626 (M,SD)			
	Baseline	Long Term	Change in PA	Baseline	Long Term	Change in PA	p-value
Vigorous MET-minutes/wk	1198.2 (1933.1)	1201.2 (1702.3)	-24.7 (2523.7)	1236.4 (1981.2)	1007.8 (1764.9)*	-238.1 (2459.4)	.115
Moderate MET-minutes/wk	441.5 (925.3)	848.2 (976.5)	391 (1164.2)	533.2 (1163.9)	1045.6 (1166.7)*	485.7 (1359.8)	.197
Walking MET-minutes/wk	1057.5 (1395.4)	823.4 (829.1)	-216.8 (1284.9)	1209.8 (1351.9)	897.7 (901.1)	-307.4 (1337.1)	.226
Total MET-minutes/wk	2549.1 (2744.5)	2753.5 (2579.4)	179.4 (3411.9)	2801.4 (2798.7)	2765.2 (2813)	-47.3 (3256.3)	.201

* $p < 0.05$ Change in MET-minutes/wk No children v Children

It was also noted that participants with tertiary education reported smaller decreases in vigorous activity (p>.05) as well as increasing overall participation rates (p>.05) compared to a decrease among their less well educated counterparts (*Appendix B, Table 4*). Participants who ran the Mini Marathon reported increases in vigorous and overall physical activity and a significantly lower decrease in walking than those who had walked the event. Repeat participants in the Mini Marathon and those who trained more regularly also demonstrated more favourable changes in physical activity between baseline and six months (p<.05) (*Appendix B, Table 5*). Finally, respondents at long term follow up were asked if they had participated in any event since the Mini Marathon; approximately 25% indicated that they did. Respondents who did participate in another event had higher reported physical activity levels at short and long term follow up than respondents who had not participated in another physical activity event. Furthermore, they experienced notable increases in vigorous intensity activity and total physical activity compared to those who did not take part in any other event (p<.05).

4.3.3.2 Baseline and short term follow up

Analysis of participation in physical activity (*Appendix B, Table 6-8*), in the Dublin 2007 sample, participation in vigorous activity and walking was relatively consistent between baseline and follow up. A substantial increase in moderate activity between baseline and follow up was apparent in all events. In all three events, there were substantial increases in days and MET-minutes/wk of moderate intensity physical activity and less notable decreases in participation in walking (*Table 26*) and vigorous intensity activity.

Table 26

Frequency and Duration of Participation in Physical Activity in Previous Seven Days at Baseline and Short Term Follow Up: Matched Analysis

	Dublin 2007 n=3,803		Dublin 2008 n=3,505		Cork 2008 n=348	
	Baseline (M,SD)	Follow Up (M,SD)	Baseline (M,SD)	Follow Up (M,SD)	Baseline (M,SD)	Follow Up (M,SD)
Vigorous Activity (Days/wk)	1.8(2)	1.8(2)	2.3(2)	2.1(2)*	2.1(2)	1.9(2)
Vigorous Activity (MET-minutes/wk)	1135.3 (1905.5)	1099.2 (1589.5)	1503.8 (1698.9)	1311.3 (1621.7)*	1160.9 (1518.3)	1139.5 (1664.3)
Moderate Activity (Days/wk)	1.7(2)	2.8(2)*	2.3(2)	3(2)*	1.9(2)	2.7(2)*
Moderate Activity (MET-minutes/wk)	497.1 (1046.6)	831.2 (957.1)*	754.8 (1034.6)	973.1 (1090.4)*	553.5 (1036.7)	809.2 (100.3)*
Walking (Days/wk)	5.2(2)	4.8(2)*	5.4(2)	4.7(2)*	5.1(2)	4.4(2)*
Walking (MET-minutes/wk)	1153.2 (1240.8)	980.7 (938.8)*	1227.8 (993.4)	989.6 (985.4)*	1011.8 (966.9)	854.5 (922.7)
Total Days (Days/wk)	8.4(3.9)	8.9(4.6)*	9.1(4.1)	9.4(4.8)*	8.8(4.5)	8.6(4.6)
Total Physical Activity (MET-minutes/wk)	2591.3 (2731.9)	2707.2 (2502.3)*	3126.7 (2547.8)	3078.7 (2676.3)	2598 (2649)	2651.7 (2591)

* $p < 0.05$ Baseline v Short Term Follow Up

A comparison of duration and intensity of physical activity between the youngest and middle age groups indicated that there was no significant difference in the change in physical activity from baseline to follow up between age groups in both Dublin events

(*Appendix B, Table 9-10*)[3]. In the Cork event, younger participants did report an increase in vigorous activity compared to a decrease among those aged 30-50 (p>.05). This was somewhat offset by a substantial decrease in walking at follow up among respondents aged less than 30 (*Table 27*).

Table 27

Change in Duration and Intensity of Physical Activity by Age: Matched Analysis (n = 348: Cork 2008)

	<30 years n=88 (M,SD)			30-50 years n=196 (M,SD)			
	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1645.1 (1858.1)	1543 (1927.9)	32.8 (2017.8)	1026.4 (1322.5)	922.4 (1324.1)	-111.5 (1578.5)	.534
Moderate MET-minutes/wk	521.2 (978.5)	808.9 (855.9)	271.9 (1312.3)	434.6 (773.9)	646.7 (777.9)	225.2 (1025.2)	.763
Walking MET-minutes/wk	934.2 (929.3)	709.1 (707.3)	-245.7 (917.1)	867.7 (932.7)	821.8 (909.5)	-62.7 (1215.3)	.231
Total MET-minutes/wk	3028.9 (2733.7)	2967.7 (2699.6)	54.8 (2983.6)	2252.6 (2190.5)	2257.9 (2162.4)	24.9 (2581.6)	.933

* $p < 0.05$ Change in MET-minutes/wk <30 years v 30-50 years

As indicated in *Table 28* women with children in the 2007 Dublin event reported a considerably lower overall increase in physical activity than those without children (p>.05). A significantly greater decline in walking was also apparent among parents. This same trend was notable in both 2008 events but was only significant among Dublin participants (*Appendix B, Table 11-12*).

[3] Some tables were moved to the *Appendices* to reduce the content in the main chapters

Table 28

Change in Duration and Intensity of Physical Activity by Parenthood: Matched Analysis (n = 3,803: Dublin 2007)

	No Children n=1,982 (M,SD)			Children n=1,763 (M,SD)			
	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1145.5 (1917.6)	1145.8 (1571.5)	4.1 (2407.1)	1144.9 (1959.5)	1043.6 (1606.5)	-89 (2293.7)	.246
Moderate MET-minutes/wk	470.7 (966.3)	799.1 (888.6)	308.4 (1177.4)	543.4 (1217.8)	890.9 (1044.7)	363.1 (1329.1)	.230
Walking MET-minutes/wk	1077.9 (1324.1)	954.7 (935.3)	-126.2 (1336.1)	1176.8 (1164.5)	997.9 (933.7)	-224.5 (1174.9)*	.035
Total MET-minutes/wk	2530.4 (2723.9)	2696.2 (2432.6)	158.7 (3203.1)	2696.4 (2820.2)	2710.8 (2583.8)	31 (3095.3)	.234

* $p < 0.05$ Change in MET-minutes/wk No children v Children

In the 2008 Dublin event, women with no tertiary education displayed a decrease in total participation in physical activity compared to an increase, albeit a minimal one, among those with tertiary education (p<.05) (*Table 29*). This finding was not replicated in the other events (*Appendix B, Table 13-14*).

Table 29

Change in Duration and Intensity of Physical Activity by Level of Education: Matched Analysis (n = 3,505: Dublin 2008)

	No Tertiary Education n=1,099 (M,SD)			Tertiary Education n=2,265 (M,SD)			
	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1523.8 (1979)	1303.7 (1845.6)	-176.8 (2116.9)	1484.2 (1548.5)	1275.1 (1536.9)	-194.1 (1690.1)	.826
Moderate MET-minutes/wk	856.8 (1189.2)	982.5 (1134.3)	156.9 (1382.1)	709.5 (955.7)	941 (1046.3)	260.5 (1213.2)	.070
Walking MET-minutes/wk	1383.2 (1060.9)	1126.2 (1082)	-241.1 (1171.9)	1164.9 (959.1)	930 (944.6)	-235.1 (1042.5)	.894
Total MET-minutes/wk	3420.8 (2937.7)	3202.5 (2957.8)	-224.9 (3111.6)	3036.7 (2362.3)	3063.6 (2607.6)	11.5 (2578.9)*	.032

* $p < 0.05$ Change in MET-minutes/wk No Tertiary v Tertiary

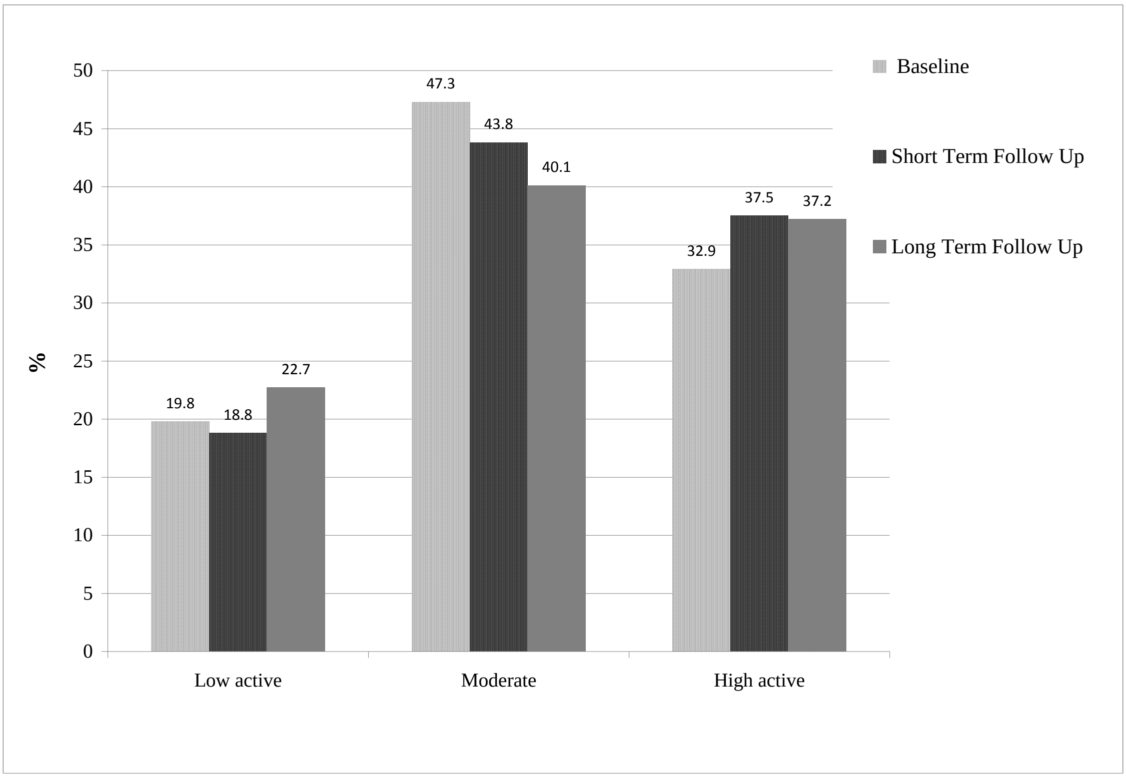
In relation to other demographic and event characteristics, it was apparent that runners and joggers in both Dublin events were more likely to increase their participation in physical activity between baseline and follow up compared to decreases among those who walked the event (p<.05). Little other consistency was noted across all events (*Appendix B, Table 15-17*).

Research Question 2b: What were the changes in proportions categorised as insufficiently/sufficiently active between baseline, short and long term follow up (2007 only)?

4.3.4 Changes in Proportion of Sufficiently/Insufficiently Active

4.3.4.1 Baseline, short and long term follow up (2007)

Matching facilitated accurate analysis of physical activity habits over the three time periods in 2007 (n = 2,020). *Figure 9* illustrates the IPAQ category of respondents at different intervals. The numbers of low active increased overall from 19.8% at baseline to 22.7 % at long term follow up. There was a consistent decrease in moderately active women, from 47.3% at baseline to 40.1% at six months. An initial increase in high active respondents was noted between baseline and short term follow up and remained relatively stable between short and long term follow up. Forced entry logistic regression revealed that participants who were low active at baseline and two months were 1.7 (95% CI, 1.24-2.24) and 3.8 (95% CI, 2.9-4.9) times more likely to be low active at six months than those who were moderate or high active. Participants who were low or moderately active at baseline and two months had an increased risk of 1.6 (95% CI, 1.2-1.9) and 5 (95% CI, 3.9-6.3) times respectively to be in a similar category at six months than high active respondents.



* $p < 0.05$ Baseline & Short Term Follow Up, † $p < 0.05$ Short & Long Term Follow Up, ‡ $p < 0.05$ Baseline & Long Term Follow Up

Figure 9. Baseline, short and long term follow up matched IPAQ analysis (n = 2,020: Dublin 2007)

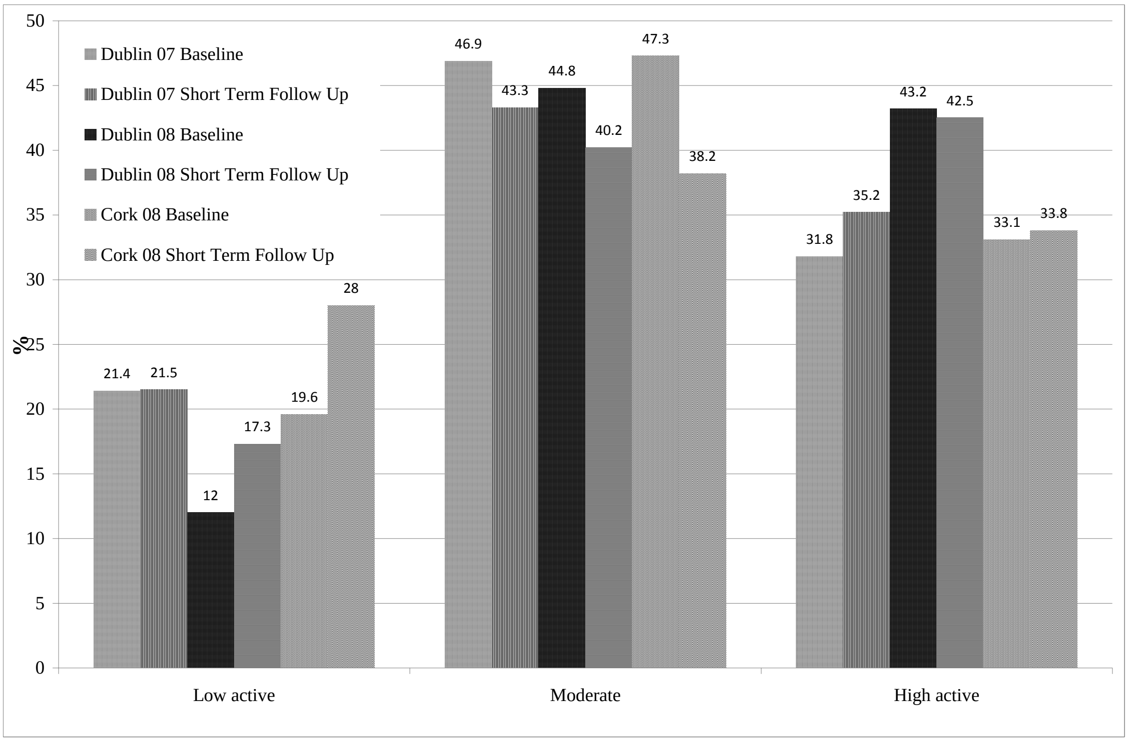
As per previously discussions in chapter 3 (p.80), those categorised as low and moderately active, at follow up, and indeed at all stages, reported low and/or insufficient participation rates in vigorous and moderate activity and subsequently did not meet minimum physical activity requirements. Overall, the proportion deemed insufficiently active remained relatively stable, decreasing slightly from 67% to 63% between baseline and long term follow up. Also, at long term follow up, the number of participants categorised as sufficiently active increased among those participants aged less than 30 ($p<.05$) and 30-50, while it decreased slightly among the oldest age cohort (*Appendix B, Table 18*). Also, at long term follow up, a greater proportion of those who had some or complete tertiary education ($p<.05$) were categorised as high active and thus achieved minimum physical activity requirements (*Appendix B, Table 19*). Furthermore, there was a greater increase in sufficiently active respondents among women with no children ($p<.05$) compared to their counterparts with children (*Appendix B, Table 20*)[4].

Also, there was an increase in insufficiently active among participants who did not report taking part in other events compared to a substantial decrease ($p<.05$) among those who were frequent event participants (*Appendix B, Table 21*). A similar trend was apparent among walkers and runners/joggers ($p<.05$) with the latter group showing a decrease and the former no change in insufficiently active between the two time points. Repeat participants in the Mini Marathon also demonstrated an increase ($p<.05$) in sufficiently active between baseline and follow up (*Appendix B, Table 22*).

4.3.4.2 Baseline and short term follow up

In the Dublin 2007 event, there was little variation in low active between baseline and follow up, a slight decrease in moderate active and a similar increase in high active; among the matched participants (*Figure 10*). In contrast, there was an increase in low active three months post baseline in both 2008 cohorts. This was complemented by a decrease in moderately active and little variation in high active. Overall, there was a slight decrease of insufficiently active (low and moderate) participants between the two time points, from 68% to 65%, in 2007 and little change in both 2008 events. In Dublin 2007, insufficiently active participants at baseline were twice (95% CI, 1.8-2.4) as likely to be low active at two months compared to high active while in both 2008 events similar insufficiently active participants at baseline were 4.2 and 3.8 (95% CI, 3.6-4.9; 2.4-6.2) times more likely to be insufficiently active at follow up than their more active counterparts, in Dublin and Cork respectively .

[4] Some tables were moved to the *Appendices* to reduce the content in the main chapters



* $p < 0.05$ Baseline & Short Term Follow Up, † $p < 0.05$ Short & Long Term Follow Up, ‡ $p < 0.05$ Baseline & Long Term Follow Up

Figure 10. Baseline and short term follow up IPAQ categories.

In all events, there was very little consistent change in insufficiently/sufficiently active between baseline and follow up across the different age groups. The most notable trend was a decrease in the proportion of participants aged less than 30 categorised (p<.05) as sufficiently active between the different time points in 2008 (*Appendix B, Table 24-25*). There were no consistent trends among other demographic and event characteristics across all events (*Appendix B, Table 26-34*).

Research Question 2c: What were the changes in sedentary behaviour between baseline and short term follow up (2008)?

4.3.5 Changes in Sedentary Behaviour

Average daily sitting time at follow up was higher in Cork respondents than Dublin respondents (275 minutes v 207 minutes per day), while television viewing time was approximately 120 minutes in both groups. *Table 30* indicates that there was a significant increase in sedentary behaviour between baseline and follow up. Increases in time spent watching television were apparent across all activity categories while decreases and minimal changes in sitting were noted (*Appendix B, Table 35).*

Table 30

Sedentary Behaviour Per Day at Short Term Follow Up: Matched Analysis

		Sitting Minutes/day (M, SD)	TV Minutes/day (M,SD)
Dublin 2008	Baseline	186.3 (125.9)	111.5 (70.1)
(n=3,505)	Follow Up	206.7 (131.6)*	118.4 (72.1)*
Cork 2008	Baseline	261.9 (152.3)	104.5 (69.9)
(n=348)	Follow Up	274.7 (154.1)*	119.1 (64.9)*

* $p < 0.05$ Baseline v Short Term Follow Up

At follow up, the most notable difference in sedentary behaviour between different demographic groups (*Appendix B, Table 36-38*) was that TV viewing time increased significantly among the oldest age group, parents and the tertiary educated.

Research Question 2d: What proportion of participants increased, decreased or maintained their participation in physical activity between baseline, short and long term follow up (2007 only)?

4.3.6 Proportion of Participants who Increased/Decreased/Maintained

4.3.6.1 Baseline and long term follow up

Table 31 highlights the changes in physical activity between baseline and long term follow up in the Dublin 2007 event. Similar proportions of participants increased and decreased their participation levels by at least 60 minutes of moderate intensity activity (240 MET-minutes) per week.

Table 31

Proportion of Participants who Increased, Decreased or Maintained their Physical Activity Levels between Baseline and Long Term Follow Up: Matched Analysis (n=2,020; Dublin 2007)

Total Matched Group (n)	2,020	
	n	%
Decreased by at least 240 MET-minutes/wk	608	41
Remained within ± 240 MET-minutes/wk	161	10.9
Increased by at least 240 MET-minutes/wk	714	48.1

Over half of those categorised as decreasers were high active at baseline while 83% of the increasers were low or moderately active at baseline. An assessment of the demographic characteristics of these sub groups indicated that increasers, maintainers and decreasers only differed significantly on level of education and mode of participation in the Mini Marathon.

Table 32

Characteristics of Increasers, Decreasers and Maintainers at Long Term Follow Up: Matched Analysis (n=2,020; Dublin 2007)

		Increasers	Maintainers	Decreasers
Age	<30	35.7	33.3	34.1
	30-50	52.3	57.9	53
	>50	11.9	8.8	12.9
Children	No Children	60.1	56.3	55.4
	Children	39.9	43.7	44.6
Education	No Tertiary	21.3	15.7	26.2
	Tertiary	78.7	84.3	73.8*
Live	Urban	74	67.3	71.9
	Rural	26	32.7	28.1
Marital Status	Married	55.2	63.9	56.1
	Single	44.8	36.1	43.9
Previous Participation	First Time	34.9	37.1	38.4
	Repeat	65.1	62.9	61.6
Mode of Participation	Walk	63.1	73.6	73.8
	Run/Jog	36.9	26.4	26.2*
Training	Do not train/week or two	65.5	74	66.2
	Train Continuously	34.5	26	33.8

* $p < 0.05$ Increasers v Maintainers v Decreasers

4.3.6.2 Baseline and short term follow up

Across all events at short term follow up, similar proportions of participants increased, decreased or maintained their physical activity levels.

Table 33

Proportion of Participants who Increased, Decreased or Maintained their PA Levels between Baseline and Short Term Follow Up; Matched Analysis (n=3,803; Dublin 2007, n=3,505; Dublin 2008, n=348; Cork 2008)

	Dublin 2007		Dublin 2008		Cork 2008	
Total Matched Group	n=3,803		n=3,505		n=348	
	n	%	n	%	n	%
Decreased by at least 240 MET-minutes/wk	1,482	40.3	1,515	45.2	150	44
Remained within ± 240 MET-minutes/wk	444	12.1	411	12.3	45	13.2
Increased by at least 240 MET-minutes/wk	1,752	47.6	1,429	42.6	146	42.8

Similar to observations at long term follow up, in all events at short term follow up, the majority of decreasers were high active at baseline while increasers were more likely to be low or moderately active. At short term follow up in Dublin in 2007, mode of participation, amount of training, having children and place of residence were all significantly different between increasers, maintainers and decreasers. Notably, a greater proportion of increasers did not have children while decreasers were less likely to train continuously.

Table 34

Characteristics of Increasers, Decreasers and Maintainers at Short Term Follow Up: Matched Analysis (n=3,803; Dublin 2007)

		Increasers n=1,752 (%)	Maintainers n=44 (%)	Decreasers n=1,482 (%)
Age	<30	34.3	30	32.5
	30-50	50.8	58.2	52.4
	>50	14.9	11.8	15.1
Children	No Children	56.3	47.2	50.4
	Children	43.7	52.8	49.6*
Education	No Tertiary	30	29.5	30.2
	Tertiary	70	70.5	69.8
Live	Urban	71.6	66.7	67.3
	Rural	28.4	33.3	32.7*
Marital Status	Married	56.2	57.6	58.9
	Single	43.8	42.4	41.1
Previous Participation	First Time	35.1	40.5	37.4
	Repeat	64.9	59.5	62.6
Mode of Participation	Walk	68.8	80.7	76.2
	Run/Jog	31.2	19.3	23.8*
Training	Do not train/week or two	86	82.8	87.6
	Train Continuously	14	17.2	12.4*

* $p < 0.05$ Increasers v Maintainers v Decreasers

In 2008, place of residence and education were the only distinguishing characteristics between participants classified as increasers, decreasers or maintainers in the Dublin event while no significant trends were apparent in the Cork equivalent. In Dublin, a greater proportion of participants living in rural areas were identified as decreasers then increasers or maintainers. A similar table for the Cork event is in *Appendix B* (*Table 39*).

Table 35

Characteristics of Increasers, Decreasers and Maintainers at Short Term Follow Up: Matched Analysis (n=3,505; Dublin 2008)

		Increasers n=1,429 (%)	Maintainers n=411 (%)	Decreasers n=1,515 (%)
Age	<30	31.2	32.7	29.9
	30-50	51	53.1	53.6
	>50	17.8	14.2	16.4
Children	No Children	51.7	53.1	48.8
	Children	48.3	46.9	51.2
Education	No Tertiary	31.1	28.2	35.2
	Tertiary	68.9	71.8	64.8*
Live	Urban	72.2	72.2	66.6
	Rural	27.8	27.8	33.4*
Marital Status	Married	57.9	62.1	60
	Single	42.1	37.9	40
Previous Participation	First Time	38.2	42.8	37.6
	Repeat	61.8	57.2	62.4
Mode of Participation	Walk	70.3	73.7	72.5
	Run/Jog	29.7	26.3	27.5
Training	Do not train/week or two	60.7	55.7	61.4
	Train Continuously	39.3	44.3	38.6

* $p < 0.05$ Increasers v Maintainers v Decreasers

4.3.6.3 Relationship between changes in self reported and self perceived levels of physical activity

Among the Dublin 2007 cohort, those categorised as increasers displayed some consistency in their assessment of their current physical activity status compared to that prior to the Mini Marathon. Almost a third recognised that their activity levels had increased, considerably more than maintainers and decreasers. A similar trend was apparent in both 2008 events (*Appendix B, Table 40-41*).

Table 36

Perceived Activity Status at Short Term Follow Up: Matched Analysis (n=3,803; Dublin 2007)

	Self Reported Change		
IPAQ Change	More active (%)	About the same (%)	Less active (%)
Increasers (n=1,752)	32.6	55.3	12.1
Maintainers (n=444)	16.9	60.2	23
Decreasers (n=1,482)	22	56.7	21.3*

* $p < 0.05$ Increasers v Maintainers v Decreasers

Despite this hint of consistency between self reported and self perceived changes in physical activity levels, discrepancy still existed, as is evident in *Appendix B* (*Table 42*); where approximately 28% of low active follow up participants in the 2008 Dublin event felt they were sufficiently active. A similar finding was apparent in the other events.

4.4 Discussion

This follow up of mass event participants provided an opportunity to assess longer term participation in physical activity. Over time, across three samples of women only participants, the proportion of low active appeared to increase while the numbers of moderately active respondents decreased, and a considerable proportion remained sufficiently active. In relation to frequency of participation in physical activity at the different time points, at long term follow up in 2007, days spent being vigorously active and walking decreased but an increase in moderate days led to an overall increase in total days spent being active. Similarly, an increase in moderate and decrease in vigorous and walking MET-minutes per week led to little change in total MET-minutes at the different time points. The most notable changes at short term follow up were increases in moderate days and MET-minutes per week in all three events. Significant decreases in walking MET-minute per week were apparent in both Dublin events, while total MET-minutes only altered significantly in Dublin 2007.

Being low or moderately active at baseline was significantly related to being in a similar category at follow up. These participants had substantial increased chances of being insufficiently active at each time point compared to their more active counterparts. Further analysis indicated that similar proportions of participants across all events exhibited the same trends post event; specifically, approximately 43% decreased their participation in physical activity by one hour of at least moderate intensity activity, 45% increased their involvement by the same amount and 12% maintained their pre event status (within ±60 minutes of moderate intensity activity). This would indicate that women's participation in physical activity, at least in this cohort, is cyclical and can fluctuate over time. Subsequent strategies and efforts designed and implemented to promote physical activity should consider this and target individuals according to whether their physical activity levels need to be increased or maintained.

4.4.1 Response Rate

Higher levels of education and lower ownership of medical cards among the Mini Marathon population, compared to the general Irish female population became more prominent across the various data collection points in 2007 and 2008; indicating that more educated, well off people respond to surveys, a point also noted in the previous chapter. It was observed, in this same discussion, that the distortion between the general and Mini Marathon population may be partially due to the use of an online data collection tool as well as the traditional postal method. Specifically, individuals with internet access are typically younger and more affluent than those who do not have access (Adams & White, 2007) in Ireland (Amárach Research, 2008) and elsewhere, and thus present a somewhat unrepresentative sample of a particular population of interest.

4.4.2 Changes in Physical Activity

An overview of the change in physical activity, which was alluded to above, is a useful undertaking. As Rose and Murfurt (2007) noted, identifying the characteristics of participants who alter their activity levels in different ways can help in efforts to develop behaviour maintenance strategies post event. Subsequent analysis indicated that participants aged less than 30 years showed an increase or less notable decrease in vigorous and total MET-minutes per week in all events than those aged 30-50, which is reflective of general findings with regard to age and physical activity. Participants aged 50 plus in both Dublin events showed favourable changes in physical activity, maintaining the high levels of physical activity which were discussed in the previous chapter. It was also observed that participants from urban areas, repeat Mini Marathon participants and runners in the event mostly displayed more favourable changes in physical activity between baseline and short term follow up. Walkers, in 2007 also demonstrated increases in the proportion not meeting minimum physical activity guidelines.

The presence of multiple roles has been deemed particularly important for exercise participation among women; Verhoef et al. (1993) noted that married women with children in their study were among the least likely to exercise frequently. In this study, as noted above results were conflicting; women who were married and had children, and single parents, at different time points, in the different surveys all reported lowest amounts of vigorous and overall physical activity. Furthermore, participants in both Dublin events who did not have children reported notable increases in physical activity between baseline and short term follow up. It would appear that parenthood alone is the most consistent predictor of physical activity and it was apparent that increasers (increase of at least 240 MET-minutes per week of physical activity) were most likely to be non parents particularly in 2007 at short and long term follow up. Indeed, in a review by Bellows-Riecken and Rhodes (2008) of physical activity and parenthood, it was concluded that physical inactivity was consistently related to having children, particularly among mothers in comparison to fathers, and that mixed findings abound in relation to the additional predictive power of age, number of children, marital status and employment on physical activity.

4.4.3 Physical Activity, Sedentary Behaviour and Educational Status

Among the most consistent observations at baseline and follow up was that tertiary educated participants displayed a lower proportion of low active participants. Furthermore, tertiary educated participants were more likely to be categorised as increasers and maintainers than decreasers. This would indicate that the relationship between socio-economic (SES) and physical activity is a particularly strong one in this population group. Indeed, Ball et al. (2006) noted that SES differences in physical activity are very prominent among females and remain present even when occupational and domestic physical activity is included; a finding that is not replicated in males. Furthermore, the authors noted that reasons for this socio-economic gradient have not been well explored, particularly in an ecological context, taking personal, social and environmental factors relating to participation into account. Interviews were subsequently undertaken with women from a low and high SES area in Australia to investigate participation and facilitators and barriers related to same. Walking was the most commonly reported activity among all women, and women from high SES were more likely to engage in structured exercise or team sports, placed less priority on sedentary habits, such as watching television and stated that their neighbourhood was more favourable to physical activity than women from low SES areas (Ball et al., 2006).

With respect to the latter, an attempt was made to assess social and environmental factors related to physical activity in this cohort at follow up (*Appendix B*). Results indicated no difference in reported ability to be active in their locality and availability of green areas to be active in among women with various levels of education; an indicator of SES in this study. Thus, there was no conclusive evidence to support the specific findings generated by Ball et al. (2006) that the environment was predictive of engagement in physical activity. However, women with lower education levels in Cork 2008 displayed greater increases in TV viewing than those with tertiary education. These results do corroborate with those from Ball et al. (2006) that women from lower SES allocate more time to sedentary behaviours such as watching television.

4.4.4 General Sedentary Behaviour

Overall, sedentary behaviour (sitting and TV viewing) increased significantly between baseline and follow up, from approximately 5 to 5.5 hours among Dublin participants and 6 to 6.5 hours among Cork participants. As noted in the previous chapter, these can be considered as conservative estimates due to the subjective nature of data collected but may still pose a health risk. Data in Australia for example indicated that adults spend approximately nine hours per day in sedentary behaviours, and this statistic collected using accelerometry was associated with increased risk of poor metabolic health (Owen et al., 2009). Furthermore, Healy et al. (2008) in another study on Australian adults found that increased television viewing time was related to increased waist circumference and blood pressure particularly among women. As noted in chapter 2 and 3, sitting time is an independent risk factor for mortality, irrespective of activity status (Owen et al., 2009). At follow up, sufficiently active respondents in this research reported 5-6 hours of sedentary behaviour, possibly an underestimate, and thus, a concern even for this active sub group, particularly as there was an increase between baseline and follow up.

In relation to TV viewing, Healy et al. (2008) recommended no more than two hours of screen time per day; respondents in this research achieved this, averaging approximately 120 minutes of TV viewing time per day. Little formal guidelines exist overall on recommended sitting times and sedentary behaviour but consideration must be given to the acknowledged health risks associated with even 43-86 minutes of TV viewing cited by Healy et al. (2008) and prolonged sitting time in general (Owen et al., 2009). These latter statistics indicate the risk apparent in relation to sedentary behaviour among the cohort of women in this research.

4.4.5 Repeat Event Participation

Analysis in this chapter revealed that frequent participation in any physical activity event was associated with higher levels of physical activity and more favourable changes in physical activity between baseline and follow up than non repeat event participants. Furthermore, in chapter 3, it was noted that repeat participants (approximately 60%) in the Mini Marathon event trained at a higher level and were subsequently more active than first time participants. Also, almost all participants (97%) indicated that they would participate in the Mini Marathon again. This offers alternative evidence for the potential legacy and long term effects of physical activity events. It appears that regular participants in events have generated a degree of attachment and allegiance (Filo et al., 2009) to these initiatives, which present a vehicle to assist them to be active and support sustained behaviour change. Also, many respondents did call for more regional events to instigate more frequent and consistent participation, further support for the organisation and support of more physical activity related events.

4.5 Limitations

Limitations in this phase of the research are similar to those presented in chapter 3. Of note, in this instance, is the increased proportion of tertiary educated and decreased proportion of medical card owners among participants at short and long term follow up, in comparison to baseline data and national statistics. Notwithstanding the observation that higher educated women are possibly more likely to participate in mass events, this is a clear indication of the lower tendency of the less well off and less educated to respond to surveys, specifically those pertaining to health behaviour. It appears more targeted recruitment protocols or alternative assessment methods may have been needed to increase response rates among these priority sub groups.

4.6 Conclusion

In this adjunct to the previous chapter and precursor to the next chapter on physical activity relapse between the different data collection points, much of the observations relating to participation and activity status were consistent with baseline analysis. Of particular note was the greater likelihood of response to repeat surveys by those who were well educated and did not have medical cards. Sedentary behaviour was also explored and deemed to be more prominent among women who did not report tertiary education and among older women.

In relation to the long term legacy of a mass participation event, analysis at short and long term follow up (in 2007) revealed that approximately one third of participants were sufficiently active at these follow up time points. Furthermore, it was apparent that repeat participation in the Mini Marathon and other physical activity events was associated with higher levels of physical activity. This is provisional, if not conclusive, evidence for the adoption of an events related/based strategy to promote physical activity in Ireland. This approach may require additional pre and post event strategies, which could maximise involvement in physical activity prior to, during and following these events (Rose & Marfurt, 2007). Examples of potential initiatives will be addressed in later chapters.

Finally, despite apparent consistent sufficiently active rates between baseline and follow up, alterations, including decreases, in frequency and duration of physical activity were identified and an initial attempt was undertaken to examine which participants were most likely to increase, maintain or decrease their physical activity levels. The next chapter will explore this, specifically participants who relapsed to lower activity levels and the predictors of this occurrence.

Chapter 5: Assessment of Relapse to Insufficient Physical Activity Levels Post Event

5.1 Background

Chapter 2 outlined the increased demand for behaviour change as the global burden of disease continues to escalate, with unhealthy lifestyles acting as a chief contributor to many conditions and associated high mortality rates. Glanz, Rimer and Viswanath (2008) extolled the opportunities that increased technology, communication, research and expertise have presented to current efforts to stimulate behaviour change. Later chapters will address many of these new ideas and innovations manifested as interventions incorporating the internet or multi level strategies at a community level, among others. However, there are many challenges inherent in the facilitation of behaviour change. Specifically, while there are numerous benefits associated with being physically active, sedentary behaviour is widespread. Furthermore, there is still a lack of understanding about participation and how to promote it and how to transfer positive findings successfully to the general population and elucidate long term behaviour change (Glanz et al., 2008).

5.1.1 Behaviour Change

Knapp (1988) presented a useful strategy for behaviour change pertaining to exercise, which advocated the development of regular physical activity as a habit; a normal part of daily living. Simultaneously, the author noted that considerable effort would be required to induce such a transformation. Knapp (1988) viewed the acquisition of this new habit, being regularly active, as a three stage process; the decision to start exercise, the early stages of behaviour change and the maintenance of this new behaviour. This process is generally guided by a theory or model of behaviour change, which were described in chapter 2. Central to the first two stages of habit acquisition is the concept of adoption while maintenance/adherence and relapse/attrition are especially important in the last stage. Indeed this sequence of adoption, maintenance and relapse and the additional concept of resumption (Sallis et al., 1990) is akin to the natural lifespan of any effort or intervention to promote physical activity. The table underneath presents a succinct definition of these terms, as they relate to physical activity:

Table 37

Definition of Terms

Term	Definition
Adoption	Refers to the initiation of a new behaviour; the movement from sedentary or insufficient participation in physical activity to a sufficiently active status
Maintenance/Adherence	Refers to sustained engagement in a pre-defined amount and intensity of physical activity sufficient to induce favourable health outcomes or for a specified period of time
Lapses	Refers to slips of a defined amount and duration that can lead to relapse outright or that provide an opportunity to administer and learn better coping strategies prior to complete relapse
Relapse	Refers to a defined amount and duration of a decrease in physical activity to insufficient activity levels or below those prescribed by the intervention after a period in the maintenance/sufficiently active stage
Attrition	Refers to the cessation of involvement in or drop out from a research study and often is associated with a lack of compliance with the purpose or intention of the intervention

5.1.2 Introduction to Adoption

Adoption is typically viewed as the most important aspect of behaviour change, particularly for the large proportion of sedentary people that exist worldwide. It is also a predictor of maintenance and is imperative in the cyclical process of behaviour change, as an individual attempts to resume or re-adopt a behaviour following relapse or attrition. This initial stage of adoption was considered in a review by Dunn (1996), which assessed studies that attempted to make sedentary adults active. Dunn noted that many characteristics of interventions and their participants can predict successful adoption of physical activity. For example, as noted earlier, it was recommended that a particular theory or model should guide intervention development and consideration should be given to the specific traits of the target population and their motivational readiness to be active.

5.1.3 Introduction to Maintenance

Upon successful adoption, a challenge exists to induce maintenance and long term behaviour change. Dunn (1996) and Wing (2000) observed that little knowledge is available on long term behaviour change. However, it has been acknowledged that maintenance is a process in itself rather than merely a step in the whole phenomenon of behaviour change (Wing, 2000). This process of maintenance is a function of and reliant on adoption and is often characterised by relapses to pre-maintenance behaviour. It is generally inconsistently assessed and quantified, surprising given its importance. A standard measure of maintenance is difficult to define as intervention guidelines on what quantifies as regularly physically active and individual requirements and goals can vary considerably across study settings (Dishman, 1988). Despite this, the development of minimum guidelines for physical activity (USDHHS, 2008) does present a uniform indicator of maintenance for regular, relatively healthy members of the population.

Variation is more apparent in the duration of this engagement in regular physical activity (i.e.) the period of time one must be regularly active to be deemed a maintainer. This often is dictated by pre-defined follow up periods in research studies. Indeed, Laitakari, Vuori and Oja (1996) stated that maintenance was typically measured as weight loss or persistent physical activity for a six month period. Subsequently, Orleans (2000) observed that little progress has been made in promoting long term behaviour change beyond this six month cut off point despite the wealth of resources and research in this area. In the interim, follow up periods have increased. In a review of physical activity interventions (Müller-Reimenschneider et al., 2008), maximum follow up periods of 24 months to assess maintenance were noted. Inherent in this defined follow up period is a tendency by researchers to be overly concerned with compliance to their exercise guidelines for the duration of their study only to uphold the integrity of their research. Rather, Dishman (1988) noted that the focus should be on facilitating continued maintenance to ensure that long term health benefits from being physically active are experienced.

5.1.4 Introduction to Relapse

Within the maintenance stage, relapse is common prior to successful long term behaviour change. It is imperative that individuals who relapse are assessed and if possible compared to those who maintain healthy behaviours. This can help identify factors associated with both outcomes to possibly devise strategies or treatments to prevent and minimise relapse. Dishman (1988) referred to typical attrition rates of 50% from physical activity during or following the delivery of interventions. Attrition as noted earlier typically refers to drop out from physical activity interventions and has been used as an indicator of relapse in many studies. The use of attrition in this context is somewhat flawed as these rates may include people who are still active, potentially in a different setting (Marcus et al., 2000). The specific analysis of these dropouts, particularly those who demonstrate some initial enthusiasm and improvement in physical activity, to more accurately identify relapsers is essential as efforts could be undertaken to encourage these participants to re-engage in the intervention.

Despite this, Dishman (1988) did compare, and note similarities between, this 50% drop out statistic and data presented by Hunt, Barnett and Branch (1971) who collated relapse rates from a number of studies that administered treatment programmes for smoking, alcohol and heroin. All rates were quite similar with initial sharp decreases in abstinence during the first three months, prior to a more gradual decline and an eventual tapering at six months with final relapse rates as high as 80%. Overall, though there is a paucity of literature examining the incidence and predictors of physical activity relapse in normal populations. In public health, research on relapse and maintenance in smoking is widespread. Ockene et al. (2000) undertook a review of this literature. Short term maintenance was defined as abstinence for between six and 12 months and long term maintenance was detailed as any length of time thereafter. After consideration of many factors, relapse was afforded two definitions; seven consecutive days of smoking at least one puff per day or smoking five or more cigarettes a day for three consecutive days, both after a period of cessation.

The concept of lapses was also explored by Ockene et al (2000); slips that typically lead to relapse outright. Wing (2000) referred to lapses in her discussion of relapse and maintenance pertaining to diet and physical activity and noted that they can be difficult to quantify in these particular fields and that even regular exercisers and healthy eaters can experience lapses. Overall, it appears that more research is required on relapse in a physical activity context, which could contribute to current models of and strategies to promote sustained behaviour change.

5.1.5 Marlatt and Gordon's Relapse Model

Few specific models to address relapse in a physical activity context are available. Consequently, Knapp (1988) used Marlatt and Gordon's relapse model to address the occurrence of relapse following behaviour change, in an exercise setting. This model was derived from studies of alcohol, smoking and drug abuse and involved defining strategies for relapse prevention. Knapp (1988) observed that applying this model to physical activity would involve the promotion of low frequency, desired behaviour rather than the denouncement of a high frequency, undesired behaviour such as drug use.

Larimer, Palmer and Marlatt (1999) presented an overview of the relapse prevention model and noted that it centred on factors related to potential relapse; immediate determinants (high risk situations, coping strategies, outcome expectancies) and covert antecedents (lifestyle imbalances and urges). The immediate determinants are linked; a person with good coping mechanisms and positive outcome expectancies can respond well to a high risk situation. Knapp (1988) provided an analogy with physical activity; a lunchtime exerciser who is presented with a looming deadline re-arranges his schedule to fit in physical activity because he has high self efficacy and appreciates the pros of engaging in regular physical activity. In a negative scenario, the worker may decide that the positives associated with getting the work done immediately far outweigh the benefits of his daily run. Larimer et al. (1999) cited this initial lapse and an individual's response to it as the abstinence violation effect. In an addiction context, an individual who attributes this lapse to their own personal failings is highly likely to suffer a full relapse. Knapp (1988) noted that this type of initial lapse has less dramatic connotations in a physical activity setting.

Covert antecedents also influence relapse, specifically high stress levels, the presence of strong urges or cravings, and imbalance between things one should do or be doing and engaging in activities that generate personal satisfaction or enjoyment. The model also includes a number of relapse prevention strategies that incorporate identifying and dealing with high risk situations and altering covert antecedents. Specifically, this can involve correcting positive outcome expectancies for slips, planning for slips, allowing certain rewards for sticking to a plan or regimen and coping with urges to lapse and relapse. Subsequently, Knapp (1988) noted that little research on the application of this model to physical activity has been undertaken; this has changed somewhat in the intervening years with a number of studies using the model to design and administer relapse prevention strategies; these will be assessed later.

5.1.6 Models of Behaviour Change, Maintenance and Relapse

Many of the behaviour change models discussed in chapter 2 have been used to predict physical activity behaviour, which includes the concepts of adoption and maintenance. The Theory of Reasoned Action (TRA) and its extended equivalent, the Theory of Planned Behaviour (TPB) (Azjen, 1991) focus primarily on the initiation of a new behaviour, which is dictated by behavioural intention and perceived behavioural control. Indeed, Godin (1994) observed that this theory is more useful in assessing intention to exercise rather than the behaviour itself and the maintenance of it. Furthermore, Biddle and Mutrie (2008) noted that these models do not take into account that many people do not translate intentions to action, failing to explain the gap between these two stages. Similarly, Godin (1994) suggested that the Health Belief Model (HBM) is inappropriate for the study of physical activity behaviour due to its illness and disease orientation and its lack of ability to predict adoption or maintenance of activity (Biddle & Mutrie, 2008). Social Cognitive Theory (SCT) (Bandura, 1986) highlights the importance of self efficacy in predicting behaviour, which was cited by Sallis et al. (1989) as the most significant predictor of physical activity among adults. Despite this, SCT along with other models discussed in this section are somewhat static and fail to view behaviour change, including adoption and maintenance as a sequence and process rather than a once off phenomenon (Sonstroem, 1988).

Subsequently, a new model was developed that encompassed a more integrated, realistic view of behaviour change. Prochaska and DiClemente (1983) presented the Stages of Change model (Transtheoretical Model – TTM), which described behaviour change as cyclical with individuals moving sequentially along a set of stages prior to the acquisition of a new behaviour. Maintenance is presented as a unique stage, achieved after satisfying change criteria for at least six months. Notably, relapse is also considered as individuals can regress as well as progress through the stages, and is deemed a threat even after long periods of maintenance (Prochaska & Marcus, 1994). The ten processes of change, decisional balance and self efficacy are all factors related to this model and are frequently measured to assess their impact on behaviour change. Behavioural processes including counterconditioning, helping relationships, reinforcement management and stimulus control are most important in the later stages and also may prevent relapse (Marcus et al., 1992), which is also averted by focusing on the pros of engaging in regular exercise (Marcus & Simkin, 1994) and high self efficacy (Marcus & Owen, 1992).

Schwarzer (1992, cited in Biddle & Mutrie, 2008) developed another model, modifying the TPB to include motivational (pre) and volitional (post) behavioural intention, the latter leading to behaviour change. This new model, the Health Action Process Approach (HAPA) includes intention, action and maintenance as separate stages unlike its previous incarnation. It also includes strategies to enhance maintenance and prevent relapse, such as a phase specific analysis of self efficacy, which included recovery self efficacy to deal with setbacks and relapse prior to maintenance. Biddle and Mutrie (2008) referred to the HAPA as somewhat of a hybrid model incorporating intention – behaviour links and aspects of stage based models.

Orleans (2000) presented a concern that these individual models are redundant at a time when ill health is so widespread and stated that action is required at a population level to induce long term behaviour change. Indeed, Marcus et al. (2000) reviewed interventions to promote physical activity and reported that less structured, community based interventions that incorporated some of the behavioural strategies from individual models were most successful in promoting maintenance. The latter also had two year follow up periods. Subsequently, Orleans (2000) advocated the adoption of models that include individual and population level intervention strategies, which facilitate the use of community settings, public policy change and environmental intervention. These models such as Sallis' ecological model, do not directly incorporate maintenance or relapse stages but do inherently promote maintenance by implementing interventions on many levels and creating a supportive environment to be active.

Indeed, Rothman (2000) noted that many of the commonly used models of behaviour change fail to distinguish between the factors that influence adoption and maintenance of health behaviours. Subsequently, recent research has endeavoured to advance understanding of this later stage in behaviour change and investigate how the aforementioned constructs can help predict relapse and promote maintenance. Similarly, Nigg (2008) noted theories and models of behaviour change may not be appropriate or sufficient to explain and encourage long term maintenance of physical activity; being more effective in the design and delivery of interventions to promote adoption. Indeed, only, the TTM and HAPA directly attempt to address maintenance by including it as a stage or distinct process in their model. Furthermore, Ockene et al. (2000) noted that most research on relapse and maintenance is only loosely based on theory and thus also agreed that currently used models were inadequately tested and evaluated.

Consequently, Nigg (2008) devised a theoretical framework to better comprehend the long term maintenance of physical activity (physical activity maintenance theory – PAM). This model focuses on maintenance, integrates triggers of relapse and includes individual and environmental factors that may help maintain physical activity. Mediators of physical activity maintenance in the model include goal setting, self efficacy and self motivation and according to the model these interact with each other to trigger or prevent relapse. Lastly the model states that the environment can enhance these mediators if they are supportive of physical activity while life stresses can have a negative impact on maintenance by eliciting relapse. Orleans (2000) called for maintenance theories and this PAM model presents a viable example of this; it directly addresses the issues of maintenance and relapse and serves as an extension to current best practice ecological models used to promote physical activity given it incorporates individual and environmental factors.

5.1.7 Physical Activity Maintenance and Relapse in Clinical Settings

Considerable research exists on adherence to cardiac rehabilitation programmes following cardiac events. Bock et al. (2003) noted that the benefits of physical activity are only apparent when individuals maintain regular physical activity. In accordance, full participation in cardiac rehabilitation can confer benefits including improved morbidity and mortality. Despite this, up to 50% of patients do not maintain regular physical activity (Bethell, 1999) and a lack of knowledge exists on factors related to such. Subsequently, Bock et al (2003) compared individuals who maintained and did not maintain regular physical activity 12 months after completing a Phase II rehabilitation programme. Following Phase II, a Phase III programme exists to assist maintenance. Despite this, approximately one third of graduates from Phase II in this study did not take part in the additional stage, which permitted interaction with staff and access to facilities to be active. Physical activity data were collected using a self report instrument from 100 participants and results indicated that individuals who participated in Phase III and who experienced longer Phase II programmes engaged in more vigorous physical activity, were more likely to continue regular physical activity following Phase II and meet minimum physical activity requirements.

Izawa et al. (2004) also assessed long term maintenance after an additional five month cardiac rehabilitation programme (n = 109), twelve months post cardiac event. Unlike the previous example, maintenance was defined using the TTM and over 80% of patients in the additional programme maintained exercise. In an extension of this study, Izawa et al. (2005) assessed levels of motivational readiness and randomly allocated 45 myocardial infarction patients to an intervention and control group following completion of an initial cardiac rehabilitation programme. The intervention included self monitoring of weight and physical activity for six months and enhancing confidence to maintain activity. All participants in the intervention group and 80% of the control group reported maintenance of physical activity.

Moore et al. (2006) assessed an intervention to promote maintenance following participation in Phase II cardiac rehabilitation, 12 months post cardiac event. The theory based CHANGE intervention incorporated cognitive behavioural strategies to promote self efficacy and prevent relapse as well as small group counselling and goal setting and began in the last weeks of Phase II. Maintenance was assessed by the number of months patients were active after Phase II and the frequency and intensity of exercise participation and mediators such as social support, self efficacy and motivation were also assessed. Patients in the CHANGE group reported greater maintenance than the control group, who were 76% more likely to cease exercise in the year following a cardiac event. Despite this, there were no significant differences in duration and intensity of activity between groups.

Research on adherence has been undertaken on other clinical, non standard population groups. Courneya et al. (2004) assessed adherence to exercise in a group of prostate cancer survivors (n = 155). All participants received normal, medical treatment, while one group engaged in a 12 week exercise programme. Adherence was assessed by attendance at sessions and it was higher in the exercise group; 78% v 65%. Overall, adherence rates appear higher for clinical groups, ranging from 30% to 100% in these examples; presenting an average rate of 65% that is somewhat higher than the adherence rate of 50% for general physical activity studies observed by Dishman (1988). The longest follow up period in these examples, which included enhanced cardiac rehabilitation programmes, was 12 months whereas Biddle and Mutrie (2008) noted that after four years, a lesser proportion (30-55%) of cardiac rehabilitation patients are still exercising. Evidently, short term adherence rates are higher in clinical populations but revert to standards similar to those reported by Dishman (1988) over time.

5.1.8 Physical Activity Adoption in Non Clinical Settings

Earlier, it was noted that intentions are used in many models of behaviour change to predict behaviour. However, Sniehotta, Schulz and Schwarzer (2005) observed that intention is not always followed by action and thus greater attention needs to be focused on the actual adoption and subsequent maintenance of behaviour change. Considering the high physical inactivity rates worldwide, the adoption of a more active lifestyle is warranted by many. For this cohort of people, studies of adoption are more important than findings related to maintenance or adherence (Sallis et al., 1992). In this latter study adopters were identified as participants who were sedentary at baseline but engaged in some physical activity (at least once a week) at 24 month follow up in a study of over 1,500 people in San Diego. Results indicated that approximately 40% of those who were sedentary at baseline adopted some level of physical activity. Eaton et al. (1993) investigated the change in physical activity between 1986-1987 and 1990-1991 in a group of men and women who were taking part in the Pawtucket Heart Health Programme. Self report physical activity was assessed at both of these time points and individuals who increased their participation from fewer than three times a week at time 1 to three or more times a week at time 2 were identified as adopters; approximately 15% of the overall sample was classified as adopters.

Boutelle et al. (2004) assessed the adoption of vigorous activity by over 1,000 men and women in a community based weight gain prevention trial and used a similar classification system to Eaton et al. (1993). Frequency and nature of vigorous activity was measured and adopters were defined as individuals who reported less than three episodes of vigorous activity per week at baseline and more than three at follow up. Titze, Stronegger and Owen (2005) undertook a survey of all female participants in a fun run in Austria in 2000. Respondents to this baseline survey were contacted two years later to assess changes in running patterns among other variables. A matched sample of over 500 was generated and adopters were defined as women who moved from irregular to regular running patterns; 13.4% of the final sample was classified as such. While this is not a direct, validated assessment of physical activity it does present an alternate method of monitoring changes in patterns and nature of engagement over time.

Dunton and Vaughan (2008) assessed affective consequences associated with adoption and maintenance of physical activity. A convenience sample of over 300 participants were recruited and participated in a 90-day intervention; physical activity was assessed using the IPAQ. Adopters were classified as participants who were insufficiently active at baseline but active at follow up; 48% adopted physical activity at follow up. Williams et al. (2008a) recruited sedentary participants (n = 205) to their trial and assessed changes in physical activity at six and twelve months. Participants, who became active, defined as engaging in 150 minutes of at least moderate intensity activity per week, between baseline and six or six and twelve months were classified as adopters. These contrasting cohort and intervention studies indicate that people do tend to commence being active over varying periods of time and that the likelihood of adoption increased following the introduction of an intervention.

5.1.9 Physical Activity Maintenance in Longitudinal Studies

In physical activity literature maintenance is referred to as an individual remaining sufficiently active over time or as a sustained intervention effect. With respect to the former classification, many of the studies cited in the previous assessment of adoption also described maintainers in their analyses. For example, Sallis et al. (1992) defined maintainers as participants who were active (at least three times a week) at both stages; approximately 60% fit this classification. Similarly Eaton et al. (1993) identified 12.2% of their sample as maintainers who were active at least three times a week at baseline and follow up. Boutelle et al. (2004) undertook a comparable classification of maintainers assessed at yearly intervals for four years. Titze et al. (2005) in their study of running had simple criteria for maintainers; being a regular runner at baseline and follow up (59.3%) while Dunton and Vaughan (2008) using IPAQ criteria identified maintainers as participants who were sufficiently active before and after a 90 day period. Of those who were sufficiently active at baseline, over two thirds were deemed maintainers; the remainder relapsed to insufficiently active. Williams et al. (2008a) classified maintainers as participants who became active, according to minimum physical activity guidelines, at six months and remained active at 12 months (65% satisfied this criteria).

5.1.10 Maintenance of Intervention Effects

Rather than assessing changes over time, the majority of physical activity behaviour change literature considers the maintenance of intervention effects. Marcus et al. (1998a) undertook a one, three and six month follow up of physical activity after a tailored print intervention. Self report physical activity increased substantially between baseline and three months but decreased at six months in the standard treatment group and increased only marginally in the tailored group. It is likely that the intervention effect would continue to decrease if additional follow up was carried out. Marcus et al. (1998b) undertook a similar study in a workplace setting focusing specifically on stage progression using the TTM. At three month follow up 13% of the overall group had regressed to a lower stage, decreasing their physical activity participation from 117 to 52 minutes per week. Miller et al. (2002) compared the effect of a print intervention with a print intervention with additional community based strategies and a control group in a group of women. Physical activity was assessed at baseline, two and five months and an initial intervention effect manifested by an increase in the proportion of women meeting minimum physical activity guidelines was not maintained at long term follow up.

Marshall et al. (2003a) following a print based intervention in Australia reported an initial increase in physical activity in the intervention and control group between baseline and two months but this decreased at six months. Although stage regression, according to the TTM, was not presented, approximate 50% progression rates at six months suggests relapse to lower stages of change. Marshall et al. (2004) replicated this study on a larger, more diverse sample. Minimal, insignificant increases in physical activity were apparent at two months in the intervention group and were maintained at eight months. Once more stage progression data were presented and a 40% progression rate indicates some regression or relapse. Similarly Napolitano et al. (2006) reported 30-55% progression rates in their comparison of two interventions to a control group between baseline and three months and three and twelve months. Self report physical activity did increase between these follow up periods but as per Marcus et al. (1998a) increases between three and twelve months were less notable. For example, the Jumpstart intervention group increased by approximately 90 minutes between baseline and three months and 10 minutes between the last two time points.

Marcus et al. (2007a) compared a print and telephone intervention and noted an increase between baseline and six months in both groups but a decrease in the telephone group between six and twelve months and a less notable increase in the print group. Lastly, Marcus et al. (2007b) compared a tailored and standard internet intervention and although initial increases in physical activity and proportion meeting physical activity guidelines were apparent, these decreased between six and twelve months. While these studies are assessed in greater depth in later chapters, they do indicate that some assessment of maintenance and relapse exists, albeit indirectly in physical activity research. This assessment is hindered by insufficient follow up, which varies between two and twelve months but does suggest that intervention effects are not always maintained over time and a number of study participants do relapse to lower levels of activity at follow up.

Indeed, in a review of physical activity interventions by Hillsdon, Foster and Thorogood (2005), it was noted that very few well designed studies had a longer than six month follow up, thus greater assessment of long term effectiveness was advocated. More recently, Müller-Riemenschneider et al. (2008) reviewed the long term effectiveness of interventions to promote physical activity, conceding, as noted earlier that maintenance is essential to maximise health gains. With long term follow up defined as at least 12 months, which would omit some of the articles discussed previously, the authors searched for randomised controlled trials on health adult populations and identified 25 articles from 5508 references to include in the review. Evidence of long term effectiveness up to 24 months was noted but this was primarily due to four high quality studies that prescribed exercise and used GP advice, counselling and print materials. Despite increases in physical activity, not all studies reported a substantial number of participants meeting minimum physical activity guidelines at follow up; this ranged from 4.6% to 81%. Pooled estimates also revealed that participants in intervention groups were over three times as likely to meet minimum physical activity targets. Furthermore, intervention effects commonly decreased over time, at different stages of follow up, suggesting a degree of relapse. Overall, the authors concluded maximum 24 month follow up permits a greater assessment of the sustainability of intervention effects.

5.1.11 Promotion of Maintenance

Evidently, researchers are concerned that many intervention effects are not sustained over time. The majority of studies in the review by Müller-Riemenschneider et al. (2008) used strategies such as repeat interventions, phone calls, group sessions and internet or print contact to boost maintenance. It was also advocated that environmental strategies should be implemented to prevent the noted decline in physical activity over time. High quality studies using these strategies increased maintenance but overall, findings were inconsistent. More recently, Keyserling et al. (2008) in their WISEWOMAN intervention administered a maintenance intervention to one group of women in their study. Participants (n = 236) were randomised to a minimal intervention group who received some mailings on diet and physical activity or an enhanced intervention group who received health counsellor visits, a number of phone calls, and participated in group sessions. After a six month assessment, a maintenance intervention was disseminated to this group. This incorporated a further counsellor visit, phone contact, mailings and community resource details and at 12 months resulted in marginally greater engagement in moderate and vigorous activity, assessed by accelerometers, by this group.

Another recent intervention – Keep Minnesota Active has also endeavoured to promote the maintenance of physical activity (Sherwood et al., 2008). Subsequently, the intervention was designed using relapse prevention strategies (using the TTM) and guidelines to promote maintenance while the need for different techniques needed to promote adoption and maintenance was also considered. It was a relatively low cost, minimal contact intervention; participants (n = 824), who were middle aged, were randomised to the treatment group and received a mail based physical activity programme delivered over a number of phone and group sessions. Discussions centred on overcoming barriers, generating motivation, enhancing self efficacy and social support and stimulating healthy eating. Participants in the control group (n = 225) received information about a 10,000 steps programme and some general physical activity information. Physical activity was assessed using self report and using an actigraph on a sub sample of participants. Results at six months, presented by Martinson et al. (2008), indicated that total energy expenditure decreased in both groups but less substantially in the intervention group. Furthermore, over half of this group maintained their engagement in moderate activity during this period compared to 36% of the control group. While this intervention did not instigate increases in physical activity, it did manage to maintain moderate participation in a number of participants, suggesting that efforts need to be focused on maintenance in people who are active as well as promotion among those deemed insufficiently active.

As noted earlier, population level intervention strategies based on ecological models of change may also be useful to promote greater long term maintenance. Sallis et al. (2006) reviewed the ecological model of behaviour change and concluded that while evidence exists to support the different elements of this model, research is required to provide direct guidelines on how to use this model to increase physical activity. Dishman et al. (2009) evaluated a 12-week social ecological based workplace intervention, which was administered to employees in eight workplaces who were randomly assigned to the treatment arm (n = 664) of the study. A similar number of worksites were allocated to the control group (n = 301) and completed a health appraisal and received newsletters related to physical activity. The intervention incorporated personal and team goal setting and organisational level action. During the last six weeks of the intervention, participation in vigorous and moderate intensity activity, measured by IPAQ, and the proportion meeting physical activity guidelines increased substantially more than the control group. Although a long term follow up was not undertaken, initial results were promising. These findings offer support for the use of ecological based interventions to promote maintenance of physical activity among intervention populations.

Other studies have assessed the change in physical activity in population samples over time, after exposure to large scale community based interventions. For example, Luepker et al.'s (1994) seven year follow up of the Minnesota Heart Health Programme, a multi level intervention, indicated that while energy expenditure on physical activity increased in the first three years of the programme, it decreased in later years, primarily due to decreased engagement in vigorous intensity activity. The intervention incorporated individual, group and community strategies, mass media, promoted environmental change, engaged community leaders and targeted schools and primary care facilities. Initial results were favourable but the dissipation of the intervention effect illustrates the need for booster strategies or fresh impetus at different intervals.

Using the aforementioned ecological approach, Maddock et al. (2006) reviewed the multi faceted, social-ecological based Healthy Hawaii initiative and reported a 7% decrease in individuals participating in no physical activity at four year follow up. Once again, this was an all encompassing intervention; developing community initiatives, generating new infrastructure, making the environment more amenable to activity and facilitating policy changes. At a school level, curriculum was modified and environmental and policy changes were supported. Finally a media campaign was delivered and further professional education with health workers was undertaken. Although, inactivity decreased, little effect was noted on obesity or cardiovascular risk factors, although this may take longer to be manifested.

Matsudo et al. (2006) undertook an evaluation of a similar physical activity promoting intervention, Agita Sao Paulo that operates at a personal, social and physical environmental level and incorporates two annual mega events; World Physical Activity Day and Active Community Day. Five years post baseline, there was a 7% increase in the proportion of people deemed active, derived using population self report surveys. It does appear that multi level interventions can induce change and once individuals become active, these and other efforts and strategies can be instigated to help them uphold this status and report maintained sufficient physical activity levels over time. Indeed, Tobias and Roberts (2001), in a modelling exercise on physical activity over the lifecycle in New Zealand reported that enabling active people to remain active, and thus preventing relapse, is 50% more effective than helping inactive people become active, as a health promotion strategy while acknowledging the need for both efforts. The greatest difficulty, it seems, is in sustaining an intervention effect over time among previously sedentary participants. More, substantial, multi level interventions are warranted to engage largely inactive communities and individuals and stimulate this initial long term behaviour change, which then must be maintained over a prolonged period.

5.1.12 Definitions of Relapse in a Physical Activity Context

As noted previously, drop out from physical activity can have many connotations depending on the definitions used to define relapse, attrition and associated states. This lack of consistency presents some difficulty in the assessment of relapse; this in conjunction with the limitations attached to self report data and use of volunteers in many studies. Despite this, literature on relapse is increasing, particularly on the identification of the predictors of relapse and subsequent strategies to prevent relapse and promote maintenance, which will be addressed in more detail later. For now, it is necessary to assess how relapse is defined in physical activity literature.

References to relapse in relation to physical activity thus far, in this review, have mainly incorporated the TTM and relapse from high to low stages of change (Marcus et al., 1998b) or a decrease in participation in physical activity (Luepker et al., 1994; Marcus et al., 1998a; Miller et al., 2002; Marshall et al., 2003a; 2004; Marcus et al., 2007a; 2007b). In the clinical studies reviewed earlier, relapse was also indirectly alluded to; Bock et al. (2003) referred to exercise attrition as exercising less at follow up than following programme completion. Izawa et al. (2004; 2005) and Moore et al. (2006) identified patients who stopped exercising after cardiac rehabilitation in the months following a cardiac event as a comparison group to maintainers.

Luszczynska and Sutton (2006) undertook a more direct assessment of relapse in their study comparing the role of self efficacy in maintainers and relapsers. Relapse in this sample of 130 patients who suffered an uncomplicated cardiac event were defined as participants who exercised three or more times a week at time 2 but exercised two or fewer times a week at time 3; 43% of the group were subsequently classified as relapsers. Time 1 was directly after the cardiac event, time 2 was eight weeks after the cardiac event and time 3 was eight months later and exercise was assessed using self report questions on frequency, duration and intensity.

In a less clinical context, Sallis et al. (1986) investigated relapse using data from the Stanford Community Health survey undertaken in 1980 and 1981. Moderate and vigorous physical activity was assessed as well as perceived change in physical activity between baseline and follow up. Participants were classified based on this self report data; those doing no activity at baseline or follow up were deemed sedentary, individuals who started some activity at follow up as adopters, who did vigorous or moderate at both time points as maintainers and finally as quitters if they did activity at baseline but not (no vigorous or less than two moderate activities) at follow up. Over half of participants who engaged in vigorous physical activity at baseline had quit at follow up, which suggests the need for some relapse prevention. In a later assessment of a community sample in San Diego, Sallis et al. (1990) categorised relapse as stopping exercise for three months after a period of continuous exercise.

Eaton et al. (1993) also cited 12% of their sample as quitters in their Pawtucket Heart Health Study; specifically as participants who decreased participation from three plus times a week to fewer than three times per week at follow up. Simkin and Gross (1994) investigated the relationship between coping with high risk situations and relapse among healthy women. Participants were 29 women who were members of health clubs and had been sedentary for the previous three months. Exercise lapses, alluded to earlier, were defined as a week of no activity in the 14 week assessment period while relapse was defined as three consecutive weeks of no exercise; this was monitored through sign in sheets at the fitness centres; 66% experienced a lapse while 41% had a full relapse. Sullum, Clark and King (2000) investigated factors associated with maintenance and relapse of physical activity in a group of college students. A group of 52 students were enrolled and followed up over three months to monitor their participation in physical activity. Relapsers (13% of the total sample) were defined as people who were exercising three or more times a week for at least 20 minutes at baseline but were not meeting this criterion at follow up.

In contrast, Berry, Naylor and Wharf-Higgins (2005) used a dichotomous question (yes/no) to assess relapse in their study of the stage of change model in relation to exercise in a group of adolescents. Participants who responded yes to this question did engage in significantly less vigorous physical activity than those who did not relapse. Levy and Cardinal (2006) also recruited college students to a nine week assessment of physical activity behaviour and related psychosocial variables. Using the TTM model, relapse was defined as moving from action or maintenance at baseline to precontemplation or contemplation at follow up; only 3% were deemed relapsers.

In another study, specifically on lapses, Conroy et al. (2007) assessed the relationship between psychosocial factors, such as self efficacy, and physical activity, and lapses of physical activity, which was measured using the Modifiable Activity Questionnaire. Lapses were defined as periods of greater than two weeks without physical activity. Participants were aged, on average 57 years, had an average BMI of 31, were categorised as insufficiently active at baseline and were in the early stages of post-menopause. Over 60% of the women experienced lapses and 39% of this group did not resume physical activity after this lapse.

Barnett et al. (2008) assessed data from three surveys carried out between 1981 and 2004. Leisure time physical activity was monitored among the sample of adults aged 18-60 years and 7% were identified as decreasers; starting above the normal daily energy expenditure levels (computed from physical activity data) but finishing below this threshold. Williams et al. (2008a) recruited sedentary adults to a randomized controlled trial designed to increase physical activity. Participants were followed up at six and twelve months, data were collected using 7-day PAR. Active was defined as participating in at least 150 minutes of at least moderate intensity physical activity per week or at least 60 minutes of vigorous intensity physical activity per week. Over one third of participants who were classified as active at six months and who had reverted to inactive at follow up twelve months later were identified as relapsers.

Dunton and Vaughan (2008), who used IPAQ classifications on their sample of over 300 healthy adults, defined relapse as moving from sufficient to insufficiently active; 31% of those active at baseline relapsed at follow up. Finally, Brown et al (2009) recruited 40,000 women to a longitudinal study on women's health monitoring changes in physical activity according to self report questionnaires administered every three years to a young, middle age and older cohort. Women were classified as ‘none’, ‘low’ or ‘active’ according to their energy expenditure at each data collection point. Participants categorised as decreasers moved from active to low or none between time 1 and time 2.

These definitions of relapse indicate the inconsistency that exists in measuring and discussing this concept. All of the assessments presented typically involved tracking physical activity patterns over time unlike the discussion on adoption and maintenance, which incorporated the initiation and sustained engagement in physical activity following the introduction of some intervention. Specific strategies are needed in these contexts and likewise, relapse prevention strategies are warranted to prevent the inevitable decrease in participation that occurs over time in some individuals. To correctly design and administer these plans, an understanding of the predictors of adoption, maintenance and relapse is required.

5.1.13 Predictors of Adoption, Maintenance and Relapse

Hunt, Barnett and Branch’s seminal paper (1971) on relapse included one of the first references to the importance of identifying the predictors of maintenance and relapse. The authors stated that it was necessary to identify the characteristics of individuals who relapsed and then use this information in subsequent analyses and interventions to promote maintenance. Subsequently, many authors including Sallis et al. (1986; 1992), Dunn (1996) and Laitakari et al. (1996) have observed that few studies have focused on what dictates the initiation of a new behaviour, which is equally important to studying the predictors of maintenance. As noted earlier, inherent in the discussion and central to the promotion of adoption and maintenance is relapse and the determinants of this particular phenomenon. The following section will attempt to address various potential predictors of these three concepts.

5.1.13.1 Personal characteristics as predictors.

Sallis et al. (1986) assessed the predictors of adoption and maintenance over a 1-year period in a community sample. A greater proportion of males adopted vigorous activity than women while the reverse was apparent for moderate intensity activity. Furthermore, the adoption of vigorous activity only declined with age. Similarly, Sallis et al. (1992) noted that adoption was more likely among younger participants. Also, previous participation in physical activity was a predictor of initiation as was education, but only among female participants. Using a comparable longitudinal design, Eaton et al. (1993), found that male and female adopters had greater education and more success with previous physical activity programmes than their sedentary counterparts. Smoking was also a significant predictor of adoption among males. Boutelle et al. (2004) cited greater education, a higher income and lower BMI as predictors of exercise initiation in their four year observational study. In a recent study by Barnett et al. (2008), males were much more likely to increase their physical activity levels above recommended levels than females, somewhat akin to results reported by Sallis et al. in 1986. This analysis suggests that males are more likely to adopt physical activity than females and that previous participation in physical activity are important predictors of increased activity levels.

Sallis et al. (1986) found that in comparison to adoption, age was not related to maintenance, nor to quitting but men were marginally more likely to maintain activity than women; this latter finding was re-affirmed in 2008 by Barnett and his co-authors in an assessment of longitudinal data in Canada. It was also observed, by Sallis et al. (1986) that education was a strong predictor of maintenance of moderate activity. In contrast, Sallis et al. (1992) observed that age was inversely related to maintenance while education only appeared as a predictor among females. Meanwhile, Eaton et al. (1993) found that education was a predictor of maintenance among males in their study. Previous success with exercise also predicted maintenance in this cohort. In a review of adherence studies, Martin et al. (2000b) noted that previous participation in physical activity was associated with maintenance, specifically of an intervention effect, similar to the longitudinal studies cited above. Luszczynska and Sutton (2006) also stated that a more active lifestyle, in this case prior to a cardiac event, was related to greater maintenance following cardiac rehabilitation.

Boutelle et al. (2004) investigated the role of BMI in exercise maintenance and found that maintainers had lower BMI's than non maintainers. Higher activity levels at baseline and higher levels of education were also related to physical activity maintenance at all follow up points. This was also apparent in findings presented by Barnett et al (2008); lower education was associated with lower odds of being consistently active. It is apparent in this analysis that as well as being more likely to adopt exercise, males are more likely to maintain being active. Indeed, overall predictors of adoption and maintenance in this paradigm of predictors are quite similar.

Inherent in the previous discussion of maintenance is a comparison to non maintainers. As noted earlier, though these non maintainers cannot always be assumed to be relapsers. Sallis et al. (1990) in their investigation of relapse in a community sample reported that females and older adults were more likely to relapse than males and their younger counterparts. Marcus et al. (2000) assessed factors associated with physical activity behaviour change and maintenance and noted that many early studies on adherence to exercise did not interpret drop out data and thus state whether drop out was related to complete cessation of exercise or some degree of lapse or relapse. More recent studies have endeavoured to investigate why some people remain active and why others become less active over time although much inconsistency in quantifying relapse and assessing predictors is apparent. Specific studies on the predictors of relapse are somewhat rare. Titze et al. (2005) in a study specifically on regression among runners found that a negative perception of health was related to decreased running. BMI was also assessed by Conroy et al. (2007) and it was noted that physical activity lapses were common among women with higher BMI scores. It was also reported that being regularly active protected against full relapse.

5.1.13.2 Motivational readiness as a predictor.

Martin et al. (2000b) noted that the most commonly assessed predictors of adherence were individual and treatment related factors. The authors called for increased consideration of social cognitive variables and psychosocial factors as indicators of behaviour change. As noted earlier, many theories and models, which incorporate these variables, exist to explain behaviour change. According to the TTM, level of motivational readiness prior to an intervention may promote adoption and maintenance. In accordance with this, many interventions are tailored to levels of motivational readiness. Dunn (1996) noted this was an innovation in the pursuit of evidence based efforts to promote adoption of physical activity and recommended that all interventions should take heed of this approach.

Subsequently, Marcus et al. (1998a; 1998b) designed tailored print materials for their intervention groups and noted greater increases in physical activity and stage progression at six and three months follow up than the control group; suggesting that motivational readiness and incorporating this in intervention design, could be an important predictor of the initial adoption and maintenance of physical activity. Marshall et al. (2003a) reported short term increases in physical activity using tailored materials but failed to replicate this finding in a larger sample (Marshall et al., 2004). Napolitano et al. (2006) reported less stage progression and increases in physical activity in their control group compared to those who received tailored materials.

Finally, Marcus et al. (2007a; 2007b) reported increases in activity in a tailored print and internet group up to six months, which was maintained to 12 months in the print group only. Despite these positive associations between tailoring to motivational readiness and adoption, it was noted in an earlier discussion on the maintenance of intervention effects that many of these increases are not maintained long term, rather are likely to dissipate after six to twelve months. Although, Marcus et al. (2007a; 2007b) noted that exercise attrition was greatest in participants who have the lowest levels of motivation to change and previously observed (Marcus et al., 1998b) that participants who received a standard intervention were more likely to regress, these are inconsistent findings. Overall, it seems that motivational readiness to change, while facilitating adoption is not a definite predictor of maintenance and insufficient data are presented to identify if it is a determinant of relapse.

5.1.13.3 Processes of change as a predictor

The TTM model also incorporates processes of change, which can vary in their use and importance across different stages of the model; from precontemplation to maintenance. Marcus et al. (1992a) recruited over 1,000 employees from two worksites to complete questionnaires on exercise behaviours. Participants were classified into individual stages and processes of change in each were assessed. Processes of change, particularly behavioural processes, were used considerably more in action and maintenance than in other stages but little difference between these two were apparent suggesting that these may be equally important factors in the adoption and maintenance of physical activity. This was a cross sectional study so it is difficult to ascertain the effect of these behavioural and cognitive factors over time. Bock et al. (2001) following the delivery of a print intervention noted that participants, in the overall group, who did not meet minimum physical activity guidelines at six months but managed to do so at twelve months (adoption) displayed a high use of behavioural processes of change.

Titze et al. (2005) observed running patterns in women over a two year period. In a similar finding to Bock et al. (2001) participants who reported frequent use of behavioural processes of change were four times more likely to adopt regular running. Levy and Cardinal (2006) also noted that use of behavioural processes increased significantly in the physical activity adopters group. Furthermore, Williams et al. (2008a) reported that behavioural processes were significantly higher among physical activity adopters at six months compared to participants who remained inactive. It is apparent that techniques to facilitate behavioural processes of change should be promoted among participants attempting to increase their physical activity levels. Traditionally, experiential processes of change had been emphasised at these early stages (Prochaska & Marcus, 1994), although more recently, Titze et al. (2005) stated that the role of these experiential processes of change was unclear in relation to the adoption of physical activity.

Upon consideration of maintenance, Plotnikoff et al. (2001) in one of the first rigorous longitudinal assessments of the TTM model and its associated constructs, found that experiential and behavioural processes were higher among action/maintainers than participants who regressed. Bock et al. (2001) also stated that the use of these processes was high among stable active participants in their cohort. Levy and Cardinal (2006) reported a similar finding for behavioural processes among maintainers in their study. In contrast, Williams et al. (2008a) observed no association between processes of change and physical activity maintenance. Finally, similar to Bock et al (2001), Levy and Cardinal (2006) observed significantly greater use of experiential techniques among maintainers in their study compared to sedentary, adopting and relapsing participants, suggesting that they may have an important role to play in the maintenance of behaviour change.

Sullum et al. (2000) categorised 13% of participants in their study on college students as relapsers and the remainder as maintainers. Analysis of processes of change measured using a 40-item questionnaire indicated that there was no difference in these factors between relapsers and maintainers. In comparison, Bock et al. (2001) and Titze et al. (2005) reported that regressers in their study reported a lower use of behavioural processes of change. Also, Levy and Cardinal (2006) reported lower, but not significantly lower, use of behavioural processes among relapsers. Conroy et al. (2007) investigated lapses in activity that can lead to relapse and found that use of behavioural processes of change are protective against full relapse to low levels of physical activity. The different analysis undertaken in various studies creates difficulty in critiquing results but overall it appears that processes of change are important in the promotion of physical activity and prevention of relapse and should be considered in efforts to facilitate adoption and maintenance.

5.1.13.4 Decisional balance as a predictor.

Marcus, Rakowski and Rossi (1992b) also assessed the applicability of decisional balance to exercise adoption. A list of 40 statements, assessing the pros and cons of being active were presented to participants and it was discovered that pros were most important in the maintenance stage of behaviour change. Similarly, Plotnikoff et al. (2001) observed higher pro scores in participants in the action/maintenance stage than those participants who relapsed. Maintainers in Levy and Cardinal's (2006) study reported higher pro scores than those who had relapsed suggesting pros are related to maintenance. No relationship between adoption and decisional balance was discovered, despite remarks by the authors that exercise adoption should be accompanied by an increase in pros and concurrent decrease in cons. Plotnikoff et al. (2001) did observe that maintainers in their study had significantly lower con scores than participants in earliest stages of the TTM. Williams et al. (2008a) also found that decisional balance was a significant predictor of maintenance of physical activity; higher scores (higher pros) were related to greater maintenance.

As noted earlier, Marcus et al. (1992b) reported that pros were important in the maintenance stage of behaviour change. Subsequently it may be deduced that higher pro scores could prevent relapse. Sullum et al. (2000) hypothesised that relapsers in their study would have lower pro scores but this was not realised. It was however noted that relapsers had significantly higher con scores than maintainers, suggesting that these may be a predictor of relapse. Similarly, Berry et al. (2005) found that relapsers reported higher con scores than adolescents who remained active. In support of Marcus et al. (1992b), Levy and Cardinal (2006) did observe a significant decrease in pro scores among relapsers while Potnikoff et al. (2001) noted that regressors had significantly lower pro scores than participants in the maintenance stage of behaviour change.

5.1.13.5 Outcome expectancies as a predictor.

Speck and Harrell (2003) discussed the role of outcome expectancies (individuals' perceptions about the outcomes of being active) in physical activity maintenance in women and conceded that this construct is rarely assessed and consequently little conclusive findings exist in its role in maintenance. In the interim, Williams et al. (2008a) assessed outcome expectancies and stated that this construct was associated with adoption and also a predictor of maintenance. In a qualitative study, Lee, Avis and Artur (2007b) interviewed older participants who took part in a programme to increase walking. Results indicated that uptake (adoption) of walking was associated with improvements in health and well being observed in other individuals who had commenced being active; which could be viewed as positive outcome expectancies. Eaton et al. (1993) observed that positive beliefs about being active also predicted maintenance in their cohort. Furthermore, Lee et al.'s (2007b) qualitative study also found that positive feelings associated with being active were indicative of maintenance in their group of elderly participants.

Dunton and Vaughan (2008) investigated the ability of anticipated affective consequences, which are an emotive expression of outcome expectancy, to predict behaviour. Results indicated that positive affective consequences predicted physical activity adoption and maintenance in participants who were insufficiently active at baseline. Furthermore, among participants who were active at baseline, positive feelings about being active increased the probability of maintaining this active status rather than relapsing. Speck and Harrell (2003) also noted that outcome expectancy was related to self efficacy; if an individual has high self efficacy then it is likely they will expect positive outcomes. Indeed, the most commonly investigated predictor of maintenance and relapse is self efficacy.

5.1.13.6 Self efficacy as a predictor.

In one of the earliest examinations of the predictors of adoption and maintenance, Sallis et al. (1986) investigated self efficacy using four questions relating to an individuals' confidence in their ability to be active. Moderate and vigorous activity was measured to investigate if different predictors were apparent for different intensities of activity. Adoption of both activity types of was predicted by self efficacy while maintenance of vigorous activity, compared to quitting, was predicted by self efficacy in females only. For moderate activity, self efficacy was a consistent predictor in both sexes. Sallis et al. (1992) replicated this study on a larger sample in San Diego who were followed up two years post baseline. Adoption and maintenance was predicted by self efficacy in men and women.

Unsurprisingly, in a review of adoption studies by Dunn (1996) it was advocated that interventions incorporate strategies to promote self efficacy to successfully initiate changes in physical activity. Subsequently, following a similarly designed intervention, by Bock et al. (2001), self efficacy was considerably higher among adopters and maintainers than sedentary participants and appeared a strong predictor of these states.

In contrast, Williams et al. (2008a) concluded that self efficacy was not predictive of adoption; only indicative of maintenance of behaviour change in this instance. In a previously referred to qualitative assessment of adoption and maintenance, Lee and Harrell (2007) found that low self efficacy, manifested as practical complications associated with being active for older people, prevented the adoption and maintenance of physical activity.

In more specific assessments of maintenance, Martin et al. (2000b) noted that adherers have higher self efficacy levels than non adherers. Also, McAuley et al. (2003) investigated the long term maintenance of physical activity in a group of 150 sedentary older adults. An intervention was administered that aimed to generate social support to promote self efficacy, which would serve to increase adherence to exercise. Physical activity was assessed at six and 18 month follow-up using a self report instrument and it was determined that participants who exercised more frequently had higher levels of social support, which enhanced self efficacy and promote maintenance. While self efficacy was an important predictor of maintenance, the most significant predictor of being active at 18 months was being active at six months.

Armitage (2005) recruited 94 participants from a gym in England and assessed physical activity, behavioural intention and behavioural control, according to the theory of planned behaviour at baseline and three months. The authors noted that behavioural control, strongly related to self efficacy and indeed where the construct was adapted from, was strongly related to maintenance of behaviour change. Furthermore, similar to McAuley et al. (2003) initial maintenance of behaviour, up to five weeks in this instance, was related to long term maintenance. Lastly, Levy and Cardinal (2006) reported higher self efficacy among maintainers in their cohort; higher even than adopters.

Sullum et al. (2000) in their study of college students found that relapsers had significantly lower self efficacy than maintainers at baseline and thus was deemed a predictor of relapse in this population. Plotnikoff et al. (2001) also observed that regressors had lower self efficacy levels than maintainers. Similarly, Berry et al. (2005) reported that adolescents who relapsed in their study had lower levels of self efficacy than individuals who remained active while Levy and Cardinal (2006) also noted lower self efficacy levels among relapsers compared to maintainers. Conroy et al. (2007) studied the relationship between psychosocial factors, such as self efficacy, and physical activity, and lapses of physical activity. Women who reported lapses had significantly lower self efficacy than women who were regularly active and did not experience any lapses in this behaviour.

In a more detailed analysis of self efficacy, Luszczynska and Sutton (2006) assessed maintainers and relapsers following cardiac rehabilitation. As noted previously, self efficacy is typically lower among relapsers suggesting that it is higher among maintainers. Consequently, two measures of self efficacy were undertaken; maintenance to assess one's beliefs in their abilities to maintain activity and recovery to ascertain an individuals' confidence in their ability to resume activity following a relapse. Results indicated that maintenance self efficacy does predict sustained physical activity while recovery self efficacy was related to performance of some activity among relapsers. Individuals who had high recovery self efficacy were much more likely to engage in exercise post relapse than those with low recovery self efficacy.

In a similar, two fold assessment of self efficacy; Schwarzer et al. (2007) used the HAPA model to investigate the adoption and maintenance of four health behaviours, including physical activity. A sample of 365 German internet users were assessed twice in a five week period on physical activity, motivational and recovery self efficacy, the latter similar to the previous study. Motivational self efficacy incorporated developing motivation to become and be active, somewhat different to maintenance self efficacy. Results indicated that recovery and motivational self efficacy were highly related and recovery self efficacy did predict physical activity adoption and maintenance and motivational self efficacy did significantly predict intention to change behaviour.

5.1.13.7 Social support as a predictor.

Sallis et al. (1992) stated that three different expressions of social support predicted adoption of vigorous physical activity among women suggesting this is an important factor for initial physical activity promotion among females. No relationship was apparent for maintenance of behaviour change in either sex. In contrast, Eaton et al. (1993) noted that manifestations of social support in their study were related to maintenance of physical activity, but similar to Sallis's findings, these were only apparent among female participants. Titze et al. (2005) in a female sample observed that regression from regular running corresponded with decreases in social support.

Luszczynska and Sutton (2006), in an assessment of physical activity following cardiac rehabilitation did observe higher levels of social support among all maintainers, irrespective of gender; this perhaps due to the clinical context of this study.

Furthermore, relapsers were more likely to report less support from family and a friend, suggesting that social support is also related to relapse. In contrast, Boutelle et al. (2004) in a four year cross sectional study of approximately 1,000 participants also investigated differences in social support between maintainers and non maintainers of physical activity and did not identify any predictive qualities for this construct. Similarly, Titze et al. (2005) and Williams et al. (2008a) did not report any relationship between social support and physical activity adoption or maintenance.

5.1.13.8 Other factors as predictors.

In the previously cited study by Sallis et al. (1986), attitudes to physical activity were the only common predictor of maintenance of vigorous activity in both sexes. In the same study health knowledge and exercise knowledge were predictive of moderate intensity activity (Sallis et al., 1986). Eaton et al. (1993) also assessed knowledge and health beliefs and noted they were predictive of the adoption and maintenance of activity among male participants. As well as attitudes and knowledge, enjoyment has also been frequently assessed as a predictor of exercise adoption and maintenance. Titze et al. (2005) noted that women who enjoyed running were eight times more likely to take up regular running than women who did not enjoy it when they reported low levels of family support. Enjoyment was also assessed by Williams et al. (2008a) and levels noted at six months were predictive of maintenance at twelve months.

Minimal research exists on potential predictors of relapse and maintenance in the physical environment and beyond, as per a social-ecological model of behaviour change. Sallis et al. (1992) did note that convenience of facilities was a predictor of maintenance among males in their study. In contrast and somewhat unexpectedly, Titze et al. (2005) did not find any relationship between the physical environment and adoption of regular running among women. The authors noted that this may be due to the fact that women who increased their running did participate previously and may have had some pre-established routes. Findings did indicate, however, that regression from regular running was associated with negative perceptions about neighbourhood attractiveness. Williams et al. (2008a) investigated access to physical activity in the home and neighbourhood but did not find that they were predictors of maintenance at twelve months. These conflicting findings indicate that more research is needed in this area, particularly considering the increased adoption of ecological models of behaviour change, which incorporate change in the physical environment to support increased physical activity.

Indeed, intervention design is also central to the successful adoption and maintenance of a particular programme. Dunn (1996) noted that community level interventions that incorporate environmental and policy approaches, as per the aforementioned ecological model, could promote physical activity adoption. Previous discussion on such interventions indicated that this approach does induce behaviour change but subsequent efforts are required to maintain these favourable outcomes. Recent endeavours by Martinson et al. (2008) provided support for interventions that focus on physical activity maintenance and relapse prevention. The concepts of targeting and tailoring have also been used in intervention design and appear to stimulate more favourable changes in physical activity than the dissemination of generic, standard information; these will be addressed in greater detail in the next chapter.

5.1.14 Summary

Long term maintenance of physical activity has attracted much attention in public health; it is important that sustained adherence to physical activity on a regular basis is achieved to avail of the health benefits of being active. Many interventions are designed and administered to facilitate sustained adherence to regular physical activity, particularly among previously sedentary, high priority cohorts. Quite often, intervention effects are not sustained long term. Consequently, the predictors of maintenance must be investigated.

The first challenge inherent in this is that not all physical activity literature has examined maintenance up to or beyond six months and less assessed the associated concept of relapse following a period of maintenance. The most consistently researched predictor of maintenance and relapse is self efficacy and it appears that attempting to increase self efficacy in an intervention may promote sustained behaviour change. Targeting and tailoring messages to motivational readiness to change, to specific sub groups of the population is another worthwhile endeavour. Support for more community, environmental and policy changes has grown and specific efforts to facilitate maintenance and prevent relapse are also required to solidify and boost initial improvements.

The second challenge in the promotion of maintenance is the ambiguity that exists in relation to its important associated concept of relapse. Relapse prevention is essential, not only in efforts to sustain improvements in physical activity among previously sedentary participants but also in endeavours to keep active people active. As noted earlier, relapse has been poorly and inconsistently examined in the physical activity paradigm. It has been allocated various, contrasting definitions; those used by Sullum et al. (2000), Williams et al. (2008a) and Dunton and Vaughan (2008) appear to be the most pragmatic and practical. These authors all used a relapse criterion of meeting minimum physical activity guidelines at baseline but not at follow up. Indeed, it is this classification of relapse that will be modified to include in this study of relapse following participation in a mass event; the Women's Mini Marathon in 2007 and 2008.

Previous chapters incorporated an assessment of the physical activity levels of participants in a mass event at baseline and follow up in three separate events; 2007 and 2008 in Dublin and 2008 in Cork. Initial follow up following the events were undertaken two to three months post event and hitherto will be referred to as short term follow up. A further assessment was undertaken approximately six months following the Mini Marathon in 2007 and this will be termed long term follow up. Behaviour change at these various time points was re-assessed in this chapter to identify relapsers and the predictors of this state. This will permit the design and operation of interventions and strategies to sustain regular engagement in physical activity following the initial short term improvement displayed upon involvement in the 10km events.

5.2 Methods

5.2.1 Study Population and Design

Data from participants in the Dublin and Cork Women's Mini Marathon who responded at baseline and short and long term follow up (in 2007) were matched, as detailed in the previous chapter. Details of questionnaires used were presented in chapter 3 and 4.

5.2.2 Relapse

5.2.2.1 Definition A – relapse as per definition A was defined using two criteria;

1. Physical activity relapse was defined as a decrease in reported physical activity by at least 240 MET-minutes/wk (60 minutes of at least moderate intensity activity). Bauman et al (2001) estimated that a change of this magnitude in self

reported physical activity is likely to be greater than the measurement error that is apparent in repeated measures, and therefore likely to be a real decline.

2. Some individuals, despite a decrease of physical activity minutes, may still exceed minimum physical activity requirements. Therefore relapse was additionally defined as being categorised as 'low' active at follow up, using IPAQ data; and therefore moving from sufficient to insufficient physical activity levels.

5.2.2.2 Definition B – definition B incorporated the following criteria;

1. Relapse was defined as a decrease in reported physical activity by at least 480 MET-minutes/wk (120 minutes of at least moderate intensity activity). This was a considerably more significant amount of behavioural relapse.
2. Relapse by 480 MET-minutes/wk was combined with relapse to 'low' active to give a more comprehensive portrayal of relapsers in this cohort.

5.2.2.3 Definition C – a further definition of relapse was defined;

1. Relapse by level of motivational readiness to change was also computed. Individuals who were sufficiently active at baseline but regressed to insufficiently active at follow up, based on readiness to change, were identified as relapsers. All other participants were categorised as non relapsers. Further detail is available in *Appendix C, Table 1*.

Definition A was used primarily in the identification and analysis of relapsers throughout the following results and discussion sections. *Definition B and C* results are presented in *Appendix C*[5].

5.2.3 Procedures

Data were matched using answers to specific identifier questions, which was provided at each time point. Various classifications of relapse were determined using literature and participants fulfilling these criteria were identified. These data were subsequently analysed to determine predictors of relapse. In 2007, it was proposed to assess relapse two and six months post participation in the Women's Mini Marathon. Analysis revealed that many participants who relapsed at six months had already

[5] Some tables were moved to the *Appendices* to reduce the content in the main chapters

reversed to insufficient levels of physical activity at two months. Consequently, relapse analysis was only undertaken at short term follow up (three months) in 2008.

5.2.4 Measures

Physical activity, self reported BMI, self efficacy data as well as demographic and participation characteristics were collected using measures outlined in chapter 3, page 65-66. Cronbach alpha coefficients for self efficacy were .62 (2007), .74 (2008) and .89 respectively for the Dublin and Cork events. Cronbach's alpha represents an assessment of the internal consistency of these measures, no test-retest analysis was conducted. Additional measures collected at follow up in 2008 only included:

5.2.4.1 Perceptions of physical environment

Environmental perceptions were assessed to measure an individual's beliefs about their surrounding environment, specifically the presence of space to be active in their locality. The measure used was adapted from one developed by Sallis et al. (1997). A reliability analysis of the two items in this construct revealed cronbach alpha coefficients of .53 and .47 for the Dublin and Cork events.

5.2.4.2 Social support

Social support was assessed using a modified version of the social support for exercise scale (Sallis et al., 1987). Respondents were asked how often their family or friends had provided support for their participation in physical activity (two items), with higher scores representing lower levels of social support. An overall score was then calculated by summing responses to three different variables, and subsequent cronbach alpha coefficients were .62 (Dublin) and .63 (Cork).

Descriptive analysis of these constructs at short term follow up is presented in *Appendix B.*

5.2.5 Data Analysis

Matched data were used to identify relapsers according to the criteria defined earlier. Sedentary behaviour groups were created for both 2008 data sets; total minutes reported for sitting time and TV viewing, at follow up, was split into two categories using median values. Descriptive analysis presented a basic overview of the numbers of relapsers in each classification and cross tabulation and chi square allowed an initial assessment of the predictors of these relapse states. Lastly, logistic regression permitted an investigation of these predictors of relapse. Binary regression was used with relapse/non relapse (using the different criteria defined above) as the outcome variable. Predictor variables were tested in the logistic models. Adjusted odds ratios were used in the presentation and analysis of results; adjusted for age, marital status, children, level of education, and previous participation and mode of participation in the event. Odds ratios less than one were associated with a decreased risk of relapse, while those greater than one were related to an increased risk of relapse. Probability values and confidence intervals for each adjusted odds ratio were assessed to determine significance. Finally, for self efficacy where higher scores represent lower expressions of this construct, inverse coding was taken into account in subsequent odds ratio analysis.

5.2.6 Research Questions

1. What was the prevalence of relapse to lower physical activity levels at short and long term follow up?
2. What were the predictors of relapse in these participants?
3. What were the physical activity levels and sedentary behaviours of relapsers at short and long term follow up?

5.3 Results

Research Question 1: What was the prevalence of relapse to lower physical activity levels at short and long term follow up?

5.3.1 Rates of Relapse

Participants fulfilling different criteria of relapse at short term follow up are displayed in *Table 38*. The number of people in each condition is specified as well as the corresponding percentage relative to the total matched population of their respective cohort. It is apparent that large proportions of participants decreased their total frequency and duration of engagement in physical activity per week but did not regress to an extent that they became insufficiently (low) active, as per IPAQ categories. For example, over one third of participants in each matched sample decreased their participation by up to two hours of at least moderate intensity activity per week. Despite this, a lower proportion of 12% overall could be deemed true relapsers; relapsing by at least one hour of at least moderate intensity activity and moving from high or moderately active to low active. Furthermore, it is notable that many of the participants who relapsed by at least one hour also decreased participation by two hours, suggesting that one hour is a credible criterion for relapse. In 2008, approximately 19% of the sample relapsed from high to low stages of change (for more detail see *Appendix C, Table 1*).

Table 38

Relapse Rates at Short Term Follow Up

	Dublin 2007		Dublin 2008		Cork 2008	
Total Matched Group	n=3,803		n=3,505		n=348	
	n	%	n	%	n	%
Relapse by at least 240 MET-minutes/wk	1,482	38.9	1,515	45.2	150	44
Relapse by at least 480 MET-minutes/wk	1,301	34.2	1,317	39.3	132	38.7
Relapse to 'low' active	478	12.6	410	12.2	60	17.6
Relapse by at least 240 MET-minutes/wk and moved to 'low' active category	434	11.4	369	11	49	14.4
Relapse by at least 480 MET-minutes/wk and moved to 'low' active category	410	10.7	348	10.1	46	13.5
Relapse by motivational stage	-	-	541	18.9	57	19.3

As expected, relapsers displayed considerably decreased time spent in the various types of physical activity at follow up (*Appendix C, Figure 1-2*). The greatest changes were apparent in vigorous activity and walking. In Dublin, in 2007, there was an approximate 80% decrease in vigorous activity and 60% decrease in walking in relapsers who decreased by 240/480 MET-minutes/wk and by IPAQ category. In contrast, there was a 26% overall increase in time spent being active by non relapsers. In the 2008 Dublin event, there was a lower change in vigorous activity (65% decrease) and higher change in walking (55% decrease) among the same relapse categories. The change in moderate activity was substantially higher in Dublin, in 2008 possibly due to the higher baseline levels of moderate activity in this event. *Figure 11* below illustrates the change in physical activity in the Cork event; changes were similar to the 2007 Dublin event apart from a less notable decrease in vigorous physical activity.

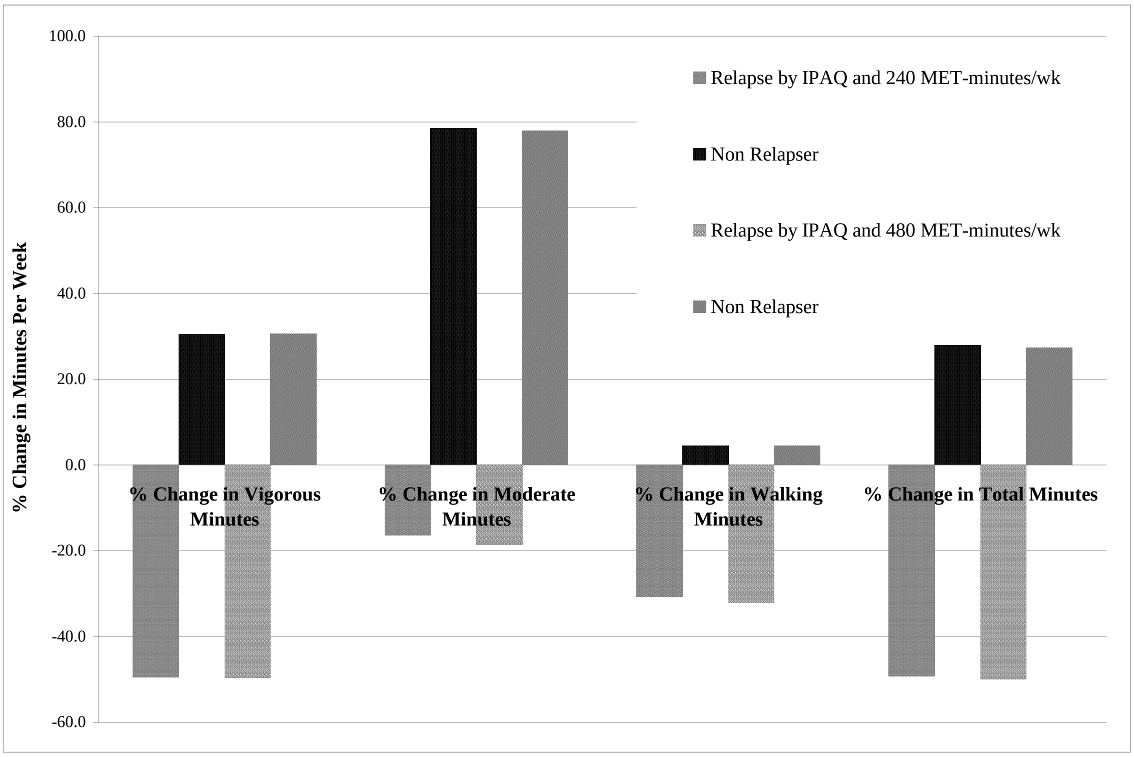


Figure 11

Change in participation in physical activity between relapsers and non relapsers at short term follow up (n = 348: Cork 2008)

In 2007, a follow up at six months necessitated a further assessment of relapse. In this instance the primary outcome variable was relapse at six months. Consequently, relapse (as per Definition A) between two and six months was first identified (n = 338). Secondly, relapse, using these same criteria, was defined between baseline and six months (n = 108). A number of participants fulfilled both of these definitions of relapse (n = 32), thus they were removed from one of the categories prior to the final identification of relapsers (n = 414).

Table 39

Relapse Rates at Long Term Follow Up

	Dublin 2007	
Total Matched Group	n=2,020	
	n	%
Relapse by at least 240 MET-minutes/wk two to six months	674	33.4
Relapse to low active at six months	357	17.7
Relapse by at least 240 MET-minutes/wk from two to six months, and to low active at six months	338	16.7
Relapse by at least 240 MET-minutes/wk and to low active between baseline and six months	108	53.5
Relapse by at least 240 MET-minutes/wk and to low active between baseline and six months, and two and six months (included in n = 338)	-32	15.8
Overall relapsers at six months	414	20.5

In *Figure 12*, relapsers are defined as per Definition A (relapse by at 240 MET-minutes/wk and to low active). Analysis of the change in physical activity at two and six months post baseline in 2007 revealed similar decreases in vigorous and moderate intensity activity and walking to both 2008 events. It appears that if participants lower their physical activity levels post event, it is likely to happen within two/three months.

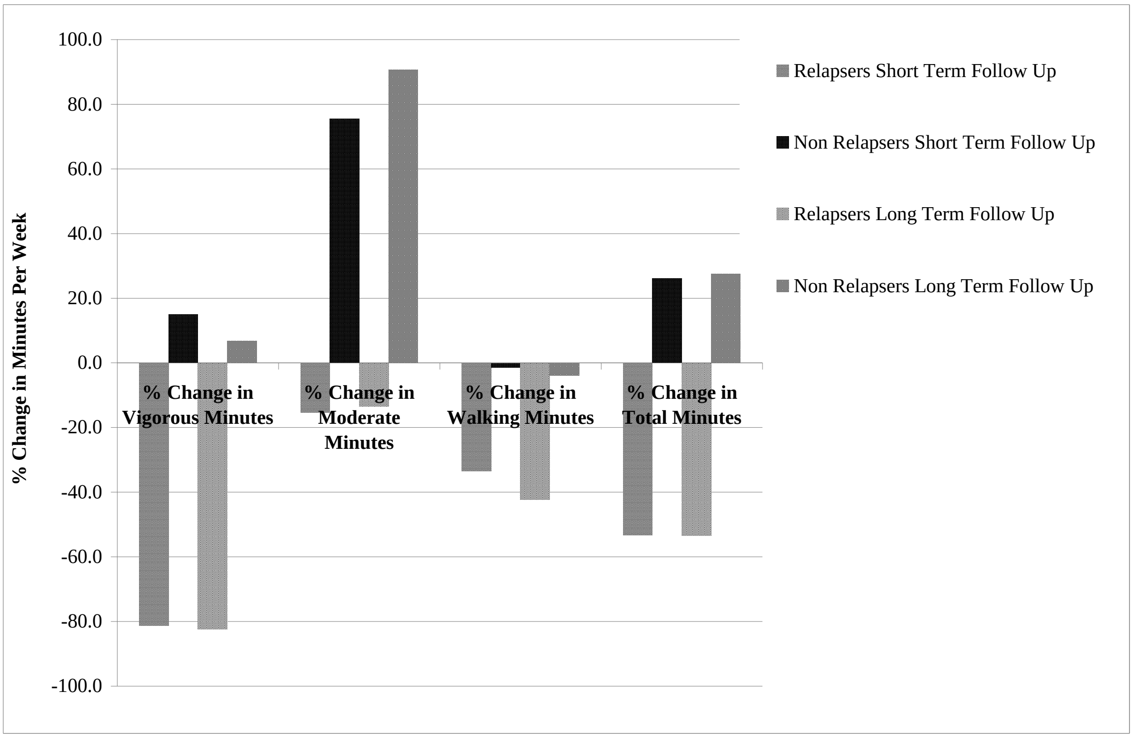


Figure 12

Change in participation in physical activity between relapsers and non relapsers at short and long term follow up 2007 (n = 2,020: Dublin 2007)

Research Question 2: What were the predictors of relapse in these participants?

5.3.2 Predictors of Relapse

In the tables below and in *Appendix C*, predictors of the different definitions of relapse are illustrated. In *Table 2-4* in *Appendix C*, significant but not altogether strong relationships between correlates used in the relapse analysis variables are evident.

5.3.2.1 Short term follow up: Dublin 2007.

Walkers had an increased risk of relapse across all categories of relapse while living in a city was associated with a decreased risk of relapse in all but one instance. No tertiary education and being aged less than 40 were related to relapse definitions that included relapse to low active. Participation in an event since the Mini Marathon was consistently associated with a lower risk of relapse (*Table 40, Appendix C, Table 5-8*).

Table 40

Predictors of Relapse (Decrease by at least 240 MET-minutes/wk and to low active) at Short Term Follow Up 2007 (n = 434: Dublin 2007)

		Relapser n=434 (%)	Non Relapser n=3,248 (%)	Adjusted OR (95% CI)
Age	Aged > 40	31.6	37.3	1.00
	Aged < 40	68.4	62.7*	1.6 (1.24-2.08)^
Children	Children	49.4	46.9	1.00
	No Children	50.6	53.1	.77 (.59-1.01)
Education	Tertiary	65.1	70.6	1.00
	No Tertiary	34.9	29.4*	1.14 (.82-1.58)
Medical Card	No	84.3	86.6	1.00
	Yes	15.7	13.4	1.08 (.81-1.45)
Live	Rural	35.9	30.1	1.00
	Urban	64.1	69.9*	.79 (.64-.98)^
Marital Status	Single	42.9	42.5	1.00
	Married	57.1	57.5	.95 (.74-1.22)
Previous Participation	Previous Participant	59.4	63.9	1.00
	First Time Participant	40.6	36.1	1.08 (.87-1.34)
Mode of Participation	Run/Jog	15.7	28.8	1.00
	Walk	84.3	71.8*	2.18(1.65-2.88)^
Training	Do not train/week or two	12.4	13.9	1.00
	Train Continuously	87.6	86.1	1.21 (.88-1.65)
Repeat Event Participation	No	87.9	74.6	1.00
	Yes	12.1	25.4*	.46 (.34-.63)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

5.3.2.2 Short term follow up: Dublin 2008.

Walking the Mini Marathon and no tertiary education were associated with an increased risk of relapse. Living in an urban area, consistent training before the event and less sedentary behaviour at follow up were related to risk reductions ($p<.05$) particularly in categories of relapse which included relapse to low active. Overall, none of the predictors of relapse for this particular event were consistent across all definitions of relapse (*Table 41, Appendix C, Table 9-13*).

Table 41

Predictors of Relapse (Decrease by at least 240 MET-minutes/wk and to low active) at Short Term Follow Up 2008 (n = 369: Dublin 2008)

		Relapser n=369 (%)	Non Relapser n=2,986 (%)	Adjusted OR (95% CI)
Age	Aged > 40	40.1	39	1.00
	Aged < 40	59.9	61	1.31 (.99-1.71)
Children	Children	54	48.9	1.00
	No Children	46	51.1	.99 (.74-1.34)
Education	Tertiary	57.2	68.6	1.00
	No Tertiary	42.8	31.4*	1.56(1.23-1.99)^
Medical Card	No	80.4	84.4	1.00
	Yes	19.6	15.6	1.19 (.88-1.59)
Live	Rural	35.8	29.7	1.00
	Urban	64.2	70.3*	.79 (.63-1)
Marital Status	Single	35.4	41.3	1.00
	Married	64.6	58.7*	1.28 (.97-1.7)
Previous Participation	Previous Participant	62.9	61.3	1.00
	First Time Participant	37.1	38.7	.92 (.73-1.17)
Mode of Participation	Run/Jog	18.8	29.5	1.00
	Walk	81.2	70.5*	1.71(1.28-2.28)^
Training	Do not train/week or two	51.1	38.1	1.00
	Train Continuously	48.9	61.9*	.62 (.49-.79)^
BMI	Overweight/Obese	28	21.5	1.00
	Underweight/Normal	72	78.5*	.78 (.59-1.05)
Follow Up SedentaryBehaviour	> 4.5 hours per day	58.9	46.8	1.00
	≤ 4.5 hours per day	41.1	53.2*	.59 (.38-.91)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and level of training. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

5.3.2.3 Short term follow up: Cork 2008.

Unlike the Dublin analysis, no significant or noteworthy predictors of relapse were apparent in the Cork event. This was likely due to the small sample size (n = 49) of relapsers (*Table 42, Appendix C, Table 14-18*).

Table 42

Predictors of Relapse (Decrease by at least 240 MET-minutes/wk and to low active) at Short Term Follow Up 2008 (n =49: Cork 2008)

		Relapser n=49 (%)	Non Relapser n=292 (%)	Adjusted OR (95% CI)
Age	Aged > 40	42.9	41.8	1.00
	Aged < 40	57.1	58.2	.92 (.44-1.94)
Children	Children	59.2	57.2	1.00
	No Children	40.8	42.8	.67 (.27-1.64)
Education	Tertiary	75.6	72.3	1.00
	No Tertiary	24.4	27.7	.75 (.34-1.66)
Medical Card	No	79.6	83.2	1.00
	Yes	20.4	16.8	1.19 (.51-2.77)
Live	Rural	38.8	35.4	1.00
	Urban	61.2	64.6	.74 (.38-1.43)
Marital Status	Single	40.8	36.3	1.00
	Married	59.2	63.7	.67 (.29-1.54)
Previous Participation	Previous Participant	55.1	59.6	1.00
	First Time Participant	44.9	40.4	1.34 (.69-2.62)
Mode of Participation	Run/Jog	24.5	32.2	1.00
	Walk	75.5	67.8	1.43 (.68-3.02)
Training	Do not train/week or two	55.1	51.2	1.00
	Train Continuously	44.9	48.8	1.06 (.54-2.08)
BMI	Overweight/Obese	48.9	34.6	1.00
	Underweight/Normal	51.1	65.4	.68 (.34-1.35)
Follow Up Sedentary Behaviour	> 6 hours per day	57.4	47.2	1.00
	≤ 6 hours per day	42.6	52.8	.72 (.37-1.41)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Although BMI as a grouped, dichotomised variable was not related to relapse, when it was included as a continuous variable, each one unit decrease in BMI was associated with a 13% reduced risk of relapse in Cork, and 3% reduced risk in Dublin (*Table 43*).

Table 43

BMI as a Predictor of Relapse (Decrease by at least 240 MET-minutes/wk and to low active) at Short Term Follow Up 2008 (n = 369: Dublin 2008, n =49: Cork 2008)

		240 MET-minutes/wk and low active (M, SD)		Adjusted OR (95% CI)
		R	NR	
BMI	08 Dublin Short (n=3,355)	25.1	24.3*	.97 (.94-.99)^
	08 Cork Short (n=341)	25.7	23.9*	.89 (.81-.96)^

R = Relapsers, NR = Non Relapsers.

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

5.3.3.4 Long term follow up: Dublin 2007.

At long term follow up, only walking the Mini Marathon and having no tertiary education remained as significant predictors of relapse. The effect of age, living in an urban area and repeat event participation dissipated and were not apparent among relapsers at six months.

Table 44

Predictors of Relapse (Decrease by at least 240 MET-minutes/wk and to low active) at Long Term Follow Up 2007 (n = 414: Dublin 2007)

		Relapser n=414 (%)	Non Relapser n=1,606 (%)	Adjusted OR (95% CI)
Age	Aged > 40	31.2	32.5	1.00
	Aged < 40	68.8	67.5	1.29 (.96-1.77)
Children	Children	43.4	41.9	1.00
	No Children	46.6	58.1	.89 (.65-1.23)
Education	Tertiary	73	78.7	1.00
	No Tertiary	27	21.3*	1.34 (1-1.82)^
Medical Card	No	89.1	89.3	1.00
	Yes	10.9	10.7	.94 (.63-1.39)
Live	Rural	29.9	27.2	1.00
	Urban	70.1	72.8	.88 (.67-1.15)
Marital Status	Single	43.1	43.8	1.00
	Married	56.9	56.2	.96 (.72-1.29)
Previous Participation	Previous Participant	61.9	63.7	1.00
	First Time Participant	38.1	36.3	1.06 (.82-1.38)
Mode of Participation	Run/Jog	25.6	33.5	1.00
	Walk	74.4	66.5*	1.52(1.15-2.01)^
Training	Do not train/week or two	34.7	32.7	1.00
	Train Continuously	65.3	67.3	.91 (.71-1.17)
Repeat Event Participation	No	76.8	72.3	1.00
	Yes	23.2	27.7	.95 (.71-1.28)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant (I < 0.05)

5.3.3 Self Efficacy, Social Support and Physical Environment as Predictors of Relapse

Self efficacy, social support and physical environment were also analysed as predictors of relapse. Average scores are presented in *Table 45*; higher scores indicate lower self efficacy, lower social support, and lower suitability of physical environment to physical activity. At short term follow up in Dublin, each one unit increase in self efficacy was related to a 9% decreased risk of relapse. Similarly, in the 2008 Dublin event, each single unit in the improvement in social support and physical environment scores was associated with a 5% and 10% reduced risk of relapse.

Table 45

Self Efficacy and Social Support as a Predictor of Relapse (Definition A) at Short and Long Term Follow Up (n = 434: Dublin 2007, n = 414: Dublin 2007), n = 369: Dublin 2008, n = 49: Cork 2008)

		240 MET-minutes/wk and low active (M, SD)		Adjusted OR (95% CI)
		R	NR	
Self Efficacy	07 Dublin Short (n=3,682)	5.2 (1.8)	4.7 (1.7)*	.91 (.87-.96)^
	07 Dublin Long (n=2,020)	5 (1.9)	4.6 (1.7)*	.89 (.84-.95)^
	08 Dublin Short (n=3,355)	10.6 (3.4)	9.5 (3.3)*	.91 (.88-.94)^
	08 Cork Short (n=341)	9.6 (4.2)	9.2 (3.6)	.99 (.91-1.09)
Social Support	08 Dublin Short (n=3,355)	7.3 (2.6)	6.9 (2.6)*	.95 (.91-.99)^
	08 Cork Short (n=341)	6.5 (2.4)	6.6 (2.6)	1.06 (.93-1.22)
Physical Environment	08 Dublin Short (n=3,355)	4.2 (1.8)	3.8 (1.8)*	.90 (.85-.96)^
	08 Cork Short (n=341)	4.3 (1.9)	3.9 (1.8)	.88 (.74-1.05)

R = Relapsers, NR = Non Relapsers.

Only two items were used to calculate self efficacy in 2007 surveys. * = significant difference between Relapsers and Non Relapsers ($p < 0.05$). ^ = odds ratio, adjusted for age, level of education, marital status, children, previous participation and mode of participation, significant ($p < 0.05$).

A more detailed assessment of the different items used to generate self efficacy scores revealed that increased confidence in the ability to be active when stressed or tired, or when the weather was bad or family took up time was related to non relapse, in both Dublin events at short and long term follow up. There were no comparable findings in the Cork event (*Appendix C, Table 19*). Unadjusted odds ratios indicated significant relationships between relapse and each of these variables, however; only decreased self efficacy to overcome poor weather conditions remained significant upon adjustment for other factors at short term follow up only.

Table 46

Self Efficacy Individual Variables as Predictors of Relapse (Definition A) at Short and Long Term Follow Up (n = 434: Dublin 2007, n = 414: Dublin 2007), n = 369: Dublin 2008)

		Relapser (%)	Non Relapser (%)	Adjusted OR (95% CI)
Dublin 2007 Short Term (n = 3,682)				
Confident in ability to be active	Disagree	24.2	20	1.00
when stressed or weather is bad	Agree	75.8	80*	.77 (.63-.95)^
Confident in ability to be active	Disagree	25.9	22.6	1.00
when family takes up time	Agree	74.1	77.4*	.96 (.79-1.17)
Dublin 2008 Short Term (n = 3,355)				
Confident in ability to be active	Disagree	18.4	13.6	1.00
when stressed	Agree	81.6	86.4*	.98 (.70-1.36)
Confident in ability to be active	Disagree	38.9	26.8	1.00
when weather is bad	Agree	61.1	73.2*	.69 (.53-.90)^
Confident in ability to be active	Disagree	49.1	39	1.00
when tired	Agree	50.9	61*	.78 (.60-1.01)
Confident in ability to be active	Disagree	41.1	30.8	1.00
when family takes up time	Agree	58.9	69.2*	.79 (.60-1.02)
Dublin 2007 Long Term Follow Up (n = 2,020)				
Confident in ability to be active	Disagree	28.3	20.1	1.00
when stressed or weather is bad	Agree	71.7	79.9*	.71 (.50-1.01)
Confident in ability to be active	Disagree	30.9	23	1.00
when family takes up time	Agree	69.1	77*	.74 (.53-1.04)

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and self efficacy items. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

A similar assessment of variables used to compile social support scores revealed no significant relationships in the Cork event (*Appendix C, Table 20*) but a decreased risk of relapse among participants who agreed that they had someone to look after their children when they wanted to be active, in the Dublin 2008 Mini Marathon. Specifically, respondents who agreed they had someone to look after their children to facilitate being active had an over 40% reduced risk of relapse.

Table 47

Social Support as a Predictor of Relapse (Definition A) at Short Term Follow Up (n = 369: Dublin 2008)

		Relapser n=369 (%)	Non Relapser n=2,986 (%)	Adjusted OR (95% CI)
Someone else to be active with	Disagree	19.9	18.7	1.00
	Agree	80.1	81.3	1.05 (.61-1.82)
Encouragement to be active from family and friends	Disagree	22.4	16.6	1.00
	Agree	77.6	83.4*	1.38 (.76-2.53)
Someone to look after children	Disagree	56.3	46	1.00
	Agree	43.7	54*	.55 (.35-.87)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation, and social support items. * = x^2 (bivariate) is significant (p < 0.05), ^ = odds ratio is significant (p < 0.05)

While a greater proportion of relapsers in the 2008 Dublin event disagreed that they could be active on the streets and roads around their residence and that there was a green area in their locality where they could be active, these were not significant (*Appendix C, Table 21*). Rather, almost twice as many relapsers in the Cork event had negative perceptions about their local environment (*Table 48*). The subsequent unadjusted odds ratio revealed that more favourable observations about local infrastructure were related to a decreased risk of relapse.

Table 48

Physical Environment as a Predictor of Relapse (Definition A) at Short Term Follow Up (n = 49: Cork 2008)

		Relapser n=49 (%)	Non Relapser n=292 (%)	Adjusted OR (95% CI)
Can be active on streets/roads in the locality	Disagree	14.9	7	1.00
	Agree	85.1	93	.58 (.35-.98)^
Green areas where you can be active	Disagree	29.5	26.3	1.00
	Agree	70.5	73.7	.92 (.62-1.37)

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and physical environment items. * = x^2 (bivariate) is significant (p < 0.05), ^ = odds ratio is significant (p < 0.05)

To complete this section, a final model including all predictors across all events at different follow up periods is presented in *Table 49*. Upon the inclusion of all predictors into the model, some of those identified as significant predictors in the previous assessments were not now apparent. For example, although approaching significance, the unadjusted odds ratio for living in an urban area was not associated with a reduced risk of relapse in the Dublin 2007 Short Term Follow Up in the final model unlike the individual model presented in *Table 40*. Also, walking the event was not related to a significantly increased risk of relapse in Dublin in 2008, despite an earlier manifestation of significance (*Table 41*). The most notable predictors of relapse across all three events were tertiary education, mode of participation, BMI and self efficacy; having no tertiary education and walking the event were related to an increased risk of relapse while each one unit increase in self efficacy and decrease in BMI was associated with an approximate 7-14% and 12% (Cork) decreased risk of relapse respectively. Consistent trends were apparent for age, having no children, place of residence, marital status and physical environment factors across all four analyses.

Table 49

Final Model of Predictors of Relapse (Definition A) at Short and Long Term Follow Up in all Events (n = 434: Dublin 2007, n = 414: Dublin 2007), n = 369: Dublin 2008, n = 49: Cork 2008)

	Dublin 2007 Short Term n = 434 (OR, 95% CI)	Dublin 2008 Short Term n = 369 (OR, 95% CI)	Cork 2008 Short Term n = 49 (OR, 95% CI)	Dublin 2007 Long Term n = 414 (OR, 95% CI)
Demographic Characteristics				
Aged < 40	1.65 (1.26-2.12)*	1.12 (.93-1.34)	1.29 (.55-2.99)	1.26 (.92-1.73)
No Children	.86 (.64-1.13)	.89 (.73-1.09)	.55 (.20-1.48)	.90 (.65-1.26)
No Tertiary Education	.94 (.64-1.38)	1.22 (1.03-1.45)*	.69 (.28-1.69)	1.39 (1.02-1.88)*
Medical Card	1.07 (.79-1.45)	1.06 (.85-1.31)	.88 (.31-2.51)	.90 (.60-1.35)
Urban Residence	.80 (.64-1.00)	.77 (.65-.91)*	.65 (.31-1.36)	.86 (.66-1.13)
Married	.93 (.72-1.22)	.96 (.79-1.16)	.66 (.25-1.72)	.97 (.72-1.30)
Low BMI	-	.99 (.98-1.02)	.88 (.81-.97)*	-
Participation Characteristics				
First Time Participant	1.13 (.90-1.42)	.94 (.80-1.10)	1.83 (.88-3.81)	1.09 (.85-1.42)
Walking	1.82 (1.36-2.44)*	1.08 (.90-1.30)	1.28 (.53-3.11)	1.33 (1-1.78)*
Train Continuously	1.33 (.96-1.84)	1.05 (.88-1.24)	1.07 (.49-2.33)	.93 (.72-1.19)
Psycho-social Characteristics				
High Self Efficacy	.86 (.81-.92)*	1.02 (.99-1.05)	1.00 (.91-1.11)	.89 (.84-.96)*
High Social Support	-	.98 (.95-1.01)	1.11 (.96-1.29)	-
High Perception of Physical Environment	-	.97 (.93-1.02)	.84 (.69-1.02)	-

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and physical environment items. * = odds ratio is significant ($p < 0.05$)

Research Question 3: What were the physical activity levels and sedentary behaviours of relapsers at short and long term follow up?

5.3.4 Characteristics of relapsers

Relapsers reported higher BMI scores ($p<.05$) and greater rates of sedentary behaviour than non relapsers at follow up, although the latter was apparent in the Dublin event only. Characteristics according to the other definitions of relapse are presented in *Appendix C, Table 22*.

Table 50

BMI and Sedentary Behaviour of Relapsers at Short Term Follow Up (n = 369: Dublin 2008, n = 49: Cork 2008)

		240 MET-minutes/wk and low active (M, SD)		480 MET-minutes/wk and low active (M, SD)	
		R	NR	R	NR
BMI	08 Dublin (n=3,355)	25.1(4.3)	24.3(3.9)*	25(4.2)	24.3(3.9)*
	08 Cork (n=341)	25.7(4.6)	23.9(3.4)*	25.9(4.7)	23.9(3.4)*
Sitting Minutes/day	08 Dublin (n=3,355)	236.5(138.2)	197.3(128.1)*	236.9(137.3)	197.4(128.4)*
	08 Cork (n=341)	288.9(154.5)	272.6(153.1)	282.4(150.4)	273.7(153.8)
TV Minutes/day	08 Dublin (n=3,355)	131.3(73.3)	114.2(71.7)*	131.9(73.5)	114.2(71.6)*
	08 Cork (n=341)	140.3(57.5)	117.5(73.8)	138.3(78.6)	118(73.8)

R = Relapsers, NR = Non Relapsers. * = $p < 0.05$ Relapsers v Non Relapsers

5.4 Discussion

5.4.1 Relapse

There are no clear definitional criteria for population relapse, and this study is one of the few that has examined behavioural maintenance in response to a community-wide event using serial follow up studies. Subsequent proportions of participants in each of the three events were consistent within the various classifications of relapse. For example, 11.4% of the Dublin 2007 event, 11% of the 2008 equivalent and 14.4% of the Cork 2008 Mini Marathon participants were deemed to relapse by at least 240 MET-minutes/wk and to low active. In contrast, the different definitions of relapse revealed substantial variations in the number of Mini Marathon participants classified as relapsers. Categorising relapse as merely a decrease in the frequency and intensity of engagement in physical activity suggested an approximate 40% relapse rate in all events at short term follow up. This is similar to an observation by Dishman et al. (1988) that attrition/relapse rates of 50% were common in interventions to promote physical activity. However, it became apparent that many of the individuals classified as relapsers in this manner would still be deemed sufficiently active, therefore an additional expression of relapse, which necessitated a decrease to insufficiently active using IPAQ categories, was established. Classifying relapse using a combination of these criteria caused relapse rates to decrease to 10-14% at short term follow up. At long term follow up, in 2007, while the number of relapsers decreased, the overall proportion increased to approximately 20% due to a smaller overall sample.

Despite the many references to relapse alluded to earlier in physical activity interventions, a lack of detail on or analysis of relapse in this context is provided; interventions typically only report overall decreases in minutes of physical activity. For example, Marcus et al. (1998b) reported an approximate 65 minute decrease in total physical activity after three months; comparable to 60-90 minute decreases in physical activity among relapsers in all events at short and long term follow up in this study. Many previous physical activity interventions have also reported increases in physical activity; Marshall et al. (2003a; 2004) identified 78 and 13 minute increases in their intervention groups at two months, Napolitano et al. (2006) observed a 90 minute increase at three months and Marcus et al. (2007a) approximate 100 minute increases at six months.

Although these interventions were quite different to the mass event that is being investigated as a catalyst for change in this study, a large proportion of participants, the comparison group to relapsers, did report increases in physical activity at short and long term follow up; between 20 and 34 minute average increases. As noted earlier, changes in physical activity at short and long term follow up in 2007 varied minimally; relapsers reported a 73 minute decrease in physical activity at two months and a 66 minute decrease at six months. Similarly, non relapsers displayed a 33 minute increase in physical activity at both time points. Consequently, in 2008, follow up was undertaken at three months only. This does fail to fulfil recommendations from Hilldson et al. (2006) and Müller-Riemenschneider et al. (2008) to undertake long term follow up at six and 12 months post intervention to permit a comprehensive assessment of behaviour change maintenance. However, relapse rather than maintenance was of primary interest among these participants and subsequent efforts were undertaken after long (2007) and short (2008) term follow up to increase and sustain the effect of participating in a mass event among these relapsing individuals. Thus, as will be indicated in later chapters, follow up among some participants was undertaken up to nine months post event. However, at this stage, many individuals were likely to re-commence preparation for the upcoming Mini Marathon and thus follow up specific to the previous years event would not be plausible.

As noted previously, research on physical activity interventions tend to report overall changes in physical activity and often fail to identify or compare actual relapsers and adopters/maintainers. Movement across stages of change and motivational readiness to be active are sometimes assessed. For example, Marcus et al. (1998b) stated that 13% of their overall group reported stage regression, similar to the approximate 18% motivational stage regression rates among Mini Marathon participants in the 2008 events. Other similar research (Marshall et al., 2003a; 2004; Napolitano et al., 2006) merely examined progression rates and did not present relapse rates.

More direct references to relapse do exist, typically incorporating some activity at baseline and not at follow up. As per classifications used in this study, Sullum et al. (2000), Williams et al. (2008a) and Dunton and Vaughan (2008) all defined relapsers as participants who were meeting minimum physical activity guidelines at baseline but not at follow up. As noted earlier, in this research, an additional disclaimer that relapsers must have demonstrated a decrease of one or two hours of at least moderate intensity activity was included. Despite this, relapse rates generated from a change in IPAQ criteria from high or moderately active to low active alone were very similar to those including a combination of IPAQ and frequency and intensity of participation. For example, 12.6% of participants in the 2007 event at short term follow up relapsed to low active while 11.4% experienced this change and a decrease in 60 minutes of at least moderate intensity activity. This suggests that relapse defined by moving from sufficiently to insufficiently active is a comprehensive assessment of decreased engagement in physical activity.

Williams et al. (2008a) recruited a sample of sedentary adults and tracked them up to twelve months to assess changes in physical activity. Of those who became active at six months, 33% relapsed to inactive at twelve months. A similar rate of relapse (31%) was reported by Dunton and Vaughan (2008) when they observed a group of healthy adults over a three month period. Unlike the previous study, participants were not all sedentary at baseline; 72% were deemed sufficiently active. Finally, Sullum et al. (2000) drafted a sample of college students who were all initially sufficiently active. Follow up, approximately 10 weeks later revealed that 13% had relapsed to insufficiently active. This latter study uncovered a similar rate of relapse to that displayed by Mini Marathon participants (approximately 13%) over a comparable follow up period. This similarity may be due to the recruitment of sufficiently active participants at baseline although the failure of the authors to use a validated measurement tool for physical activity does weaken subsequent findings and hinder comparisons. The lower rates of relapse in this research compared to those presented by Williams et al. (2008a) and Dunton and Vaughan (2008) are likely due to the presence of the Mini Marathon as a catalyst and motivator for activity between baseline and follow up measures.

Overall, a decrease to insufficiently active using IPAQ criteria and a decrease in participation by at least 240 MET-minutes/wk was the main definition of relapse used in data analysis and discussion. Notably, the majority (approximately 87%) of participants who relapsed by at least 240 MET-minutes/wk also decreased their frequency and duration of participation by at least 480 MET-minutes/wk. Relapsers in both of these categories decreased overall participation in physical activity by approximately 50% between baseline and short term follow up, with the greatest change primarily apparent in vigorous intensity activity and walking.

5.4.2 Predictors of Relapse

In this analysis, the main predictors of relapse investigated included demographic characteristics, characteristics of participation in the Mini Marathon and self efficacy. The latter proved a consistent predictor of relapse in all but the Cork event. As per Sullum et al. (2000), Plotnikoff et al. (2001), Berry et al. (2005) and Levy and Cardinal (2006) relapsers reported significantly lower scores of self efficacy at baseline than non relapsers, suggesting that low self efficacy may be related to relapse and higher self efficacy to maintenance of physical activity. Indeed, this latter observation is a common finding; Conroy et al. (2007) and Williams et al. (2008a) both cited self efficacy as a predictor of physical activity maintenance. Upon a more detailed analysis of the variables that were used to compute self efficacy, only a lack of confidence in the ability to be active when the weather was bad was indicative of relapse in both Dublin events. A considerably lower proportion of relapsers displayed a confidence to overcome poor weather conditions.

This is a particularly notable finding for two reasons. Firstly, Ireland has a relatively wet, cold, changeable climate and secondly, follow up was undertaken in September when weather typically deteriorates as winter approaches. Tucker and Gilliland (2007) reviewed studies that assessed physical activity in different seasons, in varying weather conditions. Results indicated that almost three quarters of the research articles examined cited a strong relationship between physical activity and weather conditions with poor conditions deemed a significant barrier to physical activity and a decline in participation apparent during winter months. Consequently, it is not surprising that weather and specifically self efficacy in relation to weather, is a predictor of changes in physical activity in this particular cohort at this time of year.

In the 2008 Dublin event, lower social support was also identified as a predictor, albeit a weak one, of relapse. Titze et al. (2005), Luszczynska and Sutton (2006) and Williams et al. (2008a) reported similar findings in relation to social support while Boutelle et al. (2004) found no difference in social support between maintainers and non maintainers in their study. A more detailed analysis of social support revealed that not having someone to look after children to facilitate physical activity was a significant predictor of relapse in the Dublin event in 2008 while a lack of encouragement from family and friends approached significance as a similar predictor.

The effect of parenthood on physical activity was discussed in previous chapters. A recently published study by Brown et al. (2009) reaffirmed the rather conclusive findings presented; having a child is associated with increased odds of decreasing participation in physical activity. Furthermore, Wilcox et al. (2000) in an investigation of the determinants of leisure time physical activity among a group of women in the US found that care giving, which would include child minding, was a significant predictor of sedentary behaviour. Consequently, increasing social support to be active is a common and appropriate strategy incorporated in interventions to promote physical activity (Eyler et al., 1999). This social support may be instrumental (a direct action) or appraisal related (providing encouragement) and in this context, it appears that both manifestations of social support, significant others not taking steps (specific to minding children), and a lack of encouragement from family and friends to facilitate physical activity among this group of women are related to relapse to insufficient activity levels.

There were inconsistent findings across the events in relation to demographic characteristics. At short term follow up in Dublin 2007, being aged less than 40 was associated with an increased risk of relapse. This is in contrast to findings from Sallis et al. (1990) and Sallis et al. (1992) where older adults were deemed more likely to relapse and younger men were more likely to maintain activity. The effect of age was not apparent at long term follow up in 2007 or in any of the 2008 events. Indeed, in the Cork event, a greater proportion of non relapsers were aged less than 40, although this was not significant. At long term follow up in 2007 and short term in 2008, level of education was also a significant predictor of relapse; participants who did not have tertiary education had an increased risk of relapse. Sallis et al. (1986; 1992) reported that higher education was predictive of maintenance, observed in females only in the later study. In a more recent study, Barnett et al. (2008) observed that lower education was associated with less adherence to physical activity. These citations from literature refer to maintainers rather than relapsers, but are viable comparisons as relapse is a central component and natural opposite of maintenance. As noted in chapter 3, cross sectionally, higher levels of education are related to regular participation in physical activity; it now appears that level of education is also related to enhanced adherence to physical activity.

A further discovery was that in both Dublin events at short term follow up, living in an urban area protected against relapse. It could be assumed that living in or near a town or city would entail greater access to facilities to be active. However, as indicated previously, Giles-Corti and Donovan (2002) found that only about 10% of respondents used formal, recreational facilities and that the presence of facilities was ineffective in instigating sufficient levels of physical activity. This Giles-Corti and Donovan study was based in Australia, but Irish data also suggests that facilities are not a barrier to physical activity participation (Fahey et al., 2005). Furthermore, Williams et al. (2008a) investigated access to physical activity in the home and neighbourhood as predictors of relapse but did not detect any relationship. Despite this, the promotion of the physical environment, particularly non formal facilities such as roads and parks, in facilitating physical activity has become more prominent of late particularly due to increased use of the social-ecological models of behaviour change, which stipulates that the perceived environment including access, safety, convenience, safety, attractiveness and comfort, influences physical activity.

Sallis et al. (2009) recently undertook a review of the literature in this area and found that the presence of sidewalks, shops nearby, bicycle facilities, local transport stops and low cost facilities were all related to increased physical activity levels in several countries. Urban women (Wilcox et al., 2000) more frequently cited the presence of many of these features, including sidewalks and suitable lighting in their local area than rural women, and the lack of local scenery and green areas were deemed significantly related to being inactive in rural women. Also, Eyler and Vest (2002), in a qualitative study using women from rural areas, noted that their participants felt they had fewer opportunities to be active because of their place of residence. Participants observed that more community centres and exercise programmes were available in local towns and also that poor sidewalks and lack of lighting hindered their engagement in physical activity. These environmental factors that appear to be conducive to physical activity are also more common in urban areas in Ireland, which may explain why participants living in these areas had a reduced risk of relapse in this particular study. Also, relapsers in this study had higher physical environment scores, which suggest that that their slightly more negative perception of their physical environment did influence their relapse state; this was significant only in the Dublin 2008 event.

A more specific analysis of this latter point revealed that greater proportions of non relapsers agreed that they could be active on the streets and roads in their locality and that there existed in their environment green areas where they could be active. The former was a predictor of relapse in the Cork event; the presence of infrastructure suitable for walking or running was related to a reduced risk of relapse. Giles Corti and Donovan (2002) although not finding a strong relationship between access to facilities and physical activity did discover that greater access was related to increased use. Also, Duncan and Mummery (2005), in another Australian study, which used objective and perceived assessments of the environment, noted that respondents who had direct access to parklands were up to 41% more likely to be sufficiently active. Findings in this study lend further support to the role of the physical environment particularly in maintaining sufficient physical activity levels.

Less engagement in sedentary behaviour, measured in the 2008 events only, was also related to a reduced risk of relapse; significant in the Dublin event, but only apparent as a trend in the Cork equivalent. As noted in the previous chapter, sedentary behaviour is being increasingly recognised as an independent risk factor for health outcomes such as CVD, diabetes and cancer (Healy et al., 2008). Owen et al. (2009) noted that sedentary behaviour is related to time spent being active; as one increases the other tends to decrease. Consequently, it is unsurprising that among relapsers in this study, sedentary behaviour was higher than among non relapsers at follow up. Brown et al. (2005), using data from the ALSWH on almost 9,000 women, found that over a five year period, approximately half of the participants gained weight. Subsequent assessment of the predictors of weight gain indicated that it was associated with lower amounts of physical activity and increased sitting time. Evidently, there is a symbiotic relationship of sorts between physical activity and sedentary behaviour and although no direct assessments of the latter as a predictor of relapse have been undertaken, it is not an unexpected finding.

BMI was also assessed in both 2008 events and although not significant, relapsers were more likely to be overweight or obese than non relapsers. Analysis of BMI as a continuous variable did reveal a significant association between it and relapse in Dublin and Cork. Boutelle et al. (2004) also noted that non maintainers in their study had higher BMI's than those who maintained regular physical activity. Similarly, Conroy et al. (2007) reported that lapses were more common among women with higher BMIs in their assessment of relapse post menopause. BMI was significantly related to walking the event in both 2008 analyses. This, in turn, was the most consistent predictor of relapse irrespective of the definition of relapse applied. In both Dublin events, at short and long term follow up, walkers were between one and a half times and twice as likely to relapse. This is quite significant considering almost three quarters of participants intended to walk these events. Furthermore, limited training prior to the Mini Marathon was a significant predictor of relapse in the Dublin 2008 event. Eaton et al. (1993) and Martin et al. (2000b) both noted that previous success with and participation in physical activity as well as a more active lifestyle in general was associated with maintenance. It could be assumed that women who ran or jogged the Mini Marathon and did little training fulfil these criteria and this may explain why they were less likely to relapse post event; rather they maintained or even increased their physical activity levels.

However, walking is very popular form of physical activity and many health benefits can be accrued from it. For example, Hu et al. (1999) in a prospective study on female nurses in the US found that greater leisure time physical activity was associated with a reduced risk of Type 2 diabetes and reported comparable risk reduction from walking and vigorous activity. Morris and Hardman (1997) strongly advocated the benefits of walking, albeit at a faster than normal pace, for health and fitness benefits, throughout the lifespan across various populations. Also, Ainsworth et al. (2000) stated that walking at a moderate pace on a regular basis is sufficient to fulfil minimum requirements for physical activity. Consequently, the promotion of walking is a common aspect of interventions to increase physical activity, particularly among the most sedentary and inactive and those most at risk of obesity and associated conditions. Ogilvie et al. (2007) reviewed interventions to promote walking and noted that the most successful interventions included some targeting and tailoring to specific populations or individuals, as well as evidence that increases in walking were associated with increases in cardiorespiratory fitness and reduced risk factors for heart disease.

Evidently, walkers in these Mini Marathon events are obtaining health benefits and achieving minimum physical activity requirements at baseline but they are also more likely to relapse to insufficient levels of physical activity following the event. This presents a challenge for promoters and organisers of such initiatives; should participants be encouraged to jog and/or run the event or should strategies be scheduled post event to sustain the behaviour change that accompanies participation. This latter approach; to build on the initial momentum accompanying participation, of any nature, in these mass events appears the most reasonable. Walking is a first step for many non-competitive, previously sedentary women that can in sufficient frequency and duration lead to many health benefits. Therefore, event organisers should harness any engagement in physical activity and use it as a starting point for the development of more intense physical activity. A strategy to facilitate this could be the provision of more physical activity events. Indeed, in 2007, at short term follow up, repeat participation in an event was associated with a reduced risk of relapse. More events could sustain the interest and participation of walkers and perhaps facilitate recruitment to training groups or clubs that may eventually precipitate the aforementioned increased intensity of activity.

Overall, some inconsistency in the predictors of relapse is apparent in this analysis. Furthermore, despite trends, none of the predictor variables were deemed significant in the Cork event. This may be due to a smaller sample size than both Dublin analyses. Overall, mode of participation in the Mini Marathon, self efficacy to various other degrees, social support, education, age, level of training and repeat participation in a physical activity event were the most notable predictors of relapse in this cohort.

5.5 Limitations

Analysis of relapse in this study was undertaken across three different cohorts of participants in separate mass events. Combining the data from each event may have increased the overall credibility of the findings but this was not viable due to the likely considerable overlap of respondents in both Dublin events. As noted in chapter 3, over 60% of participants in the Dublin event were repeat participants, which strengthens the likelihood of duplicate responses in the 2007 and 2008 events from individual participants.

One week measurements were used to assess physical activity pre and post event, which could lead to some inaccuracies as participants could have been sick, injured or inactive only for those particular weeks, before reverting to sufficient levels of physical activity. A more stable assessment of physical activity over several weeks, at both time points may have been warranted. However, the primary focus of this research was to invesigate relapse thus any under-reporting of physical activity prior to the event should not effect subsequent identification of these particular individuals. Furthermore, discussion earlier noted that in 2007 there was little difference in the decrease in physical activity between two and six months, which offers evidence for the stability of physical activity behaviour among participants in the months following the event. Overall, this should alleviate concerns about the accuracy of the analysis used to identify relapsers in this research.

A low response rate at baseline (20%) suggests the presence of some selection bias that was alluded to in previous chapters; that healthier, more enthusiastic event participants returned the questionnaires. This was confirmed by comparison with the random sample of 300 participants interviewed on race day and may have led to an underestimate of the true incidence of relapse. Also, the use of self report physical activity data leads to the possibility of measurement error. Any such overestimation of activity was likely to have been similar at both time points so should not influence findings. The small sample size of relapsers in the Cork event did prevent the identification of any predictors of this state in this cohort. This was likely due to the particularly low response rate (11%, n = 1,029) achieved at baseline and the subsequently small matched sample (n = 348). As noted previously, questionnaires were only disseminated on the day of this event due to the absence of a database of contact details for this group, which was not generated upon registration for the event, as is apparent in the Dublin equivalent. Consequently, online data collection and administration of reminders was not feasible, both of which were successful tools in acquiring increased response rates from the Dublin events.

Data on social support and environmental perceptions were not collected in the 2007 event, which prevented a comparable assessment to self efficacy, which was investigated as a predictor of relapse in all three events, at short and long term follow up. It may also have been pertinent to undertake a more comprehensive measurement of the relationship between environmental perceptions and relapse. Only two items were used to generate a score for this variable, which yielded some evidence for it as a predictor of relapse. Considering the increased use of social-ecological frameworks in the field of physical activity, and the associated assessment of environmental factors related to being active, a greater investigation of these in this research would have contributed to this paradigm of enquiry.

5.6 Implications for Health Promotion

While the previous chapter extolled the impact of these mass community events on physical activity, this investigation revealed that not all participants become sufficiently active at any stage pre or post event while others did not maintain adequate engagement in the months following the event. The identification of this particular sub group and specific factors associated with their relapse can assist event organisers and groups responsible for physical activity promotion in their efforts to increase the long term effectiveness of these initiatives. The discovery of increased relapse among walkers has particular implications for event organisers. Greater encouragement of a more intense participation (jogging/running) may be warranted or tailored strategies could be administered post event to this group to maintain current levels and increase the intensity of walking. General findings in relation to low education, self efficacy, social support and a rural area of residence are also useful and insinuate that not only are participation rates lower among individuals with these characteristics but they are also less capable of maintaining increased physical activity levels. This enhances their status as an 'at risk', priority target group, and should be a consideration for health and physical activity promoting agencies.

5.7 Conclusion

Considerable effort in the fields of public health and medicine is assigned to the promotion of healthy lifestyles and to the prevention and treatment of disease with an ultimate goal of maintenance of these health behaviours and a disease free state. While much resources are allocated to advocating and developing more active lifestyles among sedentary populations, there also exists a need to maintain physical activity levels among those who have increased their activity to or are already exercising at a sufficient level for health benefits. Consequently, the identification of factors that can promote maintenance is of utmost importance. Inherent in this, is the prevention of relapse. To minimise relapse, the prevalence and predictors of this occurrence must first be ascertained and then explored and refined to assist in the development of suitable, tailored relapse prevention strategies.

In this population sample of Irish women, approximately 12% of participants from matched samples from three separate recruitment settings were categorised as relapsers; decreasing their weekly physical activity levels by at least one hour of moderate intensity activity per week and moving from sufficiently to insufficiently active, as per IPAQ criteria. A subsequent analysis of the predictors of this particular relapse state indicated that the most consistent indicator of reduced physical activity was walking the Mini Marathon event. Other predictors of relapse included lower education levels, lower self efficacy and social support, living in a rural area and not engaging in any other physical activity events. It is important that efforts are undertaken to engage these potential relapsers post event and build on the initial impact on physical activity generated by their participation in a mass event.

Chapter 6: Randomised Controlled Trial to Promote Physical Activity among Insufficiently Active Women

6.1 Background

As illustrated in chapter 3 and 4, the Mini Marathon 10km events held annually in Dublin and Cork are among the biggest women's only events worldwide and they appear to have an impact on participant physical activity levels. Analysis of the events at baseline indicated that women do get active prior to the event; in 2007 for example, approximately 90% of respondents undertook training in the weeks and months before the event. Six months after the 2007 event, 20% of the final matched group (n = 2,020) who were active prior to the event had relapsed to lower levels of physical activity; the remainder had either maintained or increased their physical activity levels. Relapse was specifically defined as a decrease in physical activity by at least 240 MET-minutes/wk and a move to the low active IPAQ category between baseline and six months follow up. Evidently, the impact of this mass event was not enough to stimulate sustained increases in physical activity to levels above the minimum requirements for greater health benefits among all participants. Rose and Marfurt (2007) noted that the habitualisation of any initial behaviour change may be reliant on post event strategies, and these appear to be required in this particular instance.

6.1.1 Low Contact Interventions to Promote Physical Activity

There is scope to build on the initial effect of the Mini Marathon. A database of participant details exist and these participants represent a population based sample, thus offering an opportunity to develop effective interventions and strategies to promote physical activity that could be instigated at a national level. Much research has been undertaken in this area to develop feasible, minimal contact, low cost interventions, which as Marshall, Owen and Bauman (2004b) noted may be disseminated to large numbers of people if deemed successful. A recent review of physical activity interventions by Müller-Riemeschneider et al. (2008) did observe that the most effective physical activity interventions were those that involved exercise prescription and counselling, as well as information materials. However, it was noted in this and other reviews (Dunn et al., 1998) that less prescriptive, lifestyle based programmes, involving less contact with the participant, can also lead to increases in physical activity.

Dunn et al. (1999) compared a home based physical activity approach with a more traditional exercise prescription and supervision method where participants (n =

114) received an exercise programme that they undertook in a fitness centre, up to five times weekly; both were based on the TTM and social cognitive theory. Participants in the home based group (n = 121) were encouraged to accumulate 30 minutes of at least moderate intensity activity through daily living activities. These participants also engaged in weekly group meetings and activities and received intervention materials, home based assignments and activity calendars. At six and 24 months, both groups demonstrated positive changes in physical activity, fitness, blood pressure and body composition, with no significant difference between the groups. The lifestyle group reported three times as much moderate intensity activity while the structured exercise group engaged in more vigorous activity. Furthermore, there were similar decreases in activity between six and 24 months in both groups. Overall, the comparable increases in physical activity in both groups offer support for the delivery of physical activity interventions beyond the traditional fitness centre setting. These lifestyle based, minimal contact interventions typically incorporate mass media campaigns, and print, telephone and internet interventions, each of which will be discussed briefly below.

6.1.2 Mass Media Interventions

Mass media campaigns have been used worldwide to promote physical activity. ParticipACTION in Canada, Agita Sao Paolo in Brazil, Push Play in New Zealand and Active Australia in Australia all strived to communicate messages using channels such as newspapers, radio and television. These initiatives typically adopt a social marketing approach, which is defined as ‘the application of commercial marketing technologies to the analysis, planning, execution and evaluation of programs designed to influence the voluntary *or involuntary* behaviour of target audiences in order to improve the welfare of individuals and society’ (Donovan & Henley, 2003, p.6). This approach has gained considerable credence of late and involves developing and tailoring attractive messages on physical activity for specific, well defined segments of the population (Marcus et al., 1998c). These campaigns generally have high recall, up to 70%, but often have a less clear or significant impact on knowledge and behaviour. This was reported in a review of media based interventions by Marcus et al. (1998c). Similarly, Kahn et al. (2002) in another review of physical activity interventions noted that insufficient evidence exists to assess the effectiveness of mass media campaigns in increasing physical activity. A summary of findings from research undertaken to evaluate individual mass media interventions is presented in *Table 51*.

Owen et al. (1995) reported on the effect of two national physical activity related campaigns conducted in Australia in the early 1990s. Results indicated that while recall was high and intention to be active improved, there were no notable changes in physical inactivity following the campaign. Bauman et al. (2003a) reported on Active Australia and found that recognition of the campaign increased between 1997 and 1999 but participation in physical activity decreased by approximately 6% in the intervening period. Similar findings in relation to recall and intention to be active were noted for the Push Play campaign in New Zealand and no consistent overall change in physical activity was observed (Bauman et al., 2003b). In an assessment of ParticipACTION in Canada, an initiative that spanned 30 years, Bauman et al. (2004) observed high recall rates, while national surveys revealed increases in population physical activity levels between 1981 and 2000, although these cannot be directly attributed to the campaign alone (Craig et al., 2004).

Overall, these assessments of media led campaigns to promote physical activity are somewhat inconclusive and inadequate to strongly support the design and adoption of such initiatives on their own. Rather it was advocated that these campaigns should be implemented as a part of broader, more comprehensive efforts to promote physical activity. In turn, Agita Sao Paulo, a multi level ecological based programme was developed in Brazil. Matsudo et al. (2004) produced a comprehensive summary of evaluations undertaken on this campaign. Surveys carried out on representative samples between 1999 and 2003 indicated that the proportion of respondents deemed sufficiently active increased from 55% to 60% throughout this period. Other community based interventions, which incorporate media campaigns in their delivery, are being developed and undertaken worldwide. Some of these will be reviewed in the next chapter.

Table 51

Summary of Mass Media Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Owen et al. (1995)	Social marketing	Cross sectional	Random sample of Australian adults	National Heart Foundation Risk Factor Prevalence Study	National Heart Foundation Campaigns: Media campaign, leaflets, health visits, activity days, interviews	3-4 weeks post campaign	10-30% increase in recall and intention to be active increased to 80%; this did not translate into increased PA levels
Bauman et al. (2003a)	Social marketing	Cross sectional	Random sample of Australian adults	Active Australia	Active Australia: Mass media based campaign to increase PA	1997 &1999	Awareness of the campaign increased from 11% to 41%, participation in PA decreased by 6%
Bauman et al. (2003b)	Social marketing	Cross sectional	Random samples of New Zealand adults	New Zealand Sport and Physical Activity Survey	Push Play: Mass media campaign, events, GP scheme, community activities	Annual surveys	27% increase in awareness, 38% increase in recall. No change in proportion meeting minimum PA guidelines (38%)
Craig et al. (2004)	Social marketing	Cross sectional	Surveys of representative samples of Canadian adults	Canadian Fitness Survey	ParticipACTION : Community based programmes and actions incorporating the ParticipACTION brand	1981,1988, 1995,1998, 1999,2000	Approximate 80% recall rates. 20% increase in proportion meeting PA guidelines between 1981 and 2000
Matsudo et al. (2004)	Social-ecological model	Cross sectional	Random sample from Sao Paulo, Brazil	IPAQ	Agita Sao Paulo: mass media, events, school interventions, policy change, environmental change	Annual surveys	Increase in prevalence of sufficiently active from 1999 to 2003; 54.8% to 60.4%

PA = physical activity

6.1.3 Print Based Interventions

Print based interventions can include brochures, booklets or leaflets often tailored to an individual's motivational readiness to change their behaviour (Marshall et al., 2004b). Napolitano and Marcus (2002) discussed the advantages of print interventions and noted particularly the low cost, wide reach and sustainability of this medium. In turn, the lack of direct contact and possible inappropriateness of materials was also considered. Marcus et al. (1998a) recruited healthy, sedentary women to a trial assessing the efficacy of two low cost interventions in increasing physical activity; one incorporating self help, stage matched manuals, and individually tailored reports, the other using four standard self-help booklets. The concept of targeting (stage matched) and tailoring used in this research is becoming increasingly common and involves assessing the motivational readiness of participants (using the TTM), matching intervention materials/delivery to these stages and consequently generating individual/tailored messages rather than the generic alternative.

Napolitano and Marcus (2002) noted that these terms are often used interchangeably so targeting was defined as identifying a population group who due to their similarity will receive a particular message to the same extent. In contrast, tailoring involves addressing issues specific to an individual and supplements the dissemination of targeted materials/strategies. Ogilvie et al. (2007) reviewed interventions to promote walking and found that interventions that were tailored to participant's requirements were the most effective. Targeting, specifically those individuals already motivated to change their behaviour and those most at risk, (i.e.) the most sedentary, was also advocated as greatest increases in walking were reported in these cohorts.

A summary of a number of print based interventions conducted between 1998 and 2008 is presented in *Table 52* below. Studies were not gathered using any systematic process or defined search strategy, therefore they represent a convenience sample of the literature in this area. The targeted and tailored intervention administered by Marcus et al. (1998a) led to increases in physical activity, but this was also apparent in the control group. Marcus et al. (1998b), Bock et al. (2001), Marshall et al. (2003a) and Lewis et al. (2006) undertook similar research and observed favourable changes in the intervention group that were quite often replicated, albeit to a lesser extent, in the control group. Despite, a lack of maintenance to six months in Marshall's study, results did indicate that a minimal contact intervention can increase physical activity in a population based sample; this latter statement is particularly important considering many interventions recruit volunteers who are often pre-disposed to change regardless of subsequent intervention. Marshall et al. (2004a) replicated the study on a more diverse state-wide population, but only minimal changes in physical activity and proportions meeting minimum guidelines for physical activity were noted. These contradictory findings were attributed to seasonal variation in the delivery of each intervention and the different population and settings that participants were recruited from.

Napolitano and Marcus (2002) called for studies of print interventions on clinical populations, as well as healthy populations, to cut the expense and difficulty associated with face to face contact. In turn, Dutton et al. (2008b) instigated a print based intervention on diabetes patients among whom interventions to promote physical activity are often costly and time consuming. patients and physical activity was assessed using the 7-day PAR questionnaire. After one month the intervention group displayed an approximate 20 minute increase in physical activity compared to a minimal increase in the comparison group.

Table 52

Summary of Print Based Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Marcus et al. (1998a)	SCT, TTM, decision making theory	RCT	Healthy, sedentary men and women in US (n = 194)	PA: 7 day PAR, MR, DB, SE, processes of change	I: Individually tailored reports (feedback on MR, DB, SE, processes of change) and self help manuals (specific to stage of MR) C/SI: self help booklets (PA related)	1, 3 & 6 months	At 6 months, I: 146 mins/wk increase in PA, C/SI: 78mins/wk increase in PA (p<.05). More I met PA guidelines at 6 months (44% v 18%), (p<.05). Increase in SE, DB, process of change in both groups (p<.05)
Marcus et al. (1998b)	SCT, TTM, decision making theory	RCT	Employees in workplaces, US (n = 1559)	PA: 7 day PAR, MR	I: 5 tailored self help manuals. C/SI: 5 standard AHA manuals (PA related)	1 & 3 months	Increase in PA overall, no between group difference (p>.05). Greater stage progression in I (37%) compared to C/SI (27%)
Bock et al. (2001)	TTM, SCT	RCT	Healthy sedentary adults in US(n = 194)	7-day PAR, barriers, SE, processes of change	I: tailored feedback reports, self help manuals matched to stage of change C/SI: standard AHA materials (PA related)	1, 3, 6 & 12 months	At 6 months (p<.05), I: 134 mins/wk increase in PA, C/ST: 78 mins/wk increase in PA (p<.05), increase at 12 months (p>.05). I group more likely to meet PA guidelines at 6, (44% v 18%) and 12 months (42% v 25%) (p<.05)
Marshall et al. (2003a)	TTM, SCT	RCT	Population, community based sample, Australia (n = 462	PA: AA, MR	I: four active living booklets based on TTM (stage matched). C: no contact	2 & 6 months	At 2 months, I: 78 mins/wk increase in PA, C: 12 mins/wk increase in PA (p<.05), decrease at 6 months. I group more likely to meet PA guidelines at 2 (45% v 33%, p<.05) and 6 months (40% v 31%, p>.05)

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Marshall et al. (2004a)	TTM, SCT	RCT	Statewide random sample in Australia (n = 719)	PA: AA, MR	I: four stage matched active living booklets. C: no contact	2 & 8 months	Increase in PA at 8 months (p>.05). I: 13 mins/wk, C: 15 mins/wk (p>.05). No differences between proportion meeting PA guidelines at 8 months (32% v 32%)
Lewis et al. (2006)	TTM, SCT	RCT	Healthy, sedentary men and women in US (n = 194)	PA: 7 day PAR, MR, processes of change, SE, DB	I: tailored print materials, tailored feedback reports C/SI: standard booklets	1, 3 & 6 months	Increase in PA at 6 months (p<.05). I: 120 mins/wk, C/ST: 70 mins/wk (p<.05) I: increase in SE, processes of change
Dutton et al. (2008b)	TTM, SCT	RCT	Patients with Type 2 diabetes in US (n = 85)	PA: 7 day PAR MR	I: stage matched tailored booklets and letter C/SI: diabetes tip sheet	1 month	Increase in PA in I group only (22 mins/wk), (p>0.05)
Miller et al. (2002)	Behavioural constructs of change	RCT	Community in Australia, mothers (n = 554).	PA: AA, SS, SE	C: no contact I1: print materials I2: Print plus community resource guide and group meeting	2 & 6 months	I2 group most likely to meet PA guidelines at 2 months (60% -I2 v 50%-I1 v 46%-C, p<.05). Increase in SE and SS in I2. Changes not sustained long term
Napolitano et al. (2006)	SCT, TTM	RCT	Women from communities in US (n = 280)	PA: 7 day PAR, MR, SE, DB	I1: print booklets I2: tailored booklets C/SI general health information	3 & 12 months	Increase in PA at 3 months (p<.05). I1: 90 mins/wk, I2: 50 mins/wk, ST: 70 mins/wk (p<.05: I1 v I2/ST). Increase at 12 months (p>.05)

TTM = transtheoretical model, SCT = social cognitive theory, RCT = randomised controlled trial, AA = Active Australia Questionnaire, PA = physical activity, MR = motivational readiness (stage of change), DB = decisonal balance, SE = self efficacy, PAR = physical activity recall, AHA = American Heart Association, I = intervention, C = control, SI= standard intervention

6.1.4 Print based interventions for women.

As well as tailoring for clinical populations, there have been efforts to modify these low contact interventions to demographic characteristics, such as gender and age. Indeed, Marcus and Forsyth (1998) observed that tailored physical activity interventions may be more successful if they were also tailored to a specific gender, considering that many of the psychological constructs that underpin these interventions are different for men and women. Furthermore, physical activity levels among women are traditionally lower than and vary in intensity and context to their male counterparts (USDHHS, 1996). Lack of time can be a much stronger barrier to being active among women due to family commitments (Verhoef et al., 1993) and social support is particularly important to enable women to be regularly active (Sallis et al., 1989). Also, the environment presents unique barriers to women, and their physical development throughout the lifespan is different to males (Marcus and Forsyth, 1998). Consequently, it was suggested that efforts to promote activity among this sub group should be modified accordingly; to address specific issues related to self efficacy, social support and low self esteem and to promote a moderate intensity message that may be more appropriate for insufficiently active women.

Two studies presented in *Table 52* used a randomised controlled design to assess if gender specific minimal contact print materials could increase physical activity in women. Miller et al. (2002) recruited women with children from childcare centres in Sydney and reported increases in physical activity at two months, which were not maintained to six months. Improvements in self efficacy and social support were mediators of the inital increase in physical activity in the supplemented print intervention group. The authors suggested that the lack of a significant intervention effect in the print only group was perhaps due to the absence of tailoring to individual levels of motivational readiness to change. A direct comparison of gender tailored and motivationally tailored print materials was carried out by Napolitano et al. (2006). At three months women in the motivationally tailored group reported significantly higher levels of physical activity than the other groups. However, at twelve months, physical activity levels were similar in all groups and significantly greater than baseline levels. It was hypothesised that the group who received repeated contact throughout the trial would exhibit the greatest improvements in physical activity and although this was apparent at three months it was negated at 12 months. The increase in physical activity in the gender specific group and control group suggests the presence of a reactive effect simply upon receipt of materials and on completion of physical activity/health related questionnaires.

6.1.5 Telephone Based Interventions

Print based interventions are most useful when targeting people in a large geographical area and also those who may be socially disadvantaged. Another means of contacting these same groups is through the telephone; findings from a convenience sample of published studies are presented in *Table 53*. Pinto et al. (2002) and Nies and Partridge (2006) both evaluated telephone counselling systems, comparing them to standard treatment groups. Positive changes in physical activity were noted in both instances. Humpel et al. (2004) assessed the effectiveness of targeted and tailored print materials with and without supplemenary phone calls. All participants reported increases in walking with no between group differences, which suggests that the addition of phone calls did not supplement the effect of the print intervention.

Marcus et al. (2007a) undertook a similar study and found that print and telephone delivery of physical activity messages were equally effective in promoting activity, although at 12 months the print group demonstrated a significantly greater change in physical activity than the telephone group. A review of telephone based interventions for physical activity by Eakin et al. (2007a) similarly noted that using the telephone as a primary intervention method is effective, particularly when used with other methods, such as face to face sessions and print materials. Just less than three quarters of the studies reviewed revealed positive outcomes on physical activity. The reviewers recommended more research on the optimum duration and frequency of calls, on the maintenance of behaviour change and the consideration of the technological advancements that may improve the design and delivery of these interventions.

Table 53

Summary of Telephone Based Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Pinto et al. (2002)	TTM, SCT	RCT	Healthy sedentary adults recruited from a medical practice in US (n = 298)	PA: 7 day PA, MR	I: telephone counselling C/SI: nutrition based equivalent intervention	3 & 6 months	I group more likely to meet guidelnes for PA at 3 months (31% v 21%, p<.05). Not maintained at 6 months. More stage progression in I group
Humpel et al. (2004)	Unclear	RCT	Healthy adults from Australia (n = 399)	PA: walking	I1: print materials only, primarily promoting walking I2: print materials plus telephone contact	8-10 weeks	Increase in both groups (p<.05), I1: 17 mins/wk, I2: 18 mins/wk (p>.05)
Nies & Partridge (2006)	Social-ecological approach	RCT	Healthy sedentary women (n = 313)	PA: 7 day PAR Fitness tests, Benefits, SE goal setting, SS	I1: brief telephone call I2: telephone counselling C/SI: Video education	6 &12 months	Increase (30 mns/wk) in minutes walked per week in all groups at 6 and 12 months (p>.05)
Marcus et al. (2007a)	TTM, SCT	RCT	Healthy, sedentary men and women in US (n = 239)	PA: 7 Day PAR, MR, SE, processes of change	I1: tailored print materials I2: tailored telephone calls C: financial incentive	6 &12 months	Increases in PA at 6 months (p<.05), I1/I2 v C). I1: 130mins/wk, I2:123 mins/wk. Increase a t 12 months (I1: 33 mins/wk, I2: 4 mins/wk, p<.05). I2 5 times more likely to meet PA guidelines at 12 months than C

TTM = transtheoretical model, SCT = social cognitive theory, RCT = randomised controlled trial, PA = physical activity, MR = motivational readiness (stage of change), SE = self efficacy, SS = social support, PAR = physical activity recall, I = intervention, C = control, SI = standard intervention

6.1.6 Internet Interventions

With the advent of the internet as a cost effective, sustainable mode of delivery for physical activity interventions, much research has focused on the efficacy of print based interventions in comparison to this newer, alternative approach in promoting physical activity. A summary of a convenience sample of key studies conducted over the past seven years is presented in *Table 54.* Marshall et al. (2003b) and Marcus et al. (2007b) both investigated the effects of a physical activity programme delivered through a stage targeted website and emails and through targeted and tailored print materials. In the earlier study, after 10 weeks, there was no significant difference in physical activity, within or between groups, although recall and use of materials was higher among the print group. In the latter, at six months follow up all groups reported increases in physical activity, which decreased at 12 months but remained higher than baseline.

Other research has focused on the individual effect of internet based interventions (Napolitano et al., 2003; Spittaels, de Bourdeaudhuij & Vandelanotte, 2007). In the first study, the internet group exhibited higher levels of moderate intensity activity and walking at one month follow up with only the difference in walking sustained at three months. In the second, significant increases in physical activity and decreases in sitting time were apparent in the tailored and standard intervention groups compared to the control group; increases were greatest in the group who received supplementary email contact. Vandelanotte et al. (2007) undertook a review of web based physical activity interventions, which used a randomised controlled study design and found favourable outcomes in over half of the studies reviewed. The authors also highlighted characteristics of studies associated with efficacy; these included interventions of approximately three months duration that were based on a defined theoretical framework, and most notably, interventions that incorporated more than five communications with the participant. Attrition was also deemed quite high suggesting that is difficult to retain participants' engagement with web based interventions.

Table 54
Summary of Internet Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Marshall et al. (2003b)	TTM, SCT	RCT	University setting in Australia (n = 655)	PA: IPAQ, MR	I1: tailored print booklets I2: tailored website, emails	10 weeks	At 10 weeks, I1: 5 mins/wk increase in PA, I2: 8 mins/wk increase in(p>.05). No change in proportion meeting PA guidelines
Napolitano et al (2003)	TTM, SCT	RCT	Insufficiently active hospital employees, US (n = 65)	PA: BFRSS, MR	I: internet site, weekly emails, tailored information, goal setting C: waiting list for intervention	1 & 3 months	At 1 month, I: 30 mins/wk increase in PA, C: 16 mins/wk increase in PA (p<.05). Increase at six months in I group only (p>.05). More stage progression in I group
Marcus et al (2007b)	TTM and SCT	RCT	Healthy sedentary men and women, non random, US (n = 249), 72% tertiary	PA: 7 Day PAR, exercise test	I1: Tailored internet I2: tailored print C/SI: standard internet	6 &12 months	At 6 months, I1: 120 mins/wk increase in PA, I2: 113 mins/wk increase, SI: 90 mins/wk increase (p<.05). Decrease in all at 12 months. Similar proportion met PA guidelines at 6 months. I1: 44%, I2: 37%, ST: 37%
Spittaels et al (2007)	TTM, TPB	RCT	Insufficiently active worksite sample in Belgium (n = 562)	PA: IPAQ, accelerometer BMI, BP, body fat	I1: tailored internet advice, 8 emails/8 weeks I2: standard internet advice, no emails C: waiting control group	6 months	At 6 months, I1: 77 mins/wk increase in PA, I2: 37 mins/wk increase, C: 25 mins/wk increase (p<.05). Greater decrease in body fat in I1.

TTM = transtheoretical model, SCT = social cognitive theory, TPB = theory of planned behaviour, RCT = randomised controlled trial, BRFSS = Behaviour Risk Factor Surveillance System, IPAQ = International Physical Activity Questionnaire, BMI = body mass index, BP = blood pressure, PA = physical activity, MR = motivational readiness, PAR = physical activity recall, I = intervention, C = control, ST = standard treatment

6.1.7 Summary

Research examining the effect of various interventions on the promotion of physical activity is being increasingly undertaken in non-clinical settings, among the general population. This approach typically involves less direct contact with the participant and focuses on encouraging and assisting the participant in including physical activity in their daily life. Mass media interventions as well as print, telephone and internet equivalents are all commonly used to promote physical activity in a non face to face manner. Mass media campaigns can be costly and are largely ineffective unless combined with other strategies to promote activity. Also, while there appears some potential for the use of print materials in promoting physical activity considering the positive findings illustrated earlier, Marshall et al. (2004b) did advocate greater exploration of the amount of content and contact required to instigate and maintain improvements in physical activity among whole populations in future research efforts.

Using the telephone as a communication channel also induced favourable outcomes, but a comparison with a print intervention revealed it did not achieve equivalent long term effects. The arrival and increased prevalence of the internet has presented a new vehicle for interventions that requires further assessment and analysis. Using the internet to communicate advice achieved similar results to print materials; this indicates an opportunity to use the internet to reach more sedentary adults in a more cost-effective way as well as vindicating the continued use of print materials in targeting more socially disadvantaged individuals who perhaps do not have access to the internet, such as older and socially disadvantaged cohorts. A similar observation was presented by Müller-Riemeschneider et al. (2008) in their review of physical activity interventions.

It appears that a print based intervention is the most suitable and practical option for a geographically and demographically disparate, population based sample of Irish women who participated in a mass event in Dublin in 2007 and who have not been specifically recruited or targeted to ensure they have internet or phone access. A print intervention is a universally agreeable, low contact, inexpensive mode of communication that will serve as an efficient pilot intervention for this group. Furthermore, efforts can be made to target specific correlates of physical activity or mediators of change using these print materials, ensuring the intervention is faithful to theoretical constructs and models associated with behaviour change. Thus, the aim of this study was to generate improvements in the activity habits of women categorised as relapsers following their participation in the 2007 Mini Marathon, using stage matched print materials. Mediators of change, self efficacy, outcome expectancy, social support and barriers to activity were also assessed and it was hypothesised that positive change in physical activity would be associated with similar changes in these constructs.

6.2 Methods

6.2.1 Study Population and Design

As described previously, in June 2007, a survey was administered online and via post to women who registered for the Mini Marathon in Dublin, Ireland (n = 11,205) to assess their physical activity habits. Respondents who consented to follow up were tracked at two (n = 4,786) and six months (n = 2,095) post event to record changes, if any, in physical activity using matched analysis. Respondents who provided physical activity data at each time period (n = 2,020) and had relapsed by at least 240 MET-minutes/wk and to the 'low' active IPAQ category (n = 414) were identified and scheduled for inclusion in this trial. Relapse by this amount corresponds to an hour of moderate intensity activity per week, which is a substantial decrease in physical activity. This group of relapsers were randomly allocated to an intervention (n = 207) and control group (n = 207) and mailed a baseline questionnaire that, if returned, indicated consent to participate in the trial; n = 85 in the intervention group and n = 91 in the control group returned baseline questionnaires. Participants in the intervention group were contacted by telephone three weeks post baseline (n = 65, 76% of intervention group) to assess receipt and use of materials and all participants were contacted six weeks post baseline to collect outcome data (*Figure 13*).

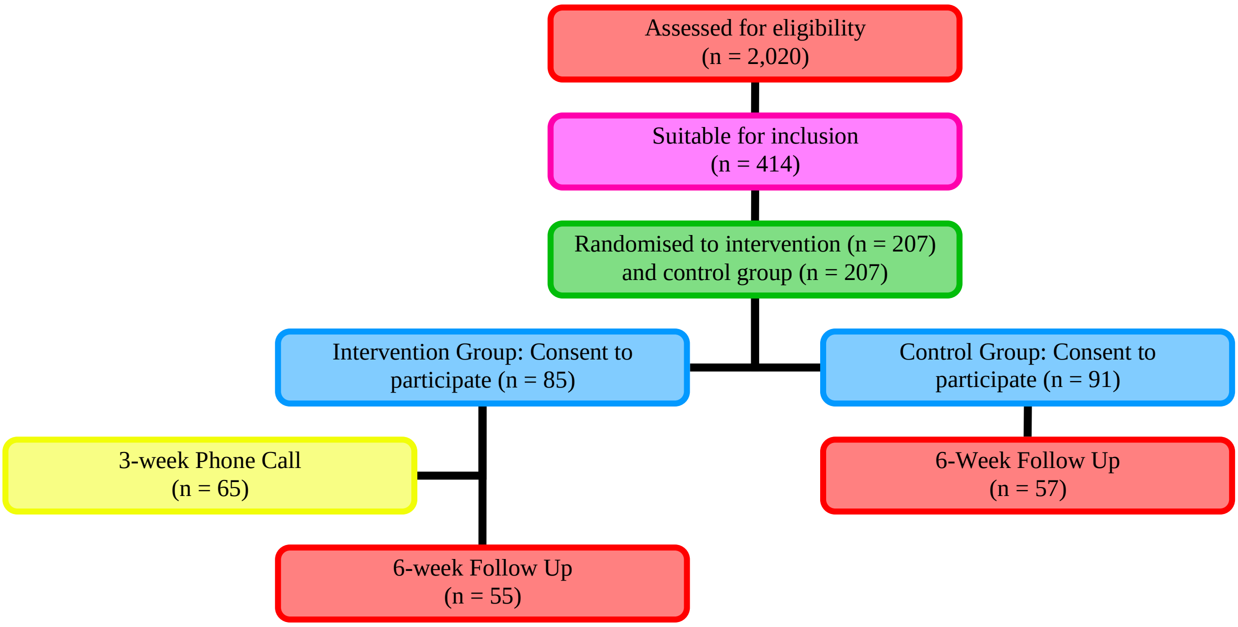


Figure 13

Recruitment to and progress through the randomised controlled trial (RCT)

6.2.2 Procedures

Participants' stage of change was assessed in the baseline questionnaire. A letter explaining the study layout was distributed with the questionnaire. Approximately one week after this baseline data was collected; participants were then sent the appropriate intervention or control materials. Those in the precontemplation and contemplation stage were mailed the same booklet for this stage. Participants' who did not provide an answer to the stage of change question were sent both booklets while all others were mailed a booklet corresponding to the later stages of change. Three weeks after the dissemination of print materials, members of the intervention group were contacted by phone to check their receipt, use and initial impact of the booklets (process evaluation). Six weeks after baseline data was recorded, follow up questionnaires were mailed or emailed to participants.

6.2.3 Participants' v Non-Participants in RCT

Of those invited (n = 414) to participate in the study, 43% consented to participate (41% intervention, 44% control). Participants were slightly older, had children and more likely to have ran the Mini Marathon than non participants (*Table 55*).

Table 55

Characteristics of Participants v Non Participants in the RCT

	Participants n=176 (%)	Non Participants n=238 (%)
Aged less than 40	64.5	73*
Married	55.6	57.7
Children	47.5	40.6
Tertiary Education	74.5	72.2
First Time Participants	36	39.4
Train Continuously	34.2	35.9
Runners in Mini Marathon	8.7	5.8

* = $p < 0.05$ Participants v Non Participants

6.2.4 Sample Characteristics

The participants in this study were all female, 84% were aged between 21 and 49, just over half were married, 47% had children and 75% had received some or complete tertiary education. The study sample was representative of the population they were selected from (all relapsers and the total Mini Marathon population) but had a much higher reported level of education than the general Irish female population. *Table 56* highlights the representativeness of the sample used in this trial compared to all relapsers identified and to total baseline respondents to the initial Mini Marathon physical activity survey.

Table 56

Representativeness of the RCT Study Sample

	RCT Sample n=176 (%)	Total Relapse Sample n=414 (%)	Total Baseline Sample n=11,205 (%)	National Statistics n=1,697,272 (%)
Tertiary Education	75	73	63	27
Aged 20-29	30	28	27	21
No Children	53	57	52	50
Married	55	57	58	46

6.2.5 Measures/Outcome Variables

At baseline, measures of physical activity, self efficacy, social support, outcome expectancy and barriers to physical activity were collected. Follow up data on these same measures was collected after six weeks as well as data assessing the receipt and use of intervention and control materials. At both time points, respondents self perceived levels of physical activity, motivational readiness to start being active, status of current activity in comparison to twelve months ago and suitability of local area to walking was also assessed. Pre and post questionnaires are visible in *Appendix E* (*p. 399 and 403*).

6.2.5.1 Physical activity.

Data were collected using validated questions, which have been used frequently in population physical activity surveys (Bauman et al., 2001; Bauman et al., 2003a) and which have shown sufficient repeatability properties in test-retest analysis (Brown et al., 2004) and are significantly related to objective measures of physical activity (Pettee et al., 2009). Specifically, respondents were asked to recall the number of occasions they undertook different types of physical activity, walking, gardening, vigorous and moderate intensity activity in the last week and the duration of these sessions. Vigorous minutes were doubled as this intensity of activity confers the greatest health benefits and added to moderate activity and walking to calculate sufficient activity minutes; average scores of this data at baseline and follow up were presented. Total activity sessions were also calculated by summing walking, moderate and vigorous sessions. Using these new variables, respondents were classified as sedentary, insufficiently active or sufficiently active (AIHW, 2003). Those reporting no physical activity were deemed sedentary; people doing at least 150 minutes over at least five sessions were classified as 'sufficiently active' for health (USDHHS, 2008), and all others doing some activity but not enough to meet minimum physical activity requirements were categorised as 'insufficiently active'. Total physical activity including and excluding gardening and one amount of vigorous activity was also calculated.

6.2.5.2 Physical activity relapse.

Physical activity relapse, discussed in considerable detail in chapter 5, was defined as a decrease in reported physical activity by at least 240 MET-minutes/wk (60 minutes of moderate intensity activity). Bauman et al. (2001) stated that a change of this magnitude in self reported physical activity is likely to be greater than the measurement error that is apparent in repeated measures. Previous commentary on relapse (Williams et al., 2008a; Luszczynska and Sutton, 2006; Sullum et al., 2000) has stated that relapse is defined as meeting physical activity guidelines at baseline but failing to do so at follow up. Some individuals, despite a decrease of physical activity minutes, may still meet minimum physical activity requirements. Therefore relapse was additionally defined as being categorised as 'low' active at follow up, using IPAQ data; and subsequently not achieving sufficient activity levels.

6.2.5.3 Readiness to change, self efficacy.

Readiness to change and self efficacy were collected using measures previously described in chapter 3. The Cronbach alpha coefficients for internal consistency of the self efficacy items at pre and post time points, in this study, were .61 and .75. There was no test-retest analysis of these or the constructs below.

6.2.5.4 Social support.

Social support was assessed using a modified version of the social support for exercise scale (Sallis et al., 1987); further detail was presented in the previous chapter. The Cronbach alpha coefficients at pre and post survey for social support items were .65 and .56.

6.2.5.5 Outcome expectancy.

Outcome expectancy was assessed using a measure used by Sallis et al. (1989). Respondents were asked to indicate their agreement with eight different outcomes that may be associated with greater levels of physical activity. Again, scores were summed to represent an overall outcome expectancy score with higher scores indicating lower levels of outcome expectancy. The Cronbach alpha coefficients at pre and post survey for items reflecting outcome expectancies were .72 and .75.

6.2.5.6 Barriers to physical activity.

Barriers to physical activity was assessed using a measure developed by Sallis et al. (1989) with respondents being asked to indicate how often a variety of suggested barriers prevented them from doing physical activity. Reponses to nine questions were summed to give an overall score for this construct, with higher scores indicating lower barriers to physical activity. The pre and post survey Cronbach alpha coefficients for items measuring barriers to physical activity were .64 and .86.

6.2.6 Intervention

The intervention consisted of two print booklets, specific to initial and later stages of motivational readiness. The booklets were based on materials previously used in various settings to promote physical activity. Initial consideration was given to booklets used in a study in Australia (Marshall et al., 2003a; 2004a). In this study, four 'Active Living' brochures were developed, broadly based on the various stages of the TTM model; specifically the precontemplation, contemplation, preparation and action/maintenance stage. Each of these was used in the creation of the two booklets for this research.

Other materials referred to and used in the development of booklets for this research included an Irish Heart Foundation brochure 'How to be Active for a Happy Heart', used in Heart Week 2007 and the 'Step by Step: A Self Help Guide to A Physically Active Lifestyle' brochure developed in the Cluster for Physical Activity and Health, Sydney School of Public Health in the University of Sydney for a study that used pedometers to promote physical activity.

Wen et al. (2002) in a community based study to increase physical activity in women developed a slogan and promoted their community initiative, using this, in local media, on t-shirts etc. In their analysis of results, the authors noted that this strategy was critical to the success of the overall project (there was a significant decrease in numbers of sedentary women post intervention). Consequently, a logo (*Figure 14*) and name 'LEG IT – Let's Exercise Girls' was developed and used on intervention materials and on all correspondence with participants.

Figure 14
LEG IT logo

Booklet 1 was entitled 'Time to Get Moving' and was designed to target participants in the earliest stages of motivational readiness. It included information on the benefits of physical activity, minimum physical activity guidelines, a step by step guide on how to increase motivation, a physical activity diary, tips for overcoming barriers and tips on how to start being active. Booklet 2 was called 'Keep Moving' and was tailored to participants who were already somewhat active and in the later stages of motivational readiness. It included more detailed information on the term 'moderate intensity', tips for overcoming barriers, tips for being active at home and at work and information on the benefit of taking the more active option (for example taking the stairs instead of the lift), a personal account from a woman who increased and maintained her physical activity levels and also tips on how to increase the intensity of physical activity. Both booklets also contained contact details for the researchers and links to other useful information sources. No pilot testing was undertaken on the booklets as they have been validated and previously used on population based samples in Australia and the US.

As indicated earlier, psychological constructs, derived from SCT and the TTM, such as self efficacy, outcome expectancy and social support, were measured pre and post intervention. Baranowski et al. (1998) suggested that interventions to promote physical activity are often unsuccessful because they do not have an effect on determinants such as self-efficacy and recommended that future research should focus on changing these physical activity related cognitive constructs. Consequently, the booklets contained information and strategies designed to alter these constructs, which may subsequently alter physical activity behaviour (Lewis et al., 2002). Research suggests such strategies include providing models of behaviour and assessing barriers to physical activity, with accompanying tips for overcoming barriers. Information should also be provided on the efficacy of the behaviour and examples of people who managed to maintain activity after intervention may also be presented (Elder et al., 1999). Focus should be on enjoyment and skills such as goal setting may also be incorporated – all strategies to increase physical activity. Finally, Moore et al. (2010) noted that a lack of knowledge about what constitutes sufficient physical activity was related to subsequent activity status and recommended that better communication strategies about minimum physical activity requirements for health are warranted. As a result, such information about these guidelines and the associated benefits of being more active were also included in the booklets.

6.2.7 Control Group

It was decided to administer a 'placebo treatment' to the control group rather than not distributing anything to this group. Therefore, all members of the control group were mailed a nutrition leaflet, developed in Ireland by the Irish Heart Foundation, An Bord Bia and the Health Promotion Unit. The leaflet focused on good eating for a healthy heart and contained a short paragraph on the added benefit of physical activity for a healthy lifestyle.

6.2.8 Data Analysis

Descriptive statistics for physical activity data and intermediate outcomes were calculated and analysed using repeated measures ANOVA to assess changes pre and post intervention in the intervention and control groups; and also between different baseline activity categories. Change scores and 95% confidence intervals were also calculated to assess the magnitude of change over time. All analysis was undertaken using SPSS Version 15.

6.2.9 Research Questions

1. Were the groups comparable at baseline on demographic, intervening and outcome variables?

2. Did participants receive and read their print materials (intervention v control)?
3. Was there a change in physical activity between baseline and follow up (intervention v control)?
4. Was there a change in perceived physical activity habits between baseline and follow up (intervention v control)?
5. Was there a change in self efficacy, social support, outcome expectancy and barriers to physical activity between baseline and follow up (intervention v control)?
6. Was any change in self efficacy, social support, outcome expectancy and barriers to physical activity related to changes in physical activity?

6.3 Results

Research Question 1: Were the groups comparable at baseline on demographic, intervening and outcome variables?

6.3.1 Baseline characteristics

At baseline, there were no significant differences between the intervention and control groups in terms of sample size, age, marital status, education, self reported and self perceived physical activity per week, readiness to get active and activity levels compared to twelve months ago (*Table 57*). Comparable groups at baseline should ensure that any subsequent change in physical activity, self efficacy etc. is due to the intervention alone.

Table 57

Baseline Characteristics of the RCT Participants

	Intervention n=85	Control n=91
Age (% less than 40)	66.3	62.8
Marital Status (% married)	53.8	55.8
Education (% tertiary)	75.6	75
Average Total Physical Activity Minutes/wk (M, SD)	272.4 (241.6)	321 (210.5)
Average Total Sufficient Physical Activity Minutes/wk (M, SD)	347 (355)	402 (293.3)
Average Total Activity Sessions/wk (M, SD)	5.7 (3.9)	6.6 (3.5)
Self Reported Sufficiently Active (%)	50	64.8
Self Reported Insufficiently Active (%)	50	35.2
Self Perceived Sufficiently Active (%)	41.9	50
Self Perceived Insufficiently Active (%)	58.1	50
Readiness to Get Active (% ready)	68.5	64.8
Activity Compared to Twelve Months Ago (% less active)	28.4	38.4

* = $p < 0.05$ Intervention v Control

Research Question 2: Did participants receive and read their print materials (intervention v control)?

6.3.2 Follow up and receipt and use of materials

Of the 85 intervention and 91 control participants, follow up data was collected on 55 (65%) intervention and 57 (63%) control participants. *Table 58* highlights the characteristics of all participants who did/did not provide follow up data. It is evident that participants who did provide follow up information were significantly younger, had higher levels of tertiary education and were more likely to not have children (p<.05).

Table 58

Characteristics of the RCT Follow Up Participants and Non – Follow Up Participants

	Follow Up n=112 (%)	Non Follow Up n=64 (%)
Aged less than 40	59	42.6*
Married	53.3	57.4
Children	41	57.4*
Tertiary Education	82.5	62.7*
Self Perceived Insufficiently Active	53.6	54.9
Self Reported Insufficiently Active	40.2	42.6

* = $p < 0.05$ Follow Up v Non Follow Up

Further analysis of the characteristics of follow up and non follow up participants in the intervention and control groups revealed differences in parents and level of tertiary education, consistent with those visible in *Table 58.* Of those who were followed up, 49.1% of the intervention group were insufficiently active at baseline, as per self reported Active Australia data, compared to 31.6% of the control group ($p<.05$).

Table 59

Characteristics of the RCT Follow Up Participants and Non – Follow Up Participants (Intervention v Control)

	Follow Up		Non Follow Up	
	Intervention n=55 (%)	Control n=57 (%)	Intervention n=30 (%)	Control n=34 (%)
Aged less than 40	72	69.1	56.7	51.6
Married	52	54.5	56.7	58.1
Children	40	41.8	63.3*	51.6
Tertiary Education	85.7	79.6	58.6*	66.7
Self Perceived Insufficiently Active	52.1	55.1	69.2	40†
Self Reported Insufficiently Active	49.1	31.6†	51.7	41.2

* = $p < 0.05$ Follow Up v Non Follow Up, † = $p < 0.05$ Intervention v Control

There was a significant difference in the receipt and use of materials between intervention and control groups (*Table 60*), although use of materials in the control group was still quite high. 98% of those who received the booklets, in the intervention group, reported some subsequent use of them compared to 91% of their respective respondents in the control group.

Table 60

Receipt and Use of Materials in the RCT

	Intervention n=55 (%)	Control n=57 (%)
Received Materials	94.5	78.9*
Used Materials	96.2	86.7*

* = $p < 0.05$ Intervention v Control

Research Question 3: Was there a change in physical activity between baseline and follow up (intervention v control)?

6.3.3 Change in physical activity

Total physical activity increased significantly between baseline and follow up in both intervention and control groups (only when using total physical activity minutes, including gardening). Although there was a greater increase in the control group, no significant difference in the change in physical activity between groups was apparent. Six weeks post baseline, numbers of respondents not meeting minimum physical activity requirements also decreased significantly in both groups. A significant increase in the number of physical activity sessions was also evident between baseline and follow up, in both the intervention and control groups. Again there was no difference in the change in physical activity sessions between groups. Interestingly, there was an increase in sitting time in both groups, although only the control group demonstrated a significant change (*Table 61*).

Table 61

Physical Activity and Sitting Time at Baseline and Follow Up in the RCT

		Intervention Baseline n=85 Six Weeks n=55	Control Baseline n=91 Six Weeks n=57
Average Total PA (including gardening) Minutes/wk(M, SD)	Baseline	255.5 (238.2)	324.5 (210.6)
	Six Weeks	364.9 (284.8)*	464.6 (295.3)*
Change in Total Physical Activity (including gardening) Minutes/wk (M, 95% CI)		109.4 (30.4-188.4)	140.2 (59.3-221.1)
Average Total Sufficient Physical Activity Minutes/wk (M, SD)	Baseline	318.2 (343.2)	390.7 (259.1)
	Six Weeks	392.2 (297.7)	536.3 (309.1)*
Change in Total Sufficient Physical Activity Minutes/wk (M, 95% CI)		73.9 (-24.9-172.8)	145.6 (64-227.1)
Average Total PA (excluding gardening) Minutes/wk (M, SD)	Baseline	237.4 (271.5)	292.9 (180.1)
	Six Weeks	307.1 (257.8)	406.2 (266.1)*
Change in Total Physical Activity (excluding gardening) Minutes/wk (M, 95% CI)		69.7 (-14.4-153.8)	113.2 (42.7-183.7)
Average Total Activity Sessions/wk (M, SD)	Baseline	5.4 (3.6)	6.9 (3.7)
	Six Weeks	6.8 (3.8)*	8.3 (3.7)*
Change in Total Activity Sessions/wk (M, 95% CI)		1.3 (0.3-2.4)	1.4 (0.5-2.3)
% Insufficiently Active	Baseline	50	35.2
	Six Weeks	32.7*	15.3*
% Sufficiently Active	Baseline	50	64.8
	Six Weeks	67.3*	84.7*
Total Sitting Minutes/day (M, SD)	Baseline	335.9 (194.9)	310.1 (224.7)
	Six Weeks	371.4 (170.1)	369.5 (152.6)*
Change in Total Sitting Minutes/day (M, 95% CI)		35.4 (-11.7-82.4)	59.3 (12.7-106)

* = $p < 0.05$ Baseline v Six Weeks

Detailed analysis (*Table 62*) of the various intensities of physical activity indicated a significant increase in walking sessions, walking minutes, moderate minutes, gardening sessions and gardening minutes in the intervention group. There was a similar change in walking sessions and minutes in the control group as well as a significant increase in vigorous physical activity minutes, from 107 to 145 minutes.

Table 62

Sessions and Duration of Walking, Moderate and Vigorous Physical Activity at Baseline and Follow Up in the RCT

		Intervention Baseline n=85 Six Weeks n=55	Control Baseline n=91 Six Weeks n=57
Walking Sessions/wk	Baseline	3.4 (1.9)	4.1 (2.2)
(M, SD)	Six Weeks	4.3 (2.3)*	5 (2.6)*
Average Walking Minutes/wk (M,	Baseline	120.3 (125.9)	162.1 (130.1)
SD)	Six Weeks	165.2 (143.6)*	229.2 (209.9)*
Moderate Sessions/wk	Baseline	0.4 (0.7)	1 (1.8)
(M, SD)	Six Weeks	0.7 (1.3)	0.9 (1.5)
Average Moderate Intensity	Baseline	27.9 (66)	42.5 (67.2)
Minutes/wk (M, SD)	Six Weeks	64.9 (122.3)*	71 (90.4)
Vigorous Gardening Sessions/wk	Baseline	0.4 (0.9)	0.5 (1.1)
(M, SD)	Six Weeks	1 (1.1)*	0.8 (1.2)
Average Vigorous Gardening	Baseline	39.2 (73.3)	44.2 (69.2)
Minutes/wk (M, SD)	Six Weeks	97.8 (93.3)*	93.5 (135.3)
Vigorous Activity Sessions/wk (M,	Baseline	1.8 (2.2)	2 (1.6)
SD)	Six Weeks	1.8 (1.6)	2.3 (1.6)
Average Vigorous Intensity	Baseline	92.1 (113)	107.1 (104.7)
Minutes/wk (M, SD)	Six Weeks	112.7 (99.1)	145.7 (79.7)*
Average Vigorous Intensity (x2)	Baseline	178.3 (245.2)	218.2 (243.2)
Minutes/wk (M, SD)	Six Weeks	225.3 (198.2)	291.3 (159.3)*

* = $p < 0.05$ Baseline v SixWeeks

Further analysis (*Table 63*) of differences between intervention and control groups among the activity categories at baseline indicate that significant increases in physical activity were apparent in the insufficiently active groups only. However, changes in activity between sufficient and insufficiently active were only significantly different for total activity sessions per week. There was no significant difference in the change in activity groups between the intervention and control group.

Table 63

Physical Activity and Sitting Time at Baseline and Follow Up in the RCT: Sufficiently and Insufficiently Active Groups

		Intervention		Control	
		Sufficiently Active Baseline n=42 Six Weeks n=37	Insufficiently Active Baseline n=42 Six Weeks n=18	Sufficiently Active Baseline n=59 Six Weeks n=50	Insufficiently Active Baseline n=32 Six Weeks n=7
Average Total Physical Activity Minutes/wk (incl.gardening) (M, SD)	Baseline	402.5 (185.4)	108.6(190.7)	416.8 (186.7)	129.6 (91.4)
	Six Weeks	465.6 (328.2)	264.2(191.3)*	524.7 (318.5)	337.8(190.1)*
Change in Average Total Physical Activity Minutes/wk (incl. gardening) (M, 95% CI)		63.2 (48.9-175.2)	155.7 (44.9-266.4)	107.9 (3.9-219.8)	208.3 (125.7-290.9)
Average Total Sufficient Physical Activity Minutes/wk (M, SD)	Baseline	499.4 (267.1)	137 (317.4)	503.8 (228.8)	152 (119.6)
	Six Weeks	515.6 (331.5)	268.7(198)	604.9 (325.1)	391.3(215.2)*
Change in Average Total Sufficient Physical Activity Minutes/wk (M, 95% CI)		16.15 (-105.4-137.7)	131.7 (-23.3-286.8)	101.2 (-10.2-212.5)	239.3 (155.3-323.3)
Change in Average Total Activity Sessions/wk (M, 95% CI)		-.2 (-1.6-1.2)	3 (1.6-4.5)	.72 (-.3-1.8)	3 (1.8-4.2)
Total Sitting Minutes/day (M, SD)	Baseline	375.5 (172.7)	293.4 (211.5)	323.4 (200.5)	281.4 (274.3)
	Six Weeks	374.1 (171.3)	368.4 (172.1)	359.1(167.8)	391.9(114.3)
Change in Total Sitting Minutes/day (M, 95% CI)		-1.4 (-41.5-38.8)	74.9 (-11.2-60.9) †	35.7 (-8.6-80.1)	110.4 (-0.4-221.3) †

* = $p < 0.05$ Baseline v Six Weeks, † = $p < 0.05$ Sufficiently Active v Insufficiently Active

Increases ($p<.05$) in walking and gardening sessions and minutes spent doing the latter and vigorous activity and were apparent among insufficiently active participants in both groups (*Table 64*). There was also an increase in moderate activity time and gardening sessions in the insufficiently active intervention group.

Table 64

Sessions and Duration of Walking, Moderate and Vigorous Physical Activity Baseline and Follow Up in the RCT: Sufficiently and Insufficiently Active Groups

		Intervention		Control	
		Sufficiently Active Baseline n=42 Six Weeks n=37	Insufficiently Active Baseline n=42 Six Weeks n=18	Sufficiently Active Baseline n=59 Six Weeks n=50	Insufficiently Active Baseline n=32 Six Weeks n=7
Walking Sessions/wk (M, SD)	Baseline	4.7 (1..3)	2 (1.5)	4.9 (1.9)	2.2 (1.6)
	Six Weeks	4.9 (2.5)	3.6 (1.8)*	5.4 (2.7)	3.9 (2.1)*
Average Walking Minutes/wk (M, SD)	Baseline	168.6 (75.8)	71.9 (147.3)	199.9 (134.4)	85.3 (78.3)
	Six Weeks	208.5 (172.5)	121.9 (91.4)	255.1 (234.9)	175.9 (136.9)*
Moderate Sessions/wk (M, SD)	Baseline	.5 (.8)	.1 (.4)	1.2 (1.9)	.4 (.7)
	Six Weeks	.7 (1.1)	.7 (1.6)	1.1 (1.6)	.5 (.9)
Average Mod. Intensity Minutes/wk (M, SD)	Baseline	51.1 (89.7)	6.9 (16.5)	49.3 (70.9)	24.6 (55)
	Six Weeks	88.9 (163.9)	43.1 (62.7)*	65.9 (87.3)	84.6 (101.1)
Vigorous Gardening Sessions/wk (M, SD)	Baseline	.6 (1.1)	.1 (.3)	.7 (1.2)	0 (0)
	Six Weeks	.8 (1)	1.2 (1.1)*	1 (1.3)	.3 (.5)* †
Average Vigorous Gardening Minutes/wk (M, SD)	Baseline	69.5 (94.3)	12.4 (31.9)	57.2 (74.1)	.13 (.35)
	Six Weeks	114.4 (96.9)	82.8 (90.4)*	102.2 (152.3)	63.9 (37.4)*
Vigorous Activity Sessions/wk (M, SD)	Baseline	3 (2.2)	.3 (.5)	2.5 (1.5)	.5 (1.1)
	Six Weeks	2.4 (1.4)	1.1 (1.5)	2.7 (1.5)	1.1 (1.4)
Average Vigorous Intensity Minutes/wk (M, SD)	Baseline	157.7 (117.7)	17.2 (32.5)	137.4 (103.9)	28.9 (55.9)
	Six Weeks	147.5 (104.9)	72.9 (76.3)*	161.4 (79.9)	105.2 (65.4)*
Average Vigorous Intensity Minutes/wk (x2) (M, SD)	Baseline	315.4 (235.4)	34.4 (64.9)	274.9 (207.8)	57.9 (111.9)
	Six Weeks	295 (209)	145.7 (152.6)*	322.8 (159.9)	210.4 (130.7)*

* = $p < 0.05$ Baseline v Six Weeks, † = $p < 0.05$ Intervention v Control

Overall, there was a consistent increase in physical activity across the different age groups; however, there was no significant difference in the increase in physical activity or sitting time between age groups (*Table 65*) or in the change in physical activity between married and single women or between those with and without tertiary education. There was, however, a significantly (p<.05) greater increase in total physical activity in parents in the intervention group, compared to non parents. Furthermore, there was a decrease in sitting time, the only visible decrease detected in this variable, in parents, in the intervention group. Lastly, repeat participants and walkers primarily displayed more favourable changes in physical activity and sitting time than first time participants and runners.

Table 65

Changes in Physical Activity and Sedentary Behaviour across Demographic and Event Characteristics in the RCT

	Change in Average Total Physical Activity Minutes/wk		Change in Total Sitting Minutes/day	
	Intervention n=55 (M, SD)	Control n=57 (M, SD)	Intervention n=55 (M, SD)	Control n=57 (M, SD)
Aged <40	76.4 (314.2)	136.8 (284.1)	35.9 (159)	42.3 (182.2)
Aged >40	155.2 (281.8)	192.4 (354.4)	7.5 (104.9)	107.9 (106.2)
Married	54.4 (196.2)	141.8 (319.8)	6.8 (110.4)	87.9 (180.8)
Unmarried	149 (382.2)	168.7 (294.2)	47.1 (175.6)	32.2 (180.8)
No Children	24.2 (303.9)	175.9 (304.1)	53.2 (159.7)	72.2 (201.4)
Children	221.5 (264.8)*	125 (312)	-15.6 (112.4)	49.2 (152.4)
No Tertiary	57.3 (195.5)	227.8 (347.8)	16.7 (125.9)	174.9 (186.4)
Tertiary	108.4 (310)	137.5 (298.8)	31.1 (152.3)	38.8 (170.4)*
First Time	53.7 (354.5)	171.2 (294.9)	41.6 (178.2)	80.7 (193.7)
Repeat	123.2 (270)	145.8 (314.6)	19.2 (118.9)	53.8 (177.1)
Walkers	130.1 (297.9)	176.4 (292.6)	22.3 (138.1)	34.5 (159.2)
Runners	-3 (317.6)	106.2 (336.3)	49.6 (172.9)	120.4 (213.3)

* = $p < 0.05$ Aged < 40 v Aged > 40, Married v Unmarried, No Children v Children, No Tertiary v Tertiary

Participants were asked how ready they were to get active at baseline; 8% indicated they were not ready to be active while 66% felt they were ready. *Table 66* indicates the change in physical activity among participants reporting different readiness to be active. In the intervention group, the greatest change in physical activity was visible in the 'not ready to be active' group; it was greatest in the 'ready to be active' respondents in the control group (p>.05). Surprisingly, sitting time actually decreased in those with a low reported readiness to be active, in both groups.

Table 66

Change in Physical Activity between Readiness to be Active Groups in the RCT

	Intervention		Control	
	Not ready to be active n=5 (M, SD)	Ready to be active n=34 (M, SD)	Not ready to be active n=8 (M, SD)	Ready to be active n=31 (M, SD)
Change in Average Total Physical Activity Minutes/wk	184.8 (342)	41.4 (283)	106 (93.2)	122.2 (344.1)
Change in Total Sitting Minutes/day	-48 (128.3)	3 (107.7)	-27.5 (60.1)	5.4 (113.5)

* = $p < 0.05$ Not Ready to be Active v Ready to be Active

Research Question 4: Was there a change in perceived physical activity habits between baseline and follow up (intervention v control)?

6.3.4 Self reported v self perceived levels of physical activity

Changes in self reported physical activity levels were consistent with changes in self perceived levels of physical activity (*Table 67*). At baseline, approximately 58% of the intervention group felt that they did not meet minimum physical activity requirements; this decreased to 42% at follow up (p>.05). There was a similar decrease in the control group, which was significant.

Table 67

Self Perceived Levels of Physical Activity at Baseline and Follow Up in the RCT

	Intervention		Control	
	Baseline n=73 (%)	Six Weeks n=53 (%)	Baseline n=74 (%)	Six Weeks n=57 (%)
Meeting Minimum Physical Activity Guidelines	42.5	58.5	50	70.2*
Not Meeting Minimum Physical Activity Guidelines	57.5	41.5	50	29.8*

* = $p < 0.05$ Baseline v Six Weeks

At follow up, 19% of total respondents cited that they were more active, while 46% felt that they were less active. A greater proportion of the intervention group felt they were more active than the control group; 22% compared to 15%. *Table 68* reveals the proportion of more/less active respondents who were sufficient or insufficiently active at follow up. In the intervention group, 90% of those who felt they were less active were actually sufficiently active according to their self report physical activity data. All of the more active respondents in the control group were categorised as sufficiently active.

Table 68

Current Physical Activity Status Compared to Twelve Months Ago at Follow Up

	Intervention		Control	
	Sufficiently Active n=33 (%)	Insufficiently Active n=16 (%)	Sufficiently Active n=45 (%)	Insufficiently Active n=6 (%)
More active than twelve months ago	50	50*	100	0
Unsure	47.1	52.9*	77.8	22.2
Less active than twelve months ago	90.9	9.1*	92	8

* = $p < 0.05$ Sufficiently Active v Insufficiently Active

6.3.5 Phone Call Data

As noted earlier, phone contact was made with intervention participants three weeks into the trial. Ninety seven per cent of the group received the booklet and 10% subsequently did not read any of the content. A corresponding 90% of respondents found the booklet somewhat or very useful, although only 50% indicated that their physical activity levels had increased over the three weeks. Of those participants who did not perceive they had increased their physical activity levels after three weeks, 43.5% were subsequently sufficiently active at follow up and 56.5% were insufficiently active (*Table 69*).

Table 69

Self Perceived Increase in Physical Activity between Activity Groups in the RCT

	Sufficiently Active n=25 (%)	Insufficiently Active n=28 (%)
Increased Physical Activity	50	50
Did Not Increase Physical Activity	43.5	56.5

* = $p < 0.05$ Yes/No Increased Physical Activity

Of those who did note an increase in physical activity, 57% felt it was due to greater levels of motivation and 32% to more knowledge on how to be active. 10% attributed their change in physical activity to their training for the 2008 Mini Marathon.

Research Question 5: Was there a change in self efficacy, social support, outcome expectancy and barriers to physical activity between baseline and follow up?

6.3.6 Changes in secondary variables

As indicated in *Table 70*, there was a significant difference between pre and post self efficacy in the intervention group and in barriers in both groups. The decrease in self efficacy represents an increase in this construct between baseline and follow up while the decrease in barriers indicates an increase in the presence of barriers.

Table 70

Secondary Variables at Baseline and Follow Up in the RCT

		Intervention Baseline n=85 Six Weeks n=55	Control Baseline n=91 Six Weeks n=57
Self – Efficacy	Baseline	10.5 (2.9)	10 (2.4)
(M, SD)	Six Weeks	9.7 (2.9)*	9.8 (2.9)
Social Support	Baseline	9 (1.9)	9.1 (2.3)
(M, SD)	Six Weeks	9 (1.9)	8.6 (2.4)
Outcome Expectancy (M, SD)	Baseline	14.5 (2.9)	14.6 (3.4)
	Six Weeks	13.8 (3.9)	14.6 (3.1)
Barriers to Physical Activity	Baseline	21 (2.7)	21.8 (2.9)
(M, SD)	Six Weeks	19.4 (2.6)*	20.4 (3.3)*

* = $p < 0.05$ Baseline v Six Weeks

Analysis of the change in secondary variables between activity groups at baseline revealed no significant difference in self efficacy, social support or outcome expectancy between sufficient and insufficiently active at baseline and follow up, in the intervention and control groups. There was, however, a significant difference in barriers to physical activity among both activity groups between baseline and follow up, indicating that barriers to physical activity actually increased six weeks post baseline.

Table 71

Secondary Variables at Baseline and Follow Up in Activity Groups in the RCT

		Intervention		Control	
		Sufficiently Active Baseline n=42 Six Weeks n=37	Insufficiently Active Baseline n=42 Six Weeks n=18	Sufficiently Active Baseline n=59 Six Weeks n=50	Insufficiently Active Baseline n=32 Six Weeks n=7
Self Efficacy (M, SD)	Baseline	9.5 (2.6)	11.8 (2.9)	9.7 (2.1)	11 (3.1)
	Six Weeks	8.7 (2.6)	11.1 (2.7)	9.6 (2.8)	10.3 (3.2)
Social Support (M, SD)	Baseline	8.5 (1.9)	9.8 (1.8)	8.8 (2.3)	10.1 (1.9)
	Six Weeks	8.2 (1.9)	10.1 (1.4)	8.3 (2.4)	9.8 (1.9)
Outcome Expectancy (M, SD)	Baseline	14.2 (2.6)	14.9 (3.3)	14.6 (3.3)	14.4 (3.9)
	Six Weeks	13.8 (3.8)	13.8 (4.2)	14.7 (3.2)	14.3 (3)
Barriers to Physical Activity (M, SD)	Baseline	21 (2.9)	21 (2.6)	22.2 (2.9)	20.5 (2.6)
	Six Weeks	19.8 (2.3)*	18.9 (2.9)*	21 (3.4)*	18.5 (2.2)*

* = $p < 0.05$ Baseline v Six Weeks

The lack of an intervention effect, as highlighted on page 212, prevented an assessment of research question 6; to assess the mediating role of self efficacy, social support, outcomes expectancy and barriers to physical activity on a change in physical activity in the intervention group.

6.4 Discussion

Results from this trial indicated that there was an increase in total physical activity time and number of activity sessions in the intervention and control groups. Both groups reported significant increases in walking sessions and duration of walking at follow up; the intervention group demonstrated significant increases in moderate and gardening/yardwork minutes and the control group showed similar changes in vigorous physical activity minutes. Furthermore, there was a significant increase in the numbers who were sufficiently active six weeks post baseline and a significant increase in sitting time in the control group only.

6.4.1 Participants and Drop Out

Just over 40% of the study sample agreed to participate in this trial, comparable to Chinn et al. (2006) who assessed individuals who did not volunteer to take part in a GP intervention in the UK designed to promote physical activity. Participants and non participants in this study of Mini Marathon participants were similar, the only difference being that a greater proportion of non participants were aged less than 40 and participants were slightly more likely to have children. Chinn et al. (2006) noted considerable variation in their study; non-volunteers were significantly more likely to smoke and not have tertiary education, while they also observed that this group were less likely to have children ($p<.05$). As befits a randomised controlled design, no differences between the intervention and control participants in this trial were apparent. A greater disparity was evident between follow up and non follow up participants. Attrition from RCTs is common and can result in bias if there are differences between follow up and non follow up participants (Dumville, Torgerson and Hewitt, 2006). In this research, an approximate 64% follow up rate was achieved and non completers were older, more likely to have children and had a lower proportion of tertiary educated individuals. This drop out rate was high; Dumville et al. (2006) noted that a greater than 20% attrition rate could induce bias but may be explained in this instance by the use of a non self selected population based sample rather than volunteers. Also, Fewtrell et al. (2008) noted that this minimal drop out rate is ambitious in lifestyle related trials.

Psaty et al. (1994) reported an approximate attrition rate of 45% in their study, which involved telephone interviews to assess self reported health behaviours with a random sample of participants in the US. Subsequent analysis of the characteristics of non follow up participants revealed that drop out was more prevalent among participants who were older, had lower levels of education, earned less, had poorer self rated health, had a history of heart problems and who exercised less. Bock et al. (2001) and Marcus et al. (1998b) also noted that completers in their study were more educated than non completers. Despite similar observed discrepancies between follow up and non follow up participants in this trial, the threat of bias is offset upon the realisation that drop out was similar in both randomised groups (65% and 63%). Furthermore, intervention and control follow up and non follow up groups only differed with respect to perceived and reported levels of physical activity and remained similar for all important demographic predictor variables. Dumville et al. (2006) and Fewtrell et al. (2008) noted that both of these factors can minimise the incidence of bias incurred by drop out.

Although all of the participants in this trial were identified as relapsers, analysis of physical activity data provided at baseline revealed that only 50% of the intervention group and 35% of the control group were insufficiently active; much lower than Marshall et al. (2003a) who reported that 74% of their intervention group and 72% of their control group were insufficiently active. In an extension of this study, Marshall et al. (2004a) had similar high insufficiently active rates at baseline. However, Miller et al. (2002) stated that just over half of both their intervention and control groups were insufficiently active at baseline, similar to rates in this research.

The high proportion of sufficiently active at baseline may be due to the timing of this trial; it was conducted in April 2008, when many of the participants (Mini Marathon 2007 respondents) would have commenced training for the 2008 event. Sixty two per cent of the 2007 respondents were participating for the second or more time so it is likely that many of the participants in this trial were repeat participants and had re-commenced low grade training for the next (2008) Mini Marathon event. In the intervention group, the reported increase in physical activity was twice as high among repeat participants compared to first time participants. While this was not replicated in the control group, more favourable changes in sitting time among frequent participants over the study period supports the notion that they had begun training for the 2008 event. Also, the fact that previous runners and people who had participated in the Mini Marathon twice or more previously were more likely to participate in the intervention suggests that transient or other reasons may have been responsible for their being classified as relapsers, and that their behaviour may have been cyclical and they had resumed physical activity after an initial drop off in physical activity.

6.4.2 Changes in Physical Activity and Sedentary Behaviour

Overall, the intervention group reported a more notable change in duration of moderate intensity activity as well as a less substantial increase (25 minutes less than control) in sitting time. Brown et al. (2005) presented longitudinal data on over eight thousand Australian women who completed three stages of a women's health study (ALSWH). Self reported measures of BMI, physical activity and sitting time were among the variables collected. Over a five year period, one half of the women surveyed reported weight gain and this was related to lower physical activity levels and increased sitting time. Sitting remained a predictor of weight gain after adjustment for energy intake and physical activity, which highlights the importance of monitoring sedentary behaviour in weight management. As noted in chapter 3 and 4, this consideration of sitting time may be as important as engaging in physical activity in the pursuit of a healthier population. As well as the less substantial increase in sitting time in the intervention group compared to the control group, a sub group of parents within the overall intervention group actually displayed a decrease, albeit a minimal change, in time spent sitting.

As indicated in *Table 52*, Marcus et al. (1998a), Bock et al., (2001) and Marshall et al. (2003a) all reported a significantly greater percentage of intervention participants meeting physical activity guidelines post intervention than control participants. The latter observed a 20% increase in the intervention group. An increase, of similar magnitude to Marshall et al. (2003a), was detected in the intervention group (50% to 67%) in this study but it was replicated in the control group (65% to 85%). There were lower rates of insufficiently active in the control group at baseline, and this was manifested in physical activity data collected at this stage; these participants engaged in approximately 320 minutes per week of physical activity compared to 255 minutes per week in the intervention group participants. This higher pre intervention engagement in activity did not preclude control participants from increasing their participation post intervention. As indicated previously, they displayed a significant improvement in physical activity, approximately 30 minutes more than the intervention group. It appears control participants were more active individuals and thus, were more likely to react and benefit from the contact, despite its generic content.

Despite the lack of an intervention effect on physical activity, the increased duration spent being active and proportion meeting physical activity guidelines is positive as it has been facilitated on a population based sample, which is rare in public health research. Many self selected samples are generated from advertisements (Marcus et al., 1998a; 2007a; 2007b; Bock et al., 2001; Lewis et al., 2006) while Marshall et al (2003a; 2004a) also recruited a population sample using databases of participants who took part in population surveys. The sample recruited to this trial and those that actually submitted follow up data were similar to the total baseline sample apart from a higher proportion of tertiary educated participants. In chapter 3 it was noted that the Mini Marathon population was somewhat different to the Irish female adult population; these mass event participants reported higher levels of tertiary education, were younger, were more likely to not have children and to be married, which explains the discrepancy between the sample in this trial and national statistics. Despite this, the sample still retains its classification as a non self selected sample

A more detailed assessment of the change in physical activity post intervention revealed a mean increase of 156 minutes in the insufficiently active intervention group (110 minutes in total group) and a 208 minute increase in their counterparts in the control group (140 minutes in total group) while the average number of sessions completed doubled in both groups; there was no between group difference. Also, the insufficiently active intervention group displayed a decrease in sitting time, albeit a minimal one, in contrast to increases in all other activity sub groups (intervention and control). Improvements in a control group are often noted; Marcus et al. (1998a) reported a similar outcome, which may have been due to the well designed physical activity materials that they distributed to their control group. Napolitano et al. (2006), after three months, also found a significant increase in physical activity in their three treatment groups (tailored, targeted, control). It was noted that mere participation in a programme and answering questions on physical activity may focus people on physical activity and motivate short term reported behaviour change (Napolitano et al., 2006; van Sluijs et al., 2006) rather than the administration of interventions or strategies. In contrast to both of these publications increases in the control group were of greater magnitude than those in the intervention group in this research despite the provision of standard, general health booklet. This suggests the role of other factors, such as the recruitment of a highly educated sample, in instigating the increase in physical activity than just the content of the materials.

Another possible reason for the favourable changes in physical activity in both the intervention and control groups in this research includes the relatively short follow up period. Typically, positive changes are apparent immediately post intervention; a reflection of the initial enthusiasm and eagerness displayed by consenting participants. Follow up data in this research was collected after six weeks only, primarily due to the timing of the trial and the re-commencement of training prior to the 2008 event, in comparison to between five and twelve month follow up in many of the studies reviewed earlier. As noted in the previous chapter, effects at short term follow up often taper at long term follow up. Significant intervention effects reported by Marshall et al. (2003a) at two months and Napolitano et al. (2006) at three and six months both disappeared by six and twelve months respectively. It is difficult to assess if the observed changes in this research could be sustained long term.

Finally, Van Sluijs et al (2006) undertook a study to assess the effect of using physical activity measurement tools on subsequent behaviour, which may also explain the findings in this research. The authors used a Solomon four-group design, which involves a standard pre and post assessment of an intervention and control group supplemented by post tests only in additional intervention and control groups. At six month follow up, analysis revealed a significant measurement effect in both conditions. While this latter point suggests that such a measurement effect would not affect the outcome, there is still a possibility that the distribution of physical activity related questionnaires is sufficient to induce behaviour change, irrespective of any subsequent intervention. This reactive effect is another possible explanation for the results generated in this particular study, particularly as both groups were somewhat predisposed to being active given their participation in a mass event.

6.4.3 Randomisation

Participants in this study were randomised to the intervention and control group prior to acquiring consent, a design similar to that described by Zelen (1990) and previously used by Lewis et al. (2006) and Spittaels et al. (2007). Zelen identified a single and double consent method where participants in a single design are randomised to a group and consent is subsequently sought in the intervention group only, to ensure control participants do not know a different intervention arm exists. In a double consent design, consent is acquired in both groups. Zelen (1990) noted that participants recruited using a double consent design were permitted to crossover to an alternative treatment, which can dilute an intervention effect as participants move from the control to treatment group. A mixture of these designs were administered in this study; consent was acquired in both intervention and control groups but control participants were not informed about or granted an opportunity to transfer to a different group. It would appear that this technique is more ethical than seeking consent before randomisation as all participants are fully informed prior to consent of the nature of their engagement in the study, which may subsequently boost recruitment and retention rates and prevent disappointment among those not receiving the main intervention (Adamson et al., 2006).

Homer (2002) observed that post randomisation consent of eligible participants prevents selection bias as preferential recruitment is not viable. Also, Adamson et al. (2006) noted in their review of the Zelen method that one of the main reasons for adopting this approach was to prevent bias and minimise the Hawthorne effect, which stipulates that participants may alter behaviour simply due to their involvement in a study and involves not revealing to participants that they are taking part in a trial. In this instance, participants were aware that they were engaging in a trial but the exact objective of the trial, to promote physical activity, was not directly conveyed to control participants. It was envisaged that this would reduce the Hawthorne effect but was not successful as both intervention and control participants reported increases in physical activity at follow up, the intended effect possibly diluted by the administration of physical activity questionnaires.

6.4.4 Summary of Positive Outcomes of the RCT

Due to the high proportion of sufficiently active at baseline, analysis of the change in physical activity was focused on the insufficiently active groups. As noted previously, this revealed a significant increase in total physical activity and physical activity sessions among the insufficiently active in both intervention and control groups. There was no difference in the change in physical activity between the intervention and control group, as per Miller et al. (2002), suggesting that the tailored materials used in this trial did not have a greater impact than standard health information and that contact alone, of any nature, was sufficient to instigate changes in physical activity.

Interestingly, high percentages of the intervention and control group recalled receiving (95% and 79%) and using (96% and 87%) materials that were mailed to them although both were significantly higher in the intervention group. All of these statistics are higher than Marshall et al. (2004a); 76% recalled receiving them and 83% subsequently used them. The high rates of recall and use in this research, particularly in the control group, offers further vindication for the merit of generating any contact with individuals to initiate behaviour change.

Another positive outcome after six weeks was the consistency between changes in self reported and self perceived physical activity, with both showing an increase between baseline and follow up. There was an element of discrepancy between respondents who were sufficiently active at follow up yet perceived they were less active than twelve months ago. Over 80% of the intervention and control group who were meeting physical activity guidelines felt they were less active than twelve months ago, in spite of their current satisfactory levels of physical activity.

In the total intervention group, there was a significant improvement in self efficacy although this was not evident when activity groups were separately assessed. Marcus et al. (1998a) reported a similar increase in self efficacy in their intervention and control groups. There was no change in outcome expectancy or social support, which was unsurprising given the short duration and low contact of this intervention. An increase in barriers to physical activity was detected in the overall and separate activity groups between baseline and follow up in intervention and control groups. Miller et al. (2002) did report a slight negative change in self efficacy and partner support in their study indicating it is not unknown to detect such changes in psychological constructs associated with physical activity. It is also likely that rather than barriers actually increasing, participants became more aware of their reasons for not being active during their involvement in the study.

6.5 Limitations

As noted earlier, although participants were identified and recruited as relapsers, six months after their participation in the 2007 Mini Marathon approximately half of the group were subsequently deemed sufficiently active in the baseline questionnaire of this study. This suggests variability in the physical activity habits of the general population as well as the difficulty in identifying relapsers or sedentary individuals using small and self report assessments. The high proportion of sufficiently active at baseline may also be due to the timing of this trial when potential participants in the 2008 Mini Marathon were likely to be re-focusing on the forthcoming event and had re-adopted some physical activity; Lane et al. (2008) reported that over 60% of Mini Marathon participants are repeat participants.

It is likely that the increases in physical activity over the six weeks were unrelated to the intervention, and due to re-training prior to the 2008 event. However, analysis of phone call data does not support this hypothesis; increases in physical activity were mostly attributed to greater motivation levels and more knowledge on how to be active. Another explanation is seasonal variation, as follow up was undertaken in May and this is a time when many people might become more active. Tucker and

Gilliland (2007) reviewed the relationship between weather and physical activity and did indeed note that physical activity levels are highest in the spring and summer, increasing from lower rates in winter.

There was some loss to follow up in this study, perhaps due to the recruitment of a diverse population based sample. Follow up rates were approximately 30% lower in both the intervention and control groups compared to those attained in research undertaken by Marshall et al. (2003a), who enlisted a similar sample. This latter study had a 92% and 93% follow up rate in the intervention and control group, compared to 65% and 63% in this research. Finally, all physical activity data collected were self report. Although instruments used to collect this data were previously validated, there may be a degree of over reporting of physical activity among participants at all stages. However, any inaccuracies should be evenly distributed among intervention and control groups.

6.6 Implications for Health Promotion

The anomaly between the classification of relapsers immediately post event and the high proportion of sufficiently active six weeks later suggests that any future intervention with insufficiently active women should commence as soon as possible after their initial identification. Also, as noted earlier, this study was undertaken in Spring 2008 when weather conditions improve and when prospective participants in the 2008 Mini Marathon may have commenced training for the June event. Increases in activity visible after six weeks may have occurred without any prompt or perhaps, the provision of tailored and standard print materials stirred participants, at a suitable time of year with a goal of increasing activity to aim for. This trial could be replicated during a different season and sooner after the Mini Marathon. If participants with similar characteristics (relapsers) to those included in this trial were recruited to a trial two or three months after the Mini Marathon, benefit could be twofold. Firstly, at this time of year, participants may be less motivated to be active and secondly, their physical activity habits may better reflect their relapse status, thus avoiding the high levels of baseline activity recorded in this trial.

Although this trial did induce changes in physical activity they were apparent in the intervention and control group and may/may not have solely been a result of the materials delivered to participants. Marshall et al. (2004a) after their print based intervention failed to induce physical activity changes, suggested that more community based approaches might enhance the effectiveness of physical activity programmes. Also, in light of the increase in physical activity attained in this minimal contact intervention, it may be more cost effective, practical and sustainable to adopt such an approach and avail of existing community resources for physical activity. Indeed, the development of more generalisable, community based interventions is a current priority in public health research. There is also evidence for including pedometers or telephone prompts as part of a print based intervention or for developing an internet based initiative to instigate greater, longer term increases in physical activity.

6.7 Conclusion

There was no difference in the increases in physical activity between intervention and control groups in this study, suggesting that the tailored materials used in this trial did not have a greater impact than standard health information and contact alone. Despite the lack of an intervention effect, this study has served as a worthwhile pilot effort involving the targeting, recruitment and delivery of an intervention to a population based sample of participants. There appears to be considerable potential to re-engage this particular cohort of women in physical activity using practical, existing resources rather than recruiting them to short term, once off trials. Thus, much has been gleaned from this trial that will be considered in the development of a more realistic, community orientated intervention following the 2008 event. Also, the increase in physical activity, most apparent among the least active, is a positive outcome, irrespective of its origin. Future investigation of these relapsing population samples would benefit from larger trials, leading into different seasons, and using more differentiated doses of intervention between groups.

Chapter 7: Community Based Cluster Randomised Controlled Trial to Promote Physical Activity among Insufficiently Active Women

7.1 Background

As noted earlier, there were over 40,000 participants in the 2008 Dublin Mini Marathon and 10,000 in the Cork equivalent, illustrating the potential for this annual mass event to motivate women in Ireland to be physically active. A number of these participants were insufficiently active before and after the event (n =172, Dublin and n = 36, Cork) and many more relapsed from high to low levels of activity following the event (n = 369, Dublin and n = 49, Cork). These individuals represent an 'at risk' population based sample, which merit intervention to increase and/or maintain their physical activity levels to/at recommended levels using cost effective and sustainable methods.

In 2007, the WHO published essential pre-requisites for population based approaches to increase physical activity; these included political commitment, integration of policies, funding, targeting, and the development of strategies to support behaviour change at an individual, social and environmental level. Later in 2008, WHO re-affirmed these best practice guidelines when discussing the provision of interventions for developing countries. This report provided specific examples of intervention strategies including raising awareness, education, building capacity and creating supportive environments that when used in collaboration with each other have the greatest effect on physical activity. Community based interventions provide a suitable vehicle for the adoption and dissemination of many of these proposed strategies.

7.1.1 Background to Community Based Interventions

Community based interventions typically refer to the community as a setting for the intervention. However, community based interventions can also involve using the community as a resource or agent where resources within the community are utilised and mobilised to induce health behaviour change (McLeroy et al., 2003). This approach incorporates the use of existing structures to intervene in a community; these can include schools, workplaces, families and government and voluntary agencies. If these can be used as agents to deliver a proposed intervention there may be a greater potential for community rather than individual behaviour change. The community based intervention discussed throughout this chapter used the community in either one or both of these ways (as a setting or resource).

Community based interventions to promote physical activity have become increasingly popular in public health research, as efforts are undertaken to enhance the external validity (the generalisability of findings from research to practice) and effectiveness of strategies designed to increase physical activity, and other lifestyle behaviours. Merzel and D'Afflitti reviewed a number of these interventions in 2003 and obseved rather unexceptional results. This included outcomes from three of the earliest and largest community based interventions that were delivered in the US in the 1990s; the Pawtucket Heart Health Program, the Standford Five-City project and the Minnesota Heart Health Program. Further independant assessment of these programmes (Eaton et al., 1999; Winkleby et al., 1996; Luepker et al., 1994) revealed only modest changes in physical activity and related risk factors for CV disease after 6-7 years. The authors noted that more significant, sustained results would warrant the involvement of more community settings with greater environmental and policy based approaches and greater targeting of sub groups within communities, which was re-affirmed by Merzel and D'Afflitti in 2003.

Many current community based interventions incorporate a socio-ecological framework in the design, implementation and evaluation of their interventions but the recommendations above suggest that a greater shift in focus to reflect the factors within this model is required. This approach, described previously in chapter 2, suggests that behaviours are a result of physical, personal, environment, social, policy and cultural factors, and aims to understand and influence behaviours in this broad context; a move from individually orientated explanations of behaviour change, which reflects best practice guidelines developed by WHO (2007; 2008a). Sallis et al. (2006) stated that 'multi-level interventions based on ecological models and targeting individuals, social environments, physical environments and policies must be implemented to achieve population change' (p. 298). The authors also recommended that interventions should provide safe settings for physical activity, incorporate motivational and educational strategies to stimulate use of these settings and mobilise mass media and community interest groups to modify social norms and culture. This represents a useful framework for community based interventions to increase physical activity, but there exists a lack of information or evidence about how best to design and implement these interventions to enhance their transferabiltiy and effectiveness.

Indeed, a problem with many community interventions is their lack of generalisability to the community at large due to a high level of complexity and/or cost.

Dzewaltowski et al. (2004) noted that researchers are preoccupied with designing effective programmes rather than focusing on the ability to deliver the programme with limited resources to a large number of people and enhancing the external validity of strategies developed. Consequently, the authors undertook a review of community based interventions that aimed to instigate behaviour change, using the RE-AIM framework (reach, efficacy/effectiveness, adoption, implementation and maintenance, Glasgow et al., 1999). The aim of this framework is to integrate internal (the degree to which changes can be attributed directly to the intervention) and external validity issues that are both important in attempts to transfer research findings into practice. Reach refers to participation rate and representativeness of eligible participants. Efficacy and effectiveness refer to the positive impact of the intervention, adoption to the involvement of agents in the community, implementation to the quality of delivery of the intervention and maintenance to the long term success of the programme.

In their review, Dzewaltowski et al. (2004) found that only 11% of the studies reviewed included information on the representativeness of participants, there was relatively little information on the involvement of settings in the community, over 50% provided information on the delivery of the programme, and less than a third of studies analysed follow up data after the conclusion of the intervention. The authors concluded that studies do not provide sufficient detail to assess the representativeness of their work and recommended that greater efforts are taken to apply the principles of the RE-AIM framework in future community based research. Wang, Moss and Hiller (2005) presented another approach to increasing the generalisability of public health interventions, which incorporated appraising the applicability and transferability of the intervention to other locations outside of the study setting. Again, the authors recommended the use of this evaluation tool to aid decision making in communities who wish to adopt interventions to improve the health of their inhabitants.

7.1.2 Review of Community Based Interventions

Table 72 is a non systematic review of a convenience sample of community based interventions with the following attributes; they incorporated intervention strategies at many levels, and cited physical activity as one of their main outcome measures. A similar undertaking was carried out on a convenience sample of community based intervention targeted to women and pedometer based interventions that both used physical activity as a main outcome measure (*Table 73 and 74*). The RE-

AIM framework was applied to the interventions in *Table 72-74* and the different aspects of it were evaluated using some of the criteria defined by Dzewaltowski et al. (2004) and other additional indicators. These indicators are described below.

- Reach was assessed in three ways: the proportion of eligible participants enrolled in and who completed the study, the comparison of participants and non participants (representativeness) and the implementation of exclusion criteria.
- Effectiveness, which is typically always reported on, was demonstrated by any positive change in physical activity or related measure (impact evaluation).
- Adoption was indicated in two ways; the participation and representativeness of community settings/resources in the intervention.
- The assessment of implementation incorporated comments on the extent and accuracy of programme delivery (i.e.) was it delivered as planned, and the success of delivery (recall rates). A consideration of requirements in relation to time or cost was also investigated in relation to implementation (process evaluation).
- Finally, maintenance, greater than six months, was measured at the individual and setting level. At the individual level, an evaluation of drop out was undertaken while at the setting level, maintenance referred to the intervention being continued after the research study was completed.

All of the interventions reviewed in *Table 72* induced favourable behavioural outcomes while engagement with community resources and settings was positive. The weakest aspect of these interventions, according to the RE-AIM framework at least, was their evaluation of implementation and maintenance, particularly the latter at a setting level. In some instances other assessments of these interventions have been undertaken that have reported on intervention delivery. However, there still remains a notable failure to carry out cost analyses of strategies to promote physical activity. A summary of the studies reviewed in *Table 72* is available in *Appendix D, Table 1*[6].

[6] Some tables were moved to the *Appendices* to reduce the content in the main chapters

Table 72

Review of Community Based Interventions to Promote Physical Activity using the RE-AIM Framework

	Wen et al. (2002)	Cochrane & Davey (2008)	Jenum et al. (2006; 2009)	Wendel-Vos et al. (2009)	Kelishadi et al. (2009)
Reach					
Participation rate of eligible individuals (response rate)	+	+	+	-	+
Representativeness of participants	-	+	+	-	+
Exclusion/inclusion criteria	-	-	-		
Effectiveness					
Positive behaviour change	+	+	+	+	+
Adoption					
Participation of settings/resources in community	+	+	+	+	+
Representativeness of resources/ettings	-	-	-	-	-
Implementation					
Extent/accuracy of delivery of intervention	+	+	-	-	+
Time or cost information	-	-	-	-	-
Success of delivery (recall)	+	-	-	-	-
Maintenance (individual level at 6 months)					
Assessment at six months or more	+	+	+	+	+
Attrition/drop out versus non drop out	-	-	+	+	-
Maintenance (Setting level: institutionalisation)	+	-	-	-	-

+ = criteria was reported on
- = criteria was not reported on

7.1.3 Community Based Interventions Targeted to Women

This thesis focuses on women, thus a similar process to that described above was carried out for community based interventions that were designed and targeted specifically, or primarily at groups of women (*Table 73*). Again, reach of these interventions was relatively well reported on although there was a failure to note or comment on the representativeness of some of the samples recruited. Many of these were self selected samples so it is likely that they were not reflective of the population which they were recruited from. Again, positive outcomes in relation to physical activity and other variables were noted (*Appendix D, Table 2*), which suggests that internal validity was high. Less impressive attempts to consider and report on adoption, implementation and maintenance indicates that external validity was limited.

Overall, the studies in *Table 72* and *73* and in *Appendix D* (*Table 1 and 2*) offer varying degrees of success in relation to physical activity behaviour change, more than likely due to the disparity in recruitment methods, follow up periods and interventions delivered. The most effective interventions and potentially the most generalisable addressed several aspects of the social-ecological framework and specific constructs within it, and include those that target physical activity alone rather than physical activity and dietary behaviour for example. It is evident that, as per findings from Dzewaltowski et al. (2004), the degree of transferability and generalisability of these interventions are hindered by the lack of reporting on the three components of the RE-AIM framework that relate to external validity.

Table 73

RE-AIM Review of Community Based Interventions Targeted to Women

	Segar et al. (2002)	Wilcox et al. (2006)	Napolitano et al. (2006)	Perry et al. (2007)	Speck et al. (2007)	Keyserling et al. (2008)	Stadler et al. (2009)
Reach							
Participation rate of eligible individuals (response rate)	+	+	+	+	-	+	-
Representativeness of participants	+	+	+	-	-	-	-
Exclusion/inclusion criteria	-	+	+	+	+	-	+
Effectiveness							
Positive behaviour change	+	+	+	+	-	+	+
Adoption							
Participation of settings/resources in community	+	+	n/a	+	+	+	-
Representativeness of resources/settings	-	-	n/a	-	-	-	-
Implementation							
Extent/accuracy of delivery of intervention	-	+	+	+	-	+	-
Time or cost information	-	-	-	-	-	-	-
Success of delivery (recall)	n/a	n/a	+	-	-	+	-
Maintenance (individual level at 6 months)							
Assessment at six months or more	+	+	+	-	-	+	-
Attrition/drop out versus non drop out	+	+	+	-	-	-	+
Maintenance (Site level: institutionalisation)	-	+	-	-	+	-	-

+ = criteria was reported on
- = criteria was not reported on

7.1.4 Pedometers, Walking and Physical Activity

Many physical activity interventions incorporate other tools such as pedometers to increase physical activity, specifically walking, among the target population. Walking is the most common activity reported in surveys of physical activity (USDHHS, 1996) and has been shown to induce significant reductions in the incidence of coronary events, comparable to those associated with vigorous activity (Manson et al., 1999). In this latter study, a group of over 70,000 nurses took part in a prospective, epidemiological study that began in 1986. The group were followed for eight years; data was collected intermittently on physical activity and coronary events. Walking, for at least three hours per week, and vigorous activity, for at least one and a half hours per week, induced similar risk reductions. Brisker walking was associated with greatest health benefits. These findings lend support to the promotion of walking, particularly among sedentary or low active individuals.

Williams et al. (2008b) reviewed interventions that have been designed to increase walking and found that theory based walking programmes were more effective than those that were less formally attached to theory. The review also stated that the value of using pedometers as a motivational tool was still largely unproven. Despite this, there is evidence that pedometers can induce favourable outcomes in relation to physical activity (*Appendix D, Table 3*). It is positive to note that some of the research on pedometers has been undertaken in community settings, using community resources (*Table 74*). Weaknesses remain in relation to the transferability of these interventions, as was apparent in the discussion of *Table 72* and *Table 73*.

Despite the positive results associated with pedometer use, it is argued that their inability to monitor and report on the intensity of physical activity is a considerable limitation. Subsequently Marshall et al. (2009) undertook a study to translate the standard moderate intensity physical activity message into a pedometer based goal. A sample of 97 adults wore pedometers while walking on a treadmill and their heart rate and oxygen uptake was monitored. Analysis indicated that between 100 and 111 steps per minute reflected moderate intensity and could be integrated into a guideline for participants using pedometers; to walk 3,000 steps in 30 minutes on five days each week. It appears overall that pedometers are a useful motivational tool to assist the promotion of physical activity, which can be enhanced by communicating specific messages about the requirements to achieve moderate intensity.

Table 74

RE-AIM Review of Pedometer Based Interventions to Promote Physical Activity

	Hultquist et al. (2005)	Dinger et al. (2005)	Clarke et al. (2007)	Merom et al. (2007)	DeCocker et al. (2008)	Finkelstein et al. (2008)	Warren et al. (2010)
Reach							
Participation rate of eligible individuals (response rate)	+	+	+	+	+		+
Representativeness of participants	+	-	-	+	-		+
Exclusion/inclusion criteria	+	-	-	+	-		-
Effectiveness							
Positive behaviour change	+	+	+	+	+		+
Adoption							
Participation of settings/resources in community	n/a	+	+	-	+		+
Representativeness of resources/settings	n/a	-	-	-	-		-
Implementation							
Extent/accuracy of delivery of intervention	-	-	-	+	-		+
Time or cost information	-	-	-	+	-		-
Success of delivery (recall)	-	-	-	-	-		-
Maintenance (individual level at 6 months)							
Assessment at six months or more	-	-	-	-	+		-
Rate of attrition/drop out versus non drop out	+	+	-	+	-		+
Maintenance (Site level: institutionalisation)	n/a	-	-	-	-		-

+ = criteria was reported on
- = criteria was not reported on

7.1.5 Summary

The design and delivery of community based interventions has become increasingly common. These programmes typically incorporate multi level strategies that reflect the social-ecological framework for behaviour change and recently produced WHO guidelines for best practice in developing population based approaches to physical activity promotion. Published results on these interventions indicate differing degrees of effectiveness, inconsistencies in design and insufficient consideration of factors related to the generalisability and transferability of interventions administered to promote physical activity (*Table 72-74*). There remains a need to develop and refine effective strategies that are faithful to a social-ecological framework, and that can be delivered at a relatively low cost in real life settings to 'at risk' population sub groups.

An intervention fitting some of these requirements was designed for a group of 'at risk' women identified following the Mini Marathon in 2007 (chapter 6). This randomised controlled trial was a theoretical, individual focused intervention, using stage matched print materials. It was undertaken on participants who had relapsed following the event to low levels of physical activity did induce significant increases in physical activity in the intervention and control group. It was noted that the intervention was scheduled at a time when women may have been beginning to get more active, irrespective of any prompt or motivation delivered to them. These findings and the intervention overall served as a useful pilot study for future intervention efforts on this same cohort.

Consequently, another, more comprehensive, community based intervention was developed and delivered following the 2008 Mini Marathon to a similar sub-group of participants. This trial, administered in multiple sites, began approximately four months post event and incorporated community based initiatives, using existing resources in the community, as well as the stage matched print materials used in the previous RCT. In this trial, the community was used as a setting and as a resource to specifically target women in their respective regions, in a variety of communities across Ireland, in a cost effective manner. The intervention was based on the social-ecological model of behaviour change, which should serve to enhance the external validity of the programme.

7.2 Methods

7.2.1 Study Population and Design

The post event relapsers from both 2008 events provided the study base for this intervention. Matched data from the Dublin 2008 (n = 3,505, Phase 1) and Cork 2008 (n = 348, Phase 2) events were analysed to identify those participants who had relapsed to lower levels of physical activity three months post baseline. More detail on matching and relapse was presented in chapter 4 and 5. *Table 75* highlights the demographic characteristics of the Dublin and Cork total matched sample and eligible study participants; participants who relapsed to insufficient activity levels post event. A significantly greater proportion of Dublin participants did not have children and lived in an urban area while a significantly lower number had some or complete tertiary education.

Table 75

Demographic Characteristics of Dublin and Cork Total Matched Samples and Cluster RCT Study Samples of Eligible Participants

	Matched Samples		Study Samples (Relapsers)	
	Dublin n=3,505 (%)	Cork n=348 (%)	Dublin n=541 (%)	Cork n=85 (%)
Aged less than 40	61.3	58.6	60.2	61.2
Married	59	62.4	63.5	61.2
No Children	51	42.8*	45.9	40*
Medical Card Holders	15	17.6	17.2	17.6
Tertiary Education	67.3	72.9*	60.1	71.6*
Urban	69.6	64*	64.9	56*

* = $p < 0.05$ Dublin v Cork

To identify the study participants relapse was defined as moving from high or moderately active to low active and decreasing total physical activity by at least 240 MET-minutes/wk. Further detail on relapse is available in chapter 5. Participants who were low active at baseline and follow up were also identified for this trial as they do not meet minimum physical activity guidelines and thus are a priority target group. *Table 76* below indicates that demographically, those respondents defined as relapsers and those defined as low active at baseline and follow up were relatively similar. The most notable difference between the groups was in relation to training for the Mini Marathon. A significantly higher proportion of relapsers stated that they trained continuously prior to the event than the low active group. This is not surprising given that the low active group, based on the physical activity data they provided, did not meet minimum physical activity recommendations at any stage.

Table 76

Characteristics of Relapse and Low Active (at Baseline and Follow Up) Participants in the Cluster RCT

	Relapsers n=418 (%)	Low Active at Baseline and Follow Up n=208 (%)
Aged less than 40	59.6	61.8
Married	64	61.5
No Children	45.3	44.5
Medical Card Holder	19.7	12.4*
Tertiary Education	59.3	66.3
Urban	63.9	63.1
Overweight/Obese	31	38.9
First Time Participants	38	44.2
Train Continuously/Several Months before Event	48.4	26.1*
Runners in Mini Marathon	19.4	16.8

* = $p < 0.05$ Relapsers v Low Active – Baseline and Follow Up

These relapsers (n =369, Dublin and n = 49, Cork) and consistently low active respondents (n = 172, Dublin and n = 36, Cork) were mailed or emailed, depending on stored contact details, to inform them about the proposed trial and to obtain their consent to participate. A further sample of participants (n = 11), who were borderline low active at baseline and low active at follow up, in the Cork region were also invited to participate to increase the overall sample size in this phase of the study. These participants did not differ from the total study participants and will hitherto be included in the low active at baseline and follow up group. A final sample of n = 637 were eligible for participation in the trial.

Email respondents to baseline and follow up surveys (n = 340) were asked to provide their postal address and therefore consent to participate, and postal respondents (n = 297) were asked to contact the project team if they preferred to withdraw from the study. *Table 77* below highlights the demographic difference between those contacted online or by post. It is evident that younger participants with no children and who had some tertiary education were more likely to be contacted by email.

Table 77

Demographic Characteristics of Online and Postal Study Participants in the Cluster RCT

	Online n=326 (%)	Postal n=297 (%)
Aged less than 40	72.1	47.5*
Married	60	66.3
No Children	55.7	33.7*
Medical Card Holder	11.7	24.8*
Tertiary Education	74.2	47.4*
Urban	69.7	57*

* = $p < 0.05$ Online v Postal

At the end of this process, a total sample of n = 402 (n = 311, Dublin, n = 91, Cork) were recruited to participate in the trial, n = 268 were relapsers (n = 221, Dublin, n = 47 Cork) and n = 134 were low active at baseline and follow up (n= 90, Dublin, n = 44, Cork). Participants were grouped into their local county/Local Sports Partnership (LSP)/geographical region and each of these units/clusters were randomly allocated to the intervention or control group. All participants in each cluster subsequently took part in the study, in the intervention or control condition. An illustration of these clusters is presented in *Appendix D, Figure 1, p.385*.

7.2.1.1 Cluster randomised controlled trial

A cluster randomised trial (RCT) was best suited to this design to prevent contamination between individuals within their respective region, which would be a limitation of individual level randomisation. This indeed is a common reason for using a cluster RCT design (Puffer Torgerson & Watson, 2005). Furthermore, this design complements the use of LSPs, leisure clubs, walking groups etc. as intervention agents, all of which deliver programmes and communicate information to groups of people in various geographical regions. It would be quite difficult for any of these entities recruited to the trial, to avoid participation by specific individuals within their respective areas who may have been allocated to a control group, as would be the case in a non clustered RCT design (Christie, O'Halloran & Stevenson, 2009).

As recommended for best practice in cluster trials to prevent selection and recruitment bias (Puffer et al., 2005), prospective participants were first asked to consent to participate and were then allocated to their respective cluster, which was subsequently randomised to the intervention or control condition. Finally, in clustered designs, it is possible for individuals within a cluster to provide quite similar (clustered) data. Therefore, data analysed at an individual level in these designs must be adjusted for any such clustering effect, which is discussed further in the *data analysis* section below. These latter two guidelines were among those presented in a CONSORT statement for cluster RCTs (Campbell, Elbourne and Altman, 2004), which outlines how to best report these designs. This framework was used for this particular trial to indicate clearly the rationale for selecting a cluster RCT design, the methodology used to recruit participants, generate clusters and allocate these to study arms and finally, the statistical adjustment undertaken on outcome data.

7.2.2 Local Sports Partnerships

As indicated in chapter 3 (p.58) and in the previous section, Local Sports Partnerships (LSPs) played a central role in the organisation and delivery of this intervention. The first strategy of the Irish Sports Council (ISC) (2000-2002) proposed the development of LSPs to promote sport at a local level, throughout

Ireland, along with other entities discussed in chapter 3. Currently, 29 LSPs exist nationwide, each striving to increase participation in sport through work with local sports agencies and organisations, enhanced use of available resources and facilities and through support of groups, clubs and communities who wish to provide more opportunities for sport and physical activity. Twelve of the current LSPs are in operation since 2001, a further four were developed in 2004 and the remainder commenced in 2006-2008.

The ISC (2008) undertook a SPEAK (Strategic Planning, Evaluation and Knowledge) self evaluation process with all LSPs to profile and evaluate the current workings of these groups. It was reported that LSPs work closely with other groups; these are quite diverse and can include schools, the Health Service Executive, Local Authorities, universities, tourism agencies, education centres, and disability, youth and community organisations. The potential volume of partnership and interaction is vast and again varied substantially between each LSP. Overall, LSPs noted that they spent 22% of their time building partnerships and networking locally. Remaining time was allocated to information related tasks, generating newsletters, websites, booklets etc (17%), to the training of individuals and groups in their communities to facilitate sports development (30%) and finally to project work and the specific development of national and local programmes designed to directly and indirectly increase physical activity (31%).

In 2007, LSPs established or delivered 433 direct projects and 102 linked 'Women in Sport' programmes. These focused on a variety of target groups; girls (34%), boys (33%), adult females (31%), disadvantaged communities and adults males (58%), youth at risk (16%) as well as sporting organisations, foreign nationals, the disabled, travellers (ethnic minorities), older people and the unemployed. Over 80% of these programmes addressed participation. Of note is that 82% of LSPs actually stated that promoting participation in physical activity was their greatest challenge. The current research may assist LSPs to overcome this as they were identified as a primary intervention agent in efforts to promote physical activity among study participants. Finally, it is important to note that the operation and function of each LSP can vary considerably. They are not standardised, equivalent entities, which does hinder the internal validity of intervention protocols that they are incorporated into. The eaxct role of LSPs in this research is outlined in the 'Intervention Outline and Procedures' section below.

7.2.3 Randomisation Procedures

As noted earlier, eligible participants who consented to participate (n = 402) were grouped into their respective county/(LSP) region in Phase 1 and geographical regions within two LSPs in Phase 2. County allocation was necessary for two regions where there was no LSP in operation (Down and Wicklow). However, there were Sport/Leisure/Recreation Authorities established in both of these areas, which were deemed equivalent to an LSP. The large predominance of Cork based participants in Phase 2 required the use of various regions within this area, and the respective LSP each were affiliated to.

Prior to consent, participants were not aware of what cluster or trial arm they were allocated to, which, indeed was never communicated directly to the participant. It is unlikely though that participants who received the information pack (further detail below) remained blind to the fact that they were receiving an intervention. All clustering and randomisation was undertaken and agreed upon by the lead researcher and supervisor who were not blind to this process. Despite this, bias was unlikely because of the specific inclusion criteria for the trial overall. These latter notes on blinding and bias, as well as earlier references to statistical adjustment should enhance the internal validity of this trial; specifically, the extent to which differences between the intervention and control arm at the end of the study may be attributed to the intervention rather than bias at the recruitment, group allocation or analysis stage (Eldridge et al., 2008).

7.2.3.1 Phase 1.

Relevant LSPs (n = 28) based on participants address details, were matched into pairs based on the number of relapsers in their area, the length of time the LSP had been in operation and geographical location. As noted earlier, LSPs have been developed in stages and some are more advanced and mature than others in relation to their staff expertise, programme development and community effectiveness. LSPs were also matched geographically to prevent any contamination between people in the intervention and control group. Some LSPs were combined due to small numbers and geographical location (Sligo and Leitrim, North and South Tipperary, South Dublin, South City Central and South East City Central and Dublin North West City Central, North City Central and City Central). One LSP from each pair was then randomly allocated into either the intervention (n = 15) or control group (n = 15) using random numbers generated in www.graphpad.com. Analysis post randomisation showed that there was a sample size of 142 in the intervention group and 169 in the control group.

7.2.3.2 Phase 2.

As the majority of the study sample was based in the Cork region, participants were grouped into four regions within the county (Cork City, Cork North, Cork West, and Cork South). All remaining participants outside this region were matched to their local LSP and included as one cluster. These clusters were grouped together based on the number of eligible and consenting participants in that area, which resulted in two clusters; Cork South (n = 51) and Cork City/West/North/Other (n = 40).

All clusters were then randomly allocated into an intervention and control group. Post randomisation, there were 16 clusters in each arm of the trial. *Figure 15* illustrates the combined recruitment and progression of participants to this cluster randomised trial. It has been stated that cluster trials with less than five clusters per arm are not recommended (Medical Research Council, 2002, cited in Puffer et al., 2005); the 16 clusters per arm in this study should enhance the credibility of subsequent findings.

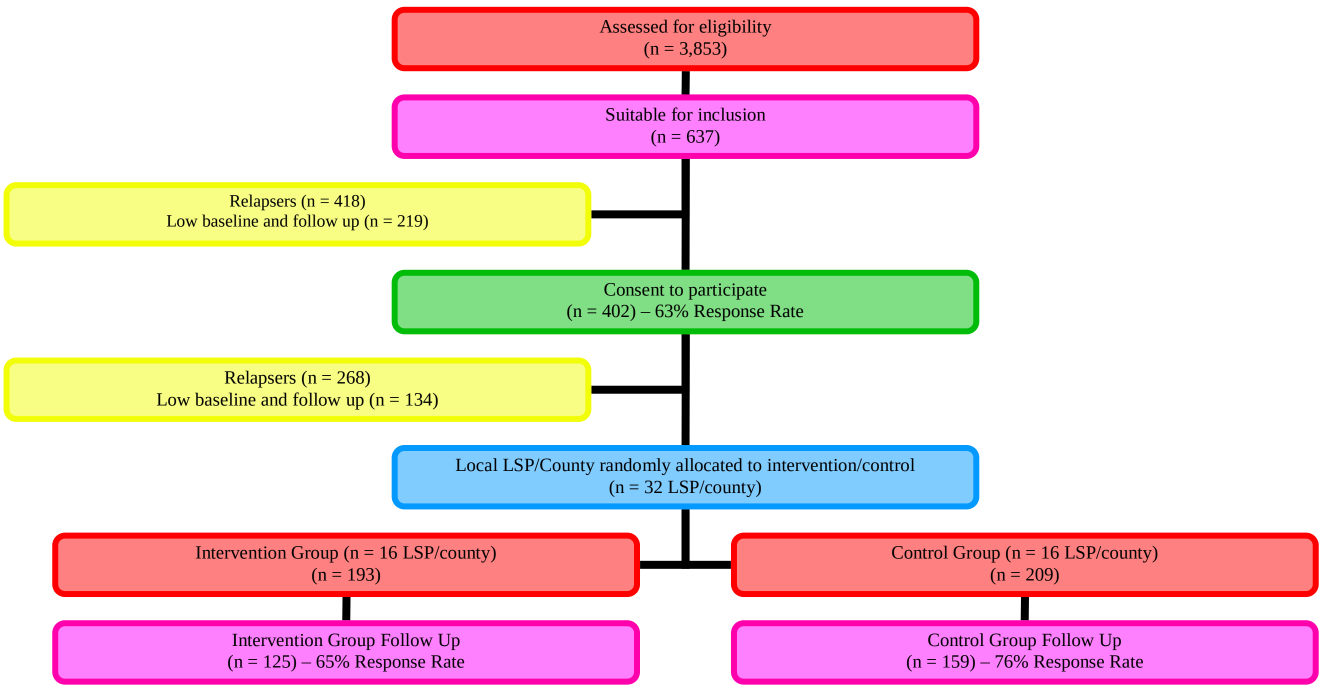


Figure 15

Recruitment to and progress through the cluster RCT

7.2.4 Participants v Non Participants

As indicated earlier, a total of 402 Mini Marathon participants agreed to take part in this trial. This corresponded to a response rate of 63%. Analysis of the characteristics of those who did and did not consent to participate (*Table 78*) shows that a significantly higher proportion of non-participants were aged less than 40, had no children, had some or complete tertiary education and were first time participants in the Mini Marathon. Compared to national statistics, a similar proportion of participants were aged 20-29 (16.1% v 17%) and had no children (38.7% v 40%). Furthermore, there was greater comparability between proportions who had a medical card (20.3% v 30%) and had tertiary education (21% v 56%) than between the overall sample of Mini Marathon participants and national statistics, as indicated in chapter 3.

Table 78

Characteristics of Participants and Non Participants in the Cluster RCT

	Participants n=395 (%)	Non Participants n=223 (%)
Aged less than 40	52.6	73.9*
Married	65.1	59.2
No Children	38.7	57*
Medical Card Holder	20.3	14
Tertiary Education	56	71.7*
Urban	61.1	68.3
Overweight/Obese	35.6	29.7
First Time Participants	35.6	48.7*
Train Continuously/Several Months before Event	42.1	39.5
Runners in Mini Marathon	17	22.2

* = $p < 0.05$ Participants v Non Participants

7.2.5 Measures/Outcome Variables

Short term follow up data was used as a baseline measurement for this trial. Follow up data, on the measures below, was then collected after 9 weeks as well as questions assessing the receipt and use of intervention and control materials. At both stages, respondents perceived levels of physical activity, motivational readiness to start being active, status of current activity in comparison to twelve months ago and suitability of local area to physical activity was assessed. Follow up questionnaires for the intervention and control group are presented in *Appendix E, p.407 and 412*.

7.2.5.1 Physical activity.

Physical activity data was collected using validated questions from the IPAQ questionnaire. Analysis, as per the IPAQ scoring protocol was undertaken to identify individuals as low, moderately or high active. High active participants were classified as sufficiently active as per discussions in chapter 3. Data was also collected on time spent sitting and watching television to assess sedentary behaviour.

7.2.5.2 Self efficacy, social support, barriers to physical activity, readiness to change.

All of the above items were assessed using scales previously defined in chapter 6, page 204-206. The alpha coefficient for pre and post versions of these items ranged between .61 and .78 and were based on the individual RCT sample (they were not adjusted for any cluster effect). Also no test-retest analysis was conducted.

7.2.5.3 Suitability of Physical Environment for Physical Activity.

Suitability of the environment for activity was assessed to measure an individual's belief about how conducive their locality is to being physically active. It was assessed using one item, which incorporated a likert scale of how easy it was to be active in the local area.

7.2.5.4 Other.

Other data was collected on perceptions of current physical activity levels and how they compared to physical activity levels prior to the Mini Marathon and prior to the intervention, and process evaluation questions on the receipt and use of materials and perceived benefit of the intervention.

7.2.6 Intervention Outline and Procedures

Each participant (n = 193) in the intervention group was mailed an information pack, with content that was targeted at both the cluster and individual participant level. For example, the pack contained an information sheet targeted specifically to a participants local area/community and a print booklet matched to each individual's readiness to change. It also included a personalised training plan, a free entry form for a 5k run scheduled for 5 weeks post baseline (Phase 1 only), details of local events (Phase 2 only) and a letter outlining the content and operation of the trial (*Table 79*).

Table 79

Weekly Outline of Cluster RCT Intervention

Week	Content
1	Information pack – LSP details, physical activity booklets, training plan, free entry for 5k run (Phase1 only), local event detail (Phase 2 only)
2 -5	No contact
6	5km run (Phase 1 only)
7	Distribute pedometer and booklet 'Stride into New Year'. Christmas/Easter postcard.
8 -9	No contact
10	Follow up data, process evaluation

All information distributed to participants in the intervention group contained the 'Leg It' logo, as detailed in chapter 1, the ISC logo and the logo of each individual LSP or its equivalent. Further detail of the development of the intervention and of the items distributed to the participants is outlined underneath.

To introduce and gain co-operation for the proposed project, a meeting was arranged with all LSP co-ordinators, which was facilitated by the ISC. Discussion identified problems with and suggestions for the project and an overall willingness by the LSPs to participate. Following this, another meeting was scheduled with co-ordinators from all LSPs based in Dublin to clarify further the most feasible method of delivering and administering this project. It became apparent that an initial plan to ask each LSP to draft and monitor the intervention programme was not viable due to a lack of resources within, and uniformity between, each unit. Consequently, it was agreed that the project would be developed and managed centrally by the researchers with input from LSPs.

As noted earlier, this intervention used the community as a resource and a setting to increase physical activity. As per recommendations from the Task Force on Community Preventive Services (2002) for successful physical activity interventions, collaboration with the LSPs should serve to facilitate the development of social and environmental support for participants in the trial; specifically through the promotion of walking and training groups and exercise classes. The Task Force also urged the delivery of tailored behaviour change programmes incorporating concepts such as goal setting, problem solving and relapse prevention. The dissemination of stage matched print materials, tailored information sheets, training plans and free registration for an upcoming event should satisfy this recommendation.

7.2.6.1 Information sheets.

Following the aforementioned discussion with LSPs, an audit (*Appendix D*) was generated to assess the workings of each LSP and more specifically to assess the events, programmes, clubs, community groups and leisure centres linked to the LSP that may help to increase the physical activity levels of the target group in question – adult females in Ireland. This audit, along with an outline of the planned intervention, was mailed to an LSP contact list. As completed audits were returned, information sheets were generated for each LSP area (*Appendix D, p.386*). Further information was acquired from the relevant LSP website, from the relevant county/city council website, and walking/cycling routes and groups were gathered from the Irish Heart Foundation, Coillte and Athletic Association of Ireland websites. Information was also taken from local tourism sites, heritage sites and commercial 'What's On' guides.

Phone calls to individual LSPs, leisure centres and community centres were made to obtain more detail on information they had initially provided. It was necessary to generate phone contact with many of the LSPs to clarify some issues and also to encourage them to respond to the LSP audit. An email reminder was also mailed to those who had not responded, ten days after the initial email. An overall response rate of 75% was generated for this LSP audit; information for those LSPS who did not respond were gathered by the researcher.

7.2.6.2 Print Booklets.

Detail on the development and content of these booklets is available in the previous chapter (chapter 6).

7.2.6.3 Training Plan and 5k Run (Phase 1 only).

A seven week training plan was designed to encourage participants to train for an upcoming 5k event, scheduled for December 14th, 2008, in Dublin. This was undertaken to facilitate goal setting among the intervention group, which is a useful strategy when attempting to initiate and maintain physical activity levels (Locke and Latham, 2002). The 5k run is an annual event that is linked to a charity; it also has a Christmas, fun theme, which may enhance participation. To enhance participation and uptake in the event, free registration for the event was also provided.

7.2.6.4 Local Events (Phase 2 only).

To complement the 5k event used in Phase 1, a compilation of all upcoming events in the intervention region during the allotted timescale was collated. These included elite and non-elite events to cater for various abilities. A training plan was also disseminated and participants were encouraged to use this to prepare for events.

7.2.6.5 Pedometers.

Silva pedometers were purchased and disseminated to all participants in the intervention group, as an additional prompt for activity during the study period. To the best of the authors knowledge, there have been no reliability assessments of these pedometers. A booklet with some information on how to use the pedometer, tips to increase motivation and information to self monitor progress was also produced. This was adapted from booklets used in the University of Sydney (Merom et al., 2007).

7.2.7 Control Group

Each participant (n = 209) in the control group received a time equivalent treatment. They were mailed a healthy eating leaflet as well as a letter explaining that they had been chosen in the control group. The leaflet was produced by the Community Nutrition and Dietetic Services in the Health Service Executive and contained information on eating for a healthy heart and healthy weight, as well as detail on how to lose weight and lower cholesterol and blood pressure.

7.2.8 Data Analysis

Data analysis was similar to that undertaken in the previous chapter to assess changes in physical activity and secondary variables within and between the intervention and control groups. The research questions presented below relate to individual level change, thus analysis was undertaken at an individual level but as this study was a cluster RCT, adjustment of outcome data was necessary. Specifically, an intraclass correlation coefficient (ICC) and design effect were calculated for all outcome variables. The ICC indicates the variation within and between clusters of individuals in the trial for each outcome variable while the design effect is derived from the ICC to identify if more cases were required in this clustered design to obtain the same precision as a simple randomised trial of individuals. A design effect greater than 1 suggests that more cases were required and that variation of data around the acquired mean value was underestimated whereas a design effect of less than 1 would suggest that variance was over-estimated.

In this study, outcome data were adjusted for any clustering (design) effect and estimates of variance were altered as required. Specifically, in SPSS 17, a complex design file was created, and this was used to generate adjusted estimates of variance and thus, a more accurate assessment of the effectiveness of the intervention was carried out. The specific steps involved in the development of the design file are presented in *Appendix D*. An intervention dose response analysis was also conducted, which incorporated grouping intervention participants into categories of how much of the intervention they were exposed to. Lastly, all costs associated with the design and administration of the study were computed and examined to facilitate a cost analysis of the intervention, relative to the control group.

7.2.9 Research Questions

1. Were the groups (intervention and control) comparable at baseline on demographic, intervening and outcome variables?
2. Did participants receive, read and use the different aspects of the intervention?
3. Was there a change in physical activity and sedentary behaviour between baseline and follow up (intervention v control)?
4. Was there a relationship between intervention components utilised (dose) and subsequent changes in physical activity?
5. Was there a change in self efficacy, social support, barriers to physical activity and suitability of environment for activity between baseline and follow up (intervention v control)?

6. Was any change in self efficacy and social support related to changes in physical activity?
7. How cost effective was the intervention in inducing changes in physical activity, relative to the control treatment?

7.3 Results

Research Question 1: Were the groups (intervention and control) comparable at baseline on demographic, intervening and outcome variables?

7.3.1 Baseline Characteristics

At baseline, there were no significant differences between intervention and control groups in relation to demographic characteristics, participation characteristics and physical activity and sedentary behaviour (*Table 80*).

Table 80

Baseline Characteristics of Participants in the Cluster RCT

	Intervention n=193	Control n=209
Aged less than 40 (%)	57.3	48.3
Married (%)	67.5	62.7
No Children (%)	38.2	39.2
Medical Card Holder (%)	19.4	21.1
Tertiary Education (%)	40.5	47.3
Urban (%)	57.9	64.2
Overweight/Obese (%)	34.3	36.9
First Time Participants (%)	35.8	35.4
Runners in Mini Marathon (%)	19.8	14.4
Train Continuously/Several Months before Event (%)	39.4	44.7
Average Total Physical Activity Minutes/wk (M, SD)	53.5 (61.1)	49.5 (66.9)
Average Sitting Minutes/day (M, SD)	270.9 (174.7)	239.5(144.8)
Average TV Time Minutes/day (M, SD)	126.4 (70.2)	125.8 (75.7)
Self Perceived Insufficiently Active (%)	71.5	66.5

* = $p < 0.05$ Intervention v Control

7.3.2 Cluster Adjustment

Intraclass correlation (ICC) coefficients and design effects for selected outcome variables are presented in *Table 81*. The ICCs were small, most ranged between -0.05 and 0.05, which are relatively close to 0. This would suggest that individuals within clusters in this study were no more likely to have similar outcomes to each other than to other participants in other clusters. It appears that the grouping variable (cluster group) had a minimal effect on these particular outcomes of interest. More notable ICCs are evident for contacting any intervention agent (-0.19), TV viewing per day (0.09) and total sessions per week (0.11). The substantial negative ICC indicates that for this variable between group variation in scores were actually less than within group variation. The larger positive ICCs suggest that individuals within clusters for these variables were more similar to each other than to participants in other groups.

Design effects computed were primarily greater than 1 (apart from self efficacy); the maximum observed is 1.71 for the 'physical activity sessions per week' variable. Design effects greater than 1 mean that more cases may have been needed in this cluster design to obtain results with a similar precision to those that would have been acquired in a simple, randomised trial. Consequently it is likely that measures of variance generated using a standard analysis would be underestimated thus should and were adjusted for this design/cluster effect. A further point is that it is not surprising that the maximum design effect was 1.71 considering the relatively low ICCs that were previously alluded to. There was little evidence of a strong clustering effect on outcome scores thus it could be assumed that the number of cases included in each cluster must be acceptable, which was what was observed in these data.

Self efficacy yielded a design effect score of 0.70 (less than 1), which suggests that, in this instance at least, this complex clustered design was more efficient than a simple randomised trial. Overall, it would appear that this design was acceptable and mean scores in the cluster adjustment analysis would be very similar to those that may have been attained in a simpler, uncomplicated design. All subsequent assessment of outcomes from this trial were adjusted for a clustering/design effect.

Table 81

Intraclass Correlation Coefficients and Design Effects for Outcome Variables

	No. of cases analysed	Average cluster size	Events per cluster	Between cluster variance	Within cluster variance	ICC	Design Effect
Receipt of Booklets	268	7.39	231	0.151	0.13	*0.04*	*1.26*
Contact any intervention agent	111 (intervention only)	0.57	44	0.221	0.24	*-0.19*	*1.09*
% High active	277	7.73	30	0.604	0.42	*0.05*	*1.35*
	No. of cases analysed	Average cluster size	Overall mean value	Between cluster variance	Within cluster variance	ICC	Design Effect
Average Total PA Minutes/wk	276	7.69	84.4	7060.761	5428.078	*0.04*	*1.25*
Average Total PA Days/wk	276	7.69	5.93	23.977	12.56	*0.11*	*1.71*
Total Sitting Minutes/day	268	7.39	299.44	29405.66	26394.08	*0.02*	*1.10*
Total TV Minutes/day	266	7.32	123.95	9234.77	5462.98	*0.09*	*1.54*
Self Efficacy	275	7.66	10.97	9.15	13.73	*-0.05*	*.70*
Social Support	273	7.58	5.37	5.25	4.49	*0.02*	*1.14*
Barriers	274	7.62	21.33	19.22	16.62	*0.02*	*1.13*

Research Question 2: Did participants receive, read and use the different aspects of the intervention?

7.3.3 Follow Up and Receipt and Use of Materials: Process Evaluation

At follow up, n = 125 (64.8%) of the intervention group and n = 159 (76.1%) returned completed questionnaires. *Table 82* illustrates the characteristics of participants who did and did not provide follow up detail; the only notable difference was that follow up participants were much more likely to have trained continuously prior to their participation in the Mini Marathon.

Table 82

Characteristics of Follow Up Participants and Non – Follow Up Participants in the Cluster RCT

	Follow Up n=284 (%)	Non Follow Up n=118 (%)
Aged less than 40	51.2	56
Married	67.4	59.5
No Children	37.6	41.4
Medical Card Holder	19.4	22.4
Tertiary Education	56.8	54
Urban	61.4	60.5
Overweight/Obese	34.4	38.5
First Time Participants	33.1	41.5
Runners in Mini Marathon	17.3	16.1
Train Continuously/Several Months before Event	47	30.5*

* = $p < 0.05$ Follow Up v Non Follow Up

Further analysis of follow up in the intervention and control group revealed a significant difference in training and first time participants between follow up and non follow up participants in the intervention group only. Overall, there were minimal differences between intervention and control participants in relation to follow up. The only difference apparent was that a greater proportion of control participants who completed the study were from an urban area (*Table 83*).

Table 83

Characteristics of Follow Up Participants and Non – Follow Up Participants in the Cluster RCT (Intervention v Control)

	Follow Up		Non Follow Up	
	Intervention n=125 (%)	Control n=159 (%)	Intervention n=68 (%)	Control n=50 (%)
Aged less than 40	56.8	46.8	58.2	53.1
Married	71	64.5	61.2	57.1
No Children	37.9	37.4	38.8	44.9
Medical Card Holder	16.9	21.3	23.9	20.4
Tertiary Education	59.7	54.5	59.1	46.8
Urban	54.8	66.7†	63.6	56.3
Overweight/Obese	33.9	34.7	35.1	43.6
First Time Participants	30.4	35.2	45.6*	36
Runners in Mini Marathon	21	14.5	17.6	14
Train Continuously/Several Months before Event	46.4	47.4	26.5*	36

* = $p < 0.05$ Follow Up v Non Follow Up, † = $p < 0.05$ Intervention v Control

Approximately 97% of those who engaged in the follow up assessment recalled receiving the physical activity booklets compared to 78% of the control group ($p<.05$, *Table 84*); a further 20% of this latter group stated that they did not read the leaflet they received.

Table 84

Receipt and Use of Materials in the Cluster RCT[a]

		Intervention n=125 (%)	Control n=159 (%)
Receipt of Booklets	Yes	96.5	77.6
	No	3.5	22.4*

[a] *= All data adjusted for cluster effects*

** = $p < 0.05$ Intervention v Control*

Table 85 highlights the receipt and use of the various components of the intervention. Overall, the recall of materials was quite high; the pedometer appeared to be the most well received component based on this initial analysis. Furthermore, 65% of participants reported using these pedometers while almost one quarter of participants (23%) indicated that they used the training plan. Also, approximately 20% of participants attended exercise classes while over 38% used the walking routes that were recommended.

Table 85

Receipt of Intervention Components in the Cluster RCT[a] (n=125)

	Received		Read	
	Yes (%)	No (%)	Yes (%)	No (%)
Booklet	95	5	97.8	2.2
Information Sheets	89.7	10.3	95.6	4.4
Training Plan	87.7	12.3	89.7	10.3
Local Event Detail	84.6	15.4	90	10
Pedometer and Booklet	97.4	2.6	86.9	13.1

[a] *= All data adjusted for cluster effects*

Although not presented below, a relatively low use (5.6%) of Meet and Train groups and LSPs (7.7%) reflects the low number of participants who reported contacting these groups (*Table 86*).

Table 86

Contact with Existing Structures in the Community in the Cluster RCT[a] (n=125)

	Contacted Existing Structures	
	Yes (%)	No (%)
Local Sports Partnership	7.7	92.3
Leisure Centre	23.4	76.6
Walking/Cycling Clubs	17.2	82.8
Meet and Train Groups	6.6	93.4
Any of these	37.7	62.3

[a] *= All data adjusted for cluster effects*

Although only 8% of respondents indicated that they contacted their LSP, 78% indicated that the intervention increased their awareness of this local vehicle to promote physical activity. Over two thirds stated that they were not familiar with LSPs prior to the intervention.

Research Question 3: Was there a change in physical activity and sedentary behaviour between baseline and follow up (intervention v control)?

7.3.4 Self Reported Change in Physical Activity

At follow up, participants were asked if they felt their activity levels had altered due to the intervention. Approximately 30% of respondents stated that their physical activity levels did not change, while 19% felt they were already sufficiently active; the remainder cited some increase after the start of the intervention. Furthermore, 47% of the intervention participants compared to 30% of their counterparts in the control group felt they were more active than prior to the study period ($p<.05$). This is apparent in *Table 87* where a significantly greater proportion of the intervention group were sufficiently active (high active only, as per discussion in chapter 3) at follow up than the control group (11.5% v 9.7%). Also, the intervention group demonstrated a greater decrease in sitting time than the control group ($p<.05$) engaging in approximately 13 minutes less sitting time per day than the control group at follow up ($p<.05$). There were significant overall within group changes in total time spent being active but no between group differences.

Table 87

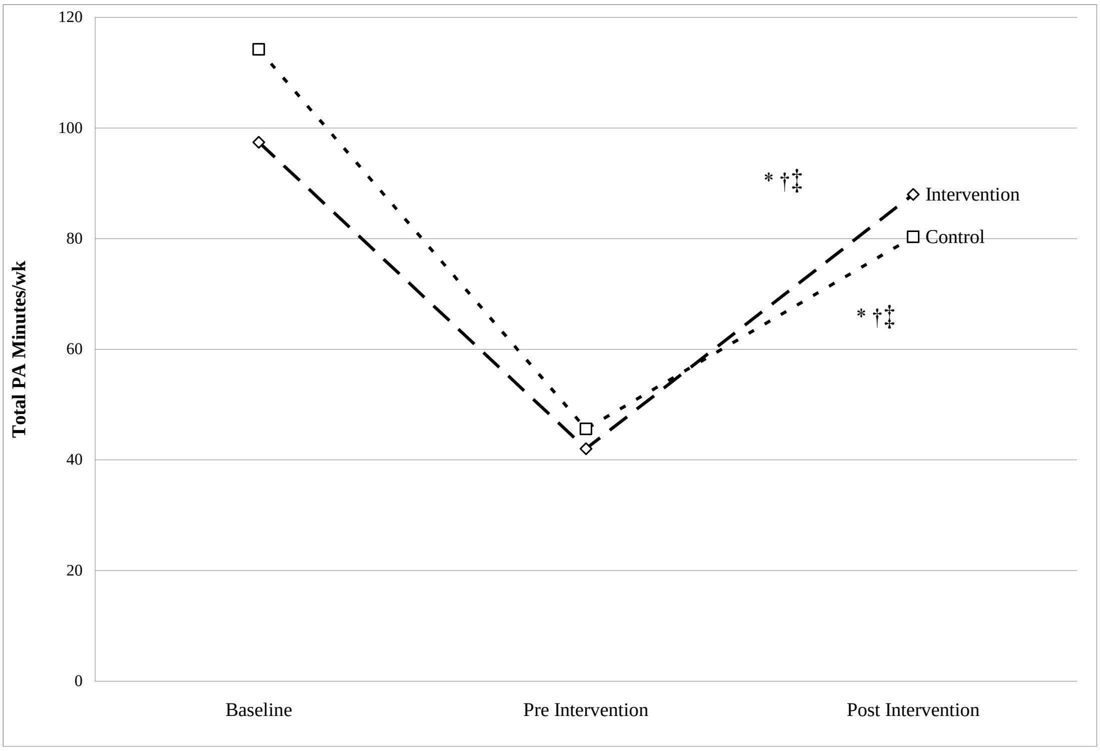
Physical Activity and Sitting Time at Baseline and Follow Up in the Cluster RCT[a]

		Intervention Baseline n=193 Nine Weeks n=125	Control Baseline n=209 Nine Weeks n=159
Average Total PA Minutes/wk	Baseline	42 (2.6)	45.6 (2.2)
(M, SE)	Nine Weeks	84.9 (4.5)*	80.3 (2.6)*
Change in Total Physical Activity Minutes/wk		39.6	37.2
(M, 95% CI)		(30.8-48.2)	(30.8-43.7)
Average Total Activity	Baseline	2.1 (.14)	2.2 (.11)
Days/wk (M, SE)	Nine Weeks	6 (.22)*	5.3 (.15)*
Change in Total Activity Days/wk		3.6	3.2
(M, 95% CI)		(3.2-4)	(2.9-3.5)
% Insufficiently Active	Baseline	100	100
	Nine Weeks	88.5	90.3
% Sufficiently Active	Baseline	0	0
	Nine Weeks	11.5	9.7†
Total Sitting Minutes/day	Baseline	274.1 (6.6)	236.8 (7.4)
(M, SE)	Nine Weeks	239.9 (4.6)	252.9 (2.4)†
Change in Total Sitting Minutes/day		-27.3	-5.2
(M, 95% CI)		(-38.9 - -15.6)	(-14.7-4.2)†

[a] = *All data adjusted for cluster effects*

* = $p < 0.05$ Baseline v Nine Weeks, † = $p < 0.05$ Intervention v Control

Figure 16 underneath highlights the change in physical activity throughout the study; prior to participation in the Mini Marathon, pre intervention (three months post event) and post intervention. It is notable that at no stage did the average score actually surpass the new minimum weekly requirements for physical activity (150 minutes per week).



[a] = *All data adjusted for cluster effects*

* $p < 0.05$ Baseline v Pre Intervention, † $p < 0.05$ Pre v Post Intervention, ‡ $p < 0.05$ Baseline v Post Intervention

Figure 16

Change in total physical activity throughout the cluster RCT[a]

A more detailed analysis of the change in physical activity indicates that both the intervention and control group demonstrated significant increases in the frequency (number of sessions) of all types of activity per week as well as a significant increase in time spent walking. Notably, only the intervention group displayed a significant increase in vigorous activity per week. However, there was no difference in the change in vigorous activity, or indeed any other intensity of activity, between both groups (*Table 88*).

Table 88

Frequency and Duration of Walking, and Moderate and Vigorous Physical Activity at Baseline and Follow Up in the Cluster RCT[a]

		Intervention Baseline n=193 Nine Weeks n=125	Control Baseline n=209 Nine Weeks n=159
Walking Days/wk	Baseline	1.8 (.1)	2.1 (.08)
(M, SE)	Nine Weeks	4.2 (.1)*	3.6 (.1)*†
Average Walking Minutes/wk	Baseline	22.2 (1.8)	31.3 (1.5)
(M, SE)	Nine Weeks	43.2 (1.4)*	42.3 (1.7)*
Moderate Days/wk	Baseline	.5 (.04)	.5 (.03)
(M, SE)	Nine Weeks	1.1 (.09)*	1.02 (.05)*
Average Moderate Intensity	Baseline	17.7 (1.1)	12.7 (1.1)
Minutes/wk (M, SE)	Nine Weeks	24.5 (2)	19.1 (.9)*
Vigorous Days/wk	Baseline	.3 (.02)	.4 (.02)
(M, SE)	Nine Weeks	.8 (.06)*	.9 (.04)*
Average Vigorous Minutes/wk	Baseline	10.8 (.8)	15.3 (.8)
(M, SE)	Nine Weeks	20.3 (7.8)*	22.7 (1.3)

[a] *= All data adjusted for cluster effects*

* = p < 0.05 Baseline v Nine Weeks † = p < 0.05 Intervention v Control

As noted previously, the intervention in this study was administered in two phases; Phase 1 (Dublin) and Phase 2 (Cork). Phase 1 began in October while Phase 2 commenced in February; presenting an opportunity to present a seasonal and regional comparison. No differences were apparent between these sites in the overall changes in physical activity and sitting time. *Table 89* shows significant increases in the duration of physical activity in all intervention and control groups, except the control group in Phase 2, thus an intervention effect was apparent for Phase 2. Participants in Phase 2 also displayed decreases in TV viewing time (-14 minutes in the intervention group, -22 minutes in the control group), compared to increases (13 minutes in the intervention and 23 minutes in the control group) in the Phase 1 cohort.

Table 89

Physical Activity and Sitting Time at Baseline and Follow Up in the Cluster RCT: Phase 1 and Phase 2[a]

		Intervention		Control	
		Phase 1 Baseline n=142 Nine Weeks n=95	Phase 2 Baseline n=51 Nine Weeks n=30	Phase 1 Baseline n=169 Nine Weeks n=129	Phase 2 Baseline n=40 Nine Weeks n=30
Average Total Physical Activity Minutes/wk (M, SE)	Baseline	37.9 (2.8)	61.3 (0)	39.9 (1.6)	71.2 (0)
	Nine Weeks	82.8 (5.5)*	100.9 (.02)*	77.7 (3.2)*	88.3 (.02)
Change in Average Total Physical Activity Minutes/wk (M, 95% CI)		39.9 (29.2-50.6)	37.9 (0)	40.9 (34.2-47.7)	19.8 (0)‡
Average Total Activity Days/wk (M, SE)	Baseline	1.8 (.12)	3.4 (0)	1.9 (.05)	3.6 (0)
	Nine Weeks	5.7 (.24)*	7.5 (.02)*	5.1 (.18)*	6.1 (.01)*
Change in Average Total Activity Days/wk (M, 95% CI)		3.6 (3.1-4.1)	3.6 (0)	3.4 (3-3.7)	2.5 (0)‡
Total Sitting Minutes/day (M, SE)	Baseline	269.7 (10.7)	280.9 (0)	217.7 (8.3)	285.9 (0)
	Nine Weeks	222.9 (6.5)	271.1 (2.2)	248.3 (3.2)	265.2 (1.9)
Change in Total Sitting Minutes/day (M, 95% CI)		-36.3 (-53.4--19.3)	-11.5 (0)	6.3 (-4.1-16.8)‡	-40 (0)‡

[a] = *All data adjusted for cluster effects*

* = $p < 0.05$ Baseline v Nine Weeks † = $p < 0.05$ Phase 1 v Phase 2 ‡ = $p < 0.05$ Intervention v Control

A more detailed comparison between Phase 1 and 2 revealed similar changes in the various intensities of activity in both cohorts. The only notable variation was the change in frequency and intensity (excluding vigorous intensity) of physical activity in the control group in Phase 1, which was not as widespread in Phase 2; there were changes in the frequency of walking and moderate intensity activity only.

Table 90

Frequency and Duration of Walking, Moderate and Vigorous Physical Activity Baseline and Follow Up in the Cluster RCT: Phase 1 and Phase 2[a]

		Intervention		Control	
		Phase 1 Baseline n=142 Nine Weeks n=95	Phase 2 Baseline n=51 Nine Weeks n=30	Phase 1 Baseline n=169 Nine Weeks n=129	Phase 2 Baseline n=40 Nine Weeks n=30
Walking Days/wk (M, SE)	Baseline	1.6 (.15)	2.6 (0)	1.8 (.05)	2.9 (0)
	Nine Weeks	4 (.12)*	4.8 (0)*	3.4 (.11)*	4.3 (0)*
Average Walking Minutes/wk (M, SE)	Baseline	18.5 (1.7)	36.6 (0)	28.7 (1.8)	38.5 (0)
	Nine Weeks	43.2 (1.7)*	43.3 (0)*	42.5 (2.1)*	41.1 (0)‡
Moderate Days/wk (M, SE)	Baseline	.5 (.04)	.8 (0)	.4 (.03)	.7 (0)
	Nine Weeks	1 (.11)	1.7 (0)	1 (.06)*	1 (0)
Average Moderate Intensity Minutes/wk (M, SE)	Baseline	16.5 (1.3)	24.1 (0)	9.6 (.57)	28.2 (0)
	Nine Weeks	23.3 (2.5)	29.7 (0)	18.6 (1.1)*‡	21.1 (0)‡
Vigorous Activity Days/wk (M, SE)	Baseline	.2 (.02)	.3 (0)	.4 (.02)	.3 (0)
	Nine Weeks	.7 (.07)*	1.1 (0)*	.8 (.04)*	1.3 (0)*
Average Vigorous Intensity Minutes/wk (M, SE)	Baseline	10.2 (.98)	13.6 (0)	14.8 (.95)	18.6 (0)
	Nine Weeks	18.9 (2.2)	26.3 (0)	19.5 (1.1)	36.4 (0)‡

[a] = *All data adjusted for cluster effects*

* = $p < 0.05$ Baseline v Nine Weeks † = $p < 0.05$ Phase 1 v Phase 2 ‡ = $p < 0.05$ Intervention v Control

Subsequent comparison of the change in physical activity between women with different demographic characteristics was undertaken (*Table 91*). Younger respondents displayed significantly more favourable changes in sedentary behaviour and frequency of physical activity. However, older respondents showed a greater average change in time spent being active primarily due to increases in walking. Unmarried participants reported more favourable changes in frequency of activity and sitting time in the intervention and control groups.

Women with children reported marginally greater changes in physical activity, while women with no children had considerably greater reductions in sitting time ($p<.05$). Participants living in a rural area in the control group reported an increase in sitting time compared to their counterparts in the intervention group, who reported an almost 30 minute daily decrease. Rural participants did however display a significantly greater increase in time spent being active per week compared to their urban counterparts. Notably, participants in the intervention group who did not have tertiary education had a significantly greater increase in physical activity than those who did have some or complete college education; this trend was also apparent in the control group. These participants reported greater changes in frequency of activity in the intervention group only.

Table 91

Changes in Physical Activity and Sedentary Behaviour across Demographic Characteristics in the Cluster RCT[a]

	Change in Average Total Physical Activity Minutes/wk n= 284 (M, SE)		Change in Average Total Days/wk n=284(M, SE)		Change in Sitting Minutes/day n=284 (M, SE)	
	Intervention	Control	Intervention	Control	Intervention	Control
Aged <40	36.3 (5)	42.3 (4.6)	3.8 (.27)	3.3 (.12)	-58.8 (8.2)	-9.9 (5.6)
Aged >40	44.5 (3.9)*	34.1 (3.4)	3.2 (.17)*	3.2 (.27)	10.2 (5.8)*	-2.7 (7.5)
Married	36.3 (2.8)	36.5 (3.3)	3.3 (.16)	2.9 (.17)	-7.9 (4.8)	16 (5.7)
Unmarried	47.8 (8.9)	41.2 (4.9)	4.2 (.38)*	4.1 (.18)*	-57.1 (11.2)*	-52.8 (8.6)*
No Children	36.8 (3.9)	37.2 (6.1)	4 (.27)	3.6 (.2)	-64.9 (9.7)	-69.7 (12.6)
Children	41.5 (3.1)	38.9 (2.5)	3.3 (.18)*	3.1 (.18)*	-2.6 (4.7)*	22.4 (6.1)*
Urban	28.6 (1.7)	40.5 (4.7)	3.3 (.18)	3.7 (.19)	-24.8 (6.5)	-29.2 (4.9)
Rural	50 (8.4)*	33.4 (2.8)	3.9 (.39)	2.4 (.17)*	-29.7 (9.1)	42.8 (5.2)*
No Tertiary	70.5 (6.7)	48.6 (3.5)	4.2 (.24)	3.3 (.25)	-27.5 (7.3)	32.4 (4.5)
Tertiary	14.5 (3.3)*	28.7 (3.8)*	3.1 (.23)*	3.3 (.13)	-27.9 (6.7)	-54.9 (5.7)*

[a] = *All data adjusted for cluster effects*

* = p < 0.05 Aged < 40 v Aged > 40, Married v Unmarried, No Children v Children, Urban v Rural, No Tertiary v Tertiary

A similar analysis of the change in physical activity between baseline BMI categories revealed that normal weight participants reported greater changes in the frequency and duration of their weekly physical activity. Also, overweight or obese participants did not report any positive changes in sitting time, rather there were slight increases in sedentary behaviour at follow up. Repeat participants in the Mini Marathon reported greater increases in time spent being active and decreases in sitting time in the intervention group while walkers and those who did not train or trained little prior to the event displayed a considerably greater increase in physical activity than runners, with the latter also conveying favourable changes in time spent sitting. In contrast, walkers reported a significantly lower decrease in sedentary behaviour than runners (*Table 92*).

Table 92

Changes in Physical Activity and Sedentary Behaviour and BMI across Participation Characteristics in the Cluster RCT[a]

	Change in Average Total Physical Activity Minutes/wk n= 284 (M, SE)		Change in Average Total Days/wk n=284(M, SE)		Change in Sitting Minutes/day n=284 (M, SE)	
	Intervention	Control	Intervention	Control	Intervention	Control
Normal	44.6 (6.7)	41.2 (3.7)	3.9 (.29)	3.5 (.21)	-35.4 (6.1)	-35.9 (8.1)
Overweight	34.5 (2.2)	26.7 (5)*	2.5 (.25)*	2.7 (.21)*	3.9 (7.9)*	28.7 (8.4)*
First time	19.9 (4.6)	36.7 (3.2)	3.5 (.22)	2.9 (.22)	-11.5 (3.3)	-41.6 (7.7)
Repeat	47.7 (6.5)*	37.5 (3.7)	3.6 (.24)	3.4 (.19)	-33.2 (6.5)	12.8 (3.3)*
Walkers	49.6 (6.3)	37.4 (3.5)	3.6 (.26)	3.1 (.19)	-21.4 (6.2)	7.2 (4.9)
Runners	4.5 (5.3)*	36.5 (7)	3.8 (.26)	3.9 (.26)*	-58.1 (11)*	-90.7 (5.8)*
Train	26.7 (3.8)	30.6 (3.6)	3.1 (.21)	3.5 (.21)	-10.9 (6.3)	.86 (7.7)
Do not train	49.5 (6.8)*	43.7 (4.9)*	3.9 (.27)*	2.9 (.15)*	-38 (8.2)*	-11.7 (4)

[a] = *All data adjusted for cluster effects*

* = p < 0.05 Underweight/Normal v Overweight/Obese, First Time v Repeat Participants, Walkers v Runners, Train Continuously v Do not Train/Train

Research Question 4: Was there a relationship between intervention components utilised (dose) and subsequent changes in physical activity?

7.3.5 Dose of Intervention

Participants in the intervention group were classified according to their combined use of the training plan, exercise classes, meet and train groups, walking routes and the pedometer. *Table 93* illustrates that while there was no significant differences between participants who received different doses/utilised different components of the intervention, those who used two or more aspects did display the greatest change in total physical activity minutes per week. Also, using any part of the intervention was related to decreases in sitting time compared to increases among participants who used none (p<.05 for none versus one part of intervention only).

Table 93

Change in Physical Activity and Sitting across Dose of Intervention Groups in the Cluster RCT[a]

	Change in Average Total Physical Activity Minutes/wk n=125 (M, SE)	Change in Sitting Minutes/day n=125 (M, SE)	Sufficiently Active n=125 (%)
Used 0 parts of intervention	17.9 (4.7)	57.1 (7.7)	4.5
Used 1 part	42 (6.3)	-61.5 (10.2)*	14
Used 2 parts	53.9 (13.7)	-56.1 (9.6)	13.3
Used 3 or more parts	49.7 (3.5)	-15.1 (4.9)	10

[a] = *All data adjusted for cluster effects*

* = $p < 0.05$ Dose of Intervention Groups

Research Question 5: Was there a change in self efficacy, social support, barriers to physical activity and suitability of environment for activity between baseline and follow up (intervention v control)?

7.3.6 Changes in Secondary Variables

There was little change in self efficacy pre and post intervention. However there was a significant increase in social support in both the intervention and control group, illustrated by lower scores at follow up. Further assessment of this change in social support revealed that the change was more notable ($p<.05$) among women with no children in both the intervention and control group. No difference in the change in social support or self efficacy was apparent between Phase 1 and Phase 2, age groups, marital status or level of education.

Table 94

Self Efficacy and Social Support at Baseline and Follow Up in the Cluster RCT[a]

		Intervention Baseline n=193 Nine Weeks n=125 (M, SE)	Control Baseline n=209 Nine Weeks n=159 (M, SE)
Self Efficacy	Baseline	11.9 (.32)	10.7 (.12)
	Nine Weeks	11.1 (.14)	11 (.07)
Social Support	Baseline	6.8 (.21)	7.2 (.09)
	Nine Weeks	5.4 (.09)*	5.5 (.09)*

[a] = *All data adjusted for cluster effects*

* = $p < 0.05$ Baseline v Nine Weeks

At follow up, there was no difference in barriers to physical activity between the intervention and control group (*Table 95*). In the overall group, women with children and those with tertiary education expressed lower overall barriers to being active at follow up; this was not apparent when the intervention and control group were analysed separately.

Table 95

Barriers to Physical Activity at Follow Up in the Cluster RCT

	Barriers to Physical Activity	
	Intervention n=125 (M, SE)	Control n=159 (M, SE)
Barriers to Physical Activity	21.4 (.18)	21.1 (.09)

[a] = *All data adjusted for cluster effects*

At baseline, approximately 33% of the overall group disagreed that their environment was conducive to physical activity. At follow up, fewer than 10% stated that it was difficult to be active in their local area, illustrating a positive change in perceived environment; there was no difference between the intervention and control group.

Research Question 6: Was any change in self efficacy and social support related to changes in physical activity?

7.3.7 Mediation Effect

In considering these data and the intervention effects apparent for vigorous intensity activity and sitting, it was worth investigating the role of self efficacy and social support as mediators in the observed improvements in physical activity. However, upon analysis, self efficacy or social support as a continuous or categorical variable was not related to the intervention. Also, vigorous activity or sitting minutes change scores were unrelated to self efficacy categories at baseline. Therefore, neither variable could be tested for mediation as they were not related to the intervention or outcome measures.

Research Question 7: How cost effective was the intervention in inducing changes in physical activity, relative to the control treatment?

7.3.8 Cost Assessment of Intervention

Efforts were undertaken to investigate the cost effectiveness of the intervention and specifically the cost of each minute increase in physical activity. This was not possible due to the lack of a clear intervention effect; therefore a cost analysis of the intervention was undertaken. A detailed list of costs including personnel, intervention development, material, and packaging, printing and posting costs is presented in *Appendix D, Table 5*. A summary of this inventory is presented underneath in *Table 96.* An aggregate sum of costs per month divided by the change in physical activity revealed that it cost just under 20 cent per participant to attain a one minute improvement in physical activity over 9 weeks in the intervention group. Furthermore, it cost 14 and 10 cent respectively to obtain one minute increases in physical activity among rural and non tertiary educated participants. Finally, significant increases in vigorous intensity activity and decreases in time spent sitting per day in the intervention group cost 65 and 23 cent per minute respectively (*Appendix D, Table 6*)[7].

[7] Some tables were moved to the *Appendices* to reduce the content in the main chapters

Table 96

Cost Analysis of the Cluster RCT Intervention

	Intervention n = 193 (€)	Control n = 209 (€)
Research Costs		
Idea Development	700	
Identification of Study Sample	350	
Total		
Intervention Development		
Preparation of Intervention	2912	
Cost of Materials	3152.77	
Total		
Administration Costs		
Preparation of Questionnaires, Consent, Tailoring Analysis	1227.78	650
Copies, Packing Post Questionnaires and Reminders, Labels	544.32	469.40
Postage	1973.05	246.40
Meeting Costs and Overheads	347.83	327.54
Total	11,207.75	1742.47
Cost per person over 9 weeks (divide by n)	58.07	8.34
Cost per person per month/week (divide previous by 2.25/9)	25.81/month 6.5/week	3.71/month 0.92/week
Average incremental cost relative to control per person per month/week	22.10/month 5.58/week	-
Cost per person per month/week per minute of improvement in PA	0.74/month 0.18/week	-

Approximately one fifth of the total study costs were allocated to evaluation, with the remainder allocated to the development of the idea and the organisation and delivery of the intervention. An analysis of the cost of the intervention alone, less evaluation/assessment costs would lead to a total intervention cost of under €8,000, and subsequent minute improvements in physical activity per person per week of under €5. Finally, to increase an individual's physical activity levels to those equivalent to minimum guidelines (150 minutes per week, USDHHS, 2008) could cost approximately €20-27 per week, using these particular intervention strategies.

7.4 Discussion

At baseline, there were no significant differences in demographic characteristics, physical activity or sedentary behaviour between the intervention and control groups. An approximate 70% follow up rate in both groups was achieved following email and postal reminders. The intervention group reported a significantly higher recall and use of the different booklets that were delivered to both groups while overall, pedometers appeared to be the most favoured aspect of the intervention. Approximately a quarter of participants in the intervention group also used the training plan and over a third attended exercise classes over the intervention period. This did lead to positive changes in physical activity (approximately 38 minute increase in total physical activity), which was apparent in both groups.

The intervention group displayed a greater decrease in sedentary behaviour and a more substantial increase in participants classified as sufficiently active, using IPAQ criteria, at follow up than their control group counterparts. Also, although both phases of this intervention were delivered in different seasons to different cohorts there was no difference in the change in physical activity between the intervention groups in each site. However, the control group in Phase 2 did not show a significant increase in total physical activity per week at follow up, which was evident in the comparison group in Phase 1. Lastly, despite the encouraging improvement in overall physical activity at follow up, the average physical activity for the group still remained approximately 70 minutes below weekly recommendations, as per the new guidelines for physical activity (USDHHS, 2008).

7.4.1 Study Participants

Although the intervention and control group were similar at baseline, there were differences between participants and non participants in this trial. Puffer et al. (2003) stated that selection bias in the recruitment of participants to a cluster randomised controlled trial can be minimised if participants are recruited and consent is acquired prior to randomisation to an intervention or control group. This procedure was adhered to in this study but did not eliminate selection bias; women with children, without tertiary education and who were not first time participants were more likely to participate in this trial (p<.05). Furthermore, there was a higher proportion of older women, married women, overweight/obese women, walkers and women with medical cards among participants compared to non participants.

Despite this disparity between participants and non participants, it appeared that this trial was successful in recruiting typically hard to reach sub groups of women who are often most at risk. This was discussed in greater detail in chapter 3 where for example, it was noted that high educational attainment and higher social class are related to increased participation rates in Ireland (Lunn and Layte, 2008; Morgan et al., 2008) and worldwide (Britton et al., 2000; Eyler et al., 2002). As Rosamond et al. (2000) noted it remains a challenge to reach women who are most at risk unless they are specifically targeted (Bock et al., 2001; Ball et al., 2006; Clarke et al., 2007; Speck et al., 2007). For example, Napolitano et al. (2006) noted that women in their trial to increase physical activity were predominantly middle and upper class and Britton et al. (2000) noted that only 27% of their sample had no tertitary education. In contrast, in this study 44% of participants reported no tertiary level education. In addition, 20% of participants had a medical card, another indicator of lower social class and clear evidence of the favourable proportion of typically hard to reach participants in the study.

Also, over half of the participants in this trial were older than 40 while almost two thirds reported having children and were married and one third were overweight. These again reflect characteristics of women who are most at risk of physical inactivity and associated disease; physical activity decreases with age (Morgan et al., 2008; Guthold et al., 2008) while marriage and parenthood are inversely related to physical activity (Verhoef et al., 1993; Brown et al., 2009). Specific targeting of women who have the greatest potential for improvement, (i.e.) sedentary and overweight among others, has also been recommended to enhance the success of and maximise the benefit attained from physical activity interventions. Therefore, it is positive to note that 35% of participants were overweight or obese according to their self reported BMI levels.

Participants in this trial were also considerably more representative of the general Irish female population than the pilot trial (chapter 6). This intervention evidently appealed to a variety of demographic groups of women and thus, overall increases in physical activity and decreases in sitting time that were observed can be viewed as potentially beneficial from a population wide, public health perspective.

7.4.2 RE-AIM Framework

The RE-AIM framework formulated by Glasgow et al. (2003) presents an evaluation model for community based interventions, which despite their proclamations to enhance generalisability and sustainability often produce findings and outcomes that do not transfer easily to a real world setting. In a recent review of cluster RCTs, Eldridge et al., (2008) used this framework to assess the external validity (generalisability) of study findings, with a particular focus on adoption and maintenance and how these factors pertain specifically to cluster rather than individual RCTs. The respective components of this framework as they pertain to this research will be discussed below.

7.4.2.1 Reach.

According to the RE-AIM model, reach refers to the characteristics of participants in the study. The participation characteristics discussed previously indicated that this trial was successful in attracting hard to reach sub groups of the female population. A participation rate of 63% (of the total eligible sample) was quite good and furthermore, the characteristics of participants, although different to non participants, were reflective of the Irish female population overall. Differences that were apparent, particularly the high level of education among the study sample, is primarily due to the greater tendency of women with some or complete college education to return questionnaires and to participate in mass events, such as the Mini Marathon. It must also be noted that a purposive sample of women were recruited that met the defined inclusion criteria, which also can lead to selection bias, although this was a population based sample, which is infrequently used in physical activity research.

7.4.2.2 Efficacy/Effectiveness.

The second aspect of the framework refers to efficacy or effectiveness and the impact of the intervention on the outcome of interest (Dzewaltowski et al., 2004). The intervention was successful in increasing physical activity but this was also apparent in the control group although a significant increase in vigorous minutes was noted in the intervention group only. A decrease in sitting time of over 27 minutes in the intervention group was much more substantial than the observed change in the control group (5 minutes) however. Self efficacy did not alter between baseline and follow up while social support improved significantly in both the intervention and control group.

Several other studies have recruited women to trials to promote physical activity with contrasting results (*Table 73*). Segar et al. (2002) observed an approximate 13 minute increase in total physical activity at follow up and a significant increase in walking, moderate and vigorous sessions per week in their intervention group. Dinger et al. (2005) used a minimal contact pedometer based intervention and noted a 200 minute increase in walking and no change in self efficacy at follow up. The authors noted that this unsuccessful attempt to enhance self efficacy may be due to a lack of tips and strategies to increase participants' confidence in their ability to be active; this could also be apparent in this research as self efficacy scores remained stagnant between both time points. The lack of a comparison group in both of these studies presents a dilemma about the source of the observed increase in physical activity at follow up; was the intervention successful or was observer bias the reason for the positive change in physical activity.

Napolitano et al. (2006) used two communities in the US to enlist women for a predominantly print based intervention and after three months observed a minimum 60 minute increase in weekly physical activity in the overall group, including the control group. In this study, a significant 38 minute increase in physical activity was apparent in the intervention and control group after nine weeks. A longer follow up and intervention period may have garnered greater effects on physical activity. Speck et al. (2007) recruited over 100 female participants to a participant led six week intervention and reported no change in physical activity at follow up. Similarly, there was no between group differences in the change in self efficacy, social support or barriers to physical activity at follow up. However the intervention group did report a significant increase in friend support; more noteworthy given the cohort of low income women used as participants in the study. There was an overall increase in social support in this research but it was not particularly prominent among women with lower levels of education or medical card holders.

Speck et al. (2007) also noted that their low income participants from an urban area reported more barriers to physical activity than their more affluent counterparts and that barriers related to family and work increased with age. Similarly, among the Mini Marathon participants, those with more education expressed lower barriers as did parents. Finally, Keyserling et al. (2008) developed an intervention that used community resources to promote physical activity among women. A significant improvement in moderate and vigorous intensity activity in the enhanced intervention group as assessed by self report was noted but there was a considerably low number of participants meeting minimum physical activity guidelines post intervention. Accelerometry data was also collected but did not reveal an equivalent change in physical acttivity.

7.4.2.2.1 Efficacy/Effectiveness: participant sub groups.

Subsequent analysis of the changes in physical activity between the various demographic segments of the female sample in this study revealed some notable trends. For example, older women in the intervention group had a greater overall increase in physical activity primarily due to an increase in walking. Previously mentioned studies including Manson et al. (1999) who reported on the Nurses Health Study have provided evidence for the health benefits associated with brisk walking, similar to those accrued from vigorous intensity activity. Consequently, the observed changes in older women are positive, assuming that the reported walking was at a moderate intensity.

Unmarried women reported greater increases in physical activity and significantly greater decreases in sitting time than married women but the latter still displayed favourable changes. Women with children displayed slightly greater improvements than women without children, who themselves reported more notable decreases in sedentary behaviour. While there were positive changes among married women and those with children, it must be noted that unmarried women and women with no children were consistently more active at baseline and follow up. This suggests that being married and having children is negatively related to physical activity among this population; a common observation, also noted by Bellows-Riecken and Rhodes (2008) in a review of literature related to parenthood and physical activity. The previously mentioned improvement in social support in this research was most apparent among women with no children who potentially had more time to avail of and take part in the group based activities that were advocated in the intervention.

At baseline, rural women engaged in significantly less physical activity than their counterparts living in urban areas. This same finding has been reported in the US (Wilcox et al., 2000; Parks et al., 2003) where women in rural areas took part in less physical activity and were less likely to meet minimum requirements for physical activity. Post intervention, however, rural women in the intervention group displayed an almost 20 minute greater increase in physical activity, although urban women remained more active. Rural based women also reported significant decreases in sedentary behaviour. Perry et al. (2007) undertook an intervention to promote walking using motivational interviewing in rural women and found improvements in cardio-respiratory fitness after 12 weeks, indicating that it is feasible to promote physical activity among this cohort of women.

In this study, a change in physical activity reported by women with no tertiary education in both intervention and control groups may be explained by lower levels of pre intervention physical activity in this group compared to women with tertiary education. Despite this, women with lower reported education levels in the intervention group engaged in more physical activity at follow up, which is quite a positive outcome. It was noted earlier that women with lower education and from lower socio-economic backgrounds engage in less physical activity than their more affluent counterparts, thus these are a priority target group when promoting physical activity. Such women took part freely in this study and experienced substantial improvements to their physical activity levels. Overall, these results indicate that this intervention did promote physical activity among typically low, or less, active sub groups of women (married women, women with children, from rural areas and with lower educational status), however, in most cases these women still reported lower physical activity levels at follow up, and did not meet minimum physical activity weekly requirements.

Repeat participants in the Mini Marathon, walkers and participants who trained little prior to the event all demonstrated the greatest changes in physical activity. Repeat participants were more active than first time participants at baseline and follow up in the intervention group only while walkers despite their substantial 40-45 minute increase in physical activity still remained less active than runners/joggers at follow up. A similar scenario was observed among participants who did not train at all or quite little before the Mini Marathon. Although, those who were more active immediately prior to the Mini Marathon retained the positive effect on their physical activity of running, training and participating frequently, it is significant that positive changes in physical activity were apparent in all subgroups of participants and suggests that strategies used in this intervention might assist in the maintenance of physical activity post event.

7.4.2.2.2 Efficacy/Effectiveness: intervention design.

This intervention was largely based on the social-ecological model of behaviour change, which purports to achieve population level behaviour change by designing and implementing multi-faceted interventions, similar to those implemented by Wen et al. (2002) and Jenum et al. (2006). Specifically, in this instance efforts were made at an intrapersonal level to promote goal setting and problem solving through the provision of training plans, physical activity diaries, case studies and tips and strategies for overcoming barriers; this represented a motivational and educational effort to improve physical activity.

At an interpersonal level, participants were encouraged to generate social support for physical activity by joining clubs, exercise classes or Meet and Train groups. Tailored information about running and walking routes in participants' locality as well as suggestions for being more active at home and work and fitting activity into daily living tasks were also provided. Links were forged with the national physical activity promoting network of LSPs and relevant sport/physical activity agencies in all regions involved in the study to utilise existing structures and thus, enhance the transferability of overall efforts to promote physical activity.

Many of the interventions noted earlier (*Table 72-74*) directly cited or contained similar elements of the social-ecological model of behaviour change in their design and administration and reported contrasting results. Segar et al. (2002) adopted a socio-psychological perspective in their efforts to promote physical activity. As well as the aforementioned increase in physical activity after the intervention, participants also cited a greater tendency to use community resources and use daily opportunities for physical activity at follow up. Speck et al. (2007) incorporated exercise classes, group walks, telephone calls and print materials that focused on tips to include physical activity in daily living in their intervention and achieved favourable results in relation to physical activity behaviour and in the ability of participants to identify resources in their neighbourhood for physical activity.

Keyserling et al. (2008) noted that previous editions of their WISEWOMAN intervention yielded only modest improvements in CVD risk factors and therefore developed a more comprehensive, intense intervention that included counselling, group sessions, phone contact, print materials and community resource detail. In this instance, no improvement in physical activity was detected but this may be due to an additional focus on dietary change and the longer follow up period of six months. DeCocker et al. (2008) also developed a multi-level intervention using various settings, mass media and individual strategies (pedometers) for a community in Belgium. At follow up, compared to the comparison community, there were significant improvements in step counts and sedentary behaviour.

There was no such between group difference in overall physical activity in this research, which suggests that any attention or contact may have caused this predominantly previously active cohort of participants to improve their physical activity. However, the improvement in vigorous intensity activity, decrease in sitting time and assimilation and use of the various strategies offered to the intervention group was positive and may promote longer maintenance and further increases in physical activity. In relation to the communication of strategies to increase physical activity, over three quarters of respondents stated that their awareness of their LSP increased; indication of the need to publicise and communicate opportunities and resources for activity in local neighbourhoods and communities directly to participants. Also, just over a third of the participants used local walking routes while two thirds used the pedometers that were delivered to them after six weeks of the intervention. These latter statistics indicate that walking was perhaps the most feasible and accessible form of physical activity for the participants in this trial.

The use of pedometers as a motivational tool to promote walking has proved successful in previous studies (Dinger et al., 2005; Clarke et al., 2007; DeCocker et al., 2008). In this study, there was a significant improvement in time spent walking between baseline and follow up; 20 and 11 minute increases respectively in the intervention and control groups. This is beneficial for health and particularly notable among this population of insufficiently active women as brisk walking is promoted as possibly the most suitable form of aerobic activity for relatively sedentary individuals (USDHHS, 2008).

7.4.2.3 Adoption and Implementation.

The uptake of the various intervention strategies presented earlier indicates evidence of adoption and implementation; additional components of the RE-AIM framework, which relate to the number of intervention agents that participate in a study and the delivery of the intervention. The primary intervention agent in this study, LSPs or their equivalent, were informed about the study and co-operated, with the assistance of some phone contact and reminders, in the compilation of tailored information for participants in the intervention group. The intervention, which sourced and communicated information on existing structures within the community, is not part of the standard practice and general workings of these local physical activity promoting structures. Therefore, the design and delivery of the intervention represented a concerted effort between these regional entities and the researchers to evaluate current awareness of the LSPs and assess a new communication/working strategy that may potentially improve the effectiveness of LSPs.

The intervention was administered centrally by the researchers and not by each individual LSP. As a result of this influence of the researcher, findings such as increased awareness of LSPs and greater use of local walking routes may not be directly generalisable to other similar physical activity promoting agencies. These groups will need to alter and deliver their own individual communication or operating strategies to achieve similar positive outcomes to those acquired in this study. No assessment of outcomes across the different LSPs in the intervention group was undertaken as information disseminated about each was largely consistent. Also, there was no attempt to investigate the different services offered, infrastructure quality and workings of each LSP, which would have facilitated an examination of the link between these factors and subsequent contact with LSPs, uptake of strategies and changes in behaviour. This may have explained the low interaction with LSPs observed in the intervention group, which is discussed furtehr below.

In a further discussion of implementation, Dzewaltowski et al. (2004) noted that researchers need to understand and report intervention delivery as well as receipt of intervention materials. Wilson et al. (2009) had similar observations, remarking that implementation should be assessed in relation to intervention fidelity (was it delivered as planned), the dose or amount delivered and the dose received. With regard to intervention delivery in this research, as the intervention was managed centrally, there was consistency in the distribution and administration of the intervention and thus a high fidelity rate. However, due to the considerable variety in programmes offered, resources available etc within individual LSPs, each cluster in the trial received slightly different intervention protocols.

Secondly, in relation to dose delivered and received, recall of the intervention was relatively good, particularly in comparison to the control group; 97% of the intervention group recalled receiving their booklets compared to 78% of the control group. Furthermore, approximately 90% of participants recalled receiving the various intervention materials; this increased to 97% in relation to the pedometer. Lower proportions used or acted on the components of the intervention; under a quarter of participants contacted their local leisure centres and a similar proportion availed of exercise classes. Also, as noted previously, almost 40% used walking routes and two thirds used the pedometers that were disseminated. Wilson et al. (2009) developed guidelines for dose analysis; high dose corresponded to >75% values, moderate between 50-74% and low 25-49%. This permits a more critical analysis of intervention delivery for this study. Overall, dose in relation to receiving and reading intervention materials was high, ranging between 85% and 97%, contact with groups such as LSPs and gyms quite low (7-23%) and use of strategies, such as walking routes and pedometers low to moderate (23-65%).

Wilson et al. (2009) also noted that an even more comprehensive assessment of implementation should incorporate linking the dose of intervention delivery to outcomes. In their study on the delivery of a worksite programme, dose of delivery was dichotomised into full participation (return of all biweekly goal sheets) or not (partial return only); results indicated no difference between participation rates in physical activity post intervention. In this instance, intervention dose was split into four categories; using none of the intervention strategies, using one, using two or using three or more. The latter groups reported the greatest change in total physical activity, an increase of approximately 50 minutes post intervention, while using any aspect of the intervention resulted in a minimum 20 minute greater increase in physical activity and substantial decreases in sitting, than using no parts of the intervention; this group actually reported an increase in sitting at follow up. Also, it is worthwhile noting that Wilson et al. (2009) did observe different outcomes between groups with differing levels of intervention fidelity. Worksites who reported a more comprehensive implementation of the intervention achieved greater changes in vigorous intensity physical activity. This was not apparent in our study as the intervention was managed centrally but has implications should it be delivered by individual entities, such as LSPs, in the future.

As noted above, 65% of intervention participants used the pedometers that were disseminated during the intervention. Eakin et al. (2007b) investigated the use of pedometers in their community based intervention; the 10,000 Steps Rockhampton project in Australia. In the follow up survey of over 2,000 adults, correlates of pedometer use were identified. Usage rates were considerably lower than those reported in our study (12-18%) although follow up was undertaken two years post baseline. However, participants were asked about their pedometer use overall in the previous 18 months, which facilitates a comparison with rates in this research. Such an undertaking would suggest that pedometers were considerably more acceptable among women recruited in this study. Results from Eakin et al. (2007b) indicated that odds of using pedometers was significantly greater among women, as well as among older (aged > 45) respondents, those with higher levels of education and with higher BMI's (> 30). The female only, highly educated sample in this study share this profile, which may offer some explanation for the high rates of pedometer use. Despite this, no similar significant trends in relation to pedometer use and education among other variables were apparent possibly due to a small sample size, but trends indicated that those who used pedometers were more likely to be aged less than 40, have no children and be single. These results are presented in *Appendix D, Table 4*.

7.4.2.3.1 Adoption/Implementation: cost assessment

A further analysis of intervention delivery, specifically of the time allotted to the design and management of the intervention permitted a cost assessment of the programme. As noted earlier, a cost effectiveness anaysis was not viable in this research due to the lack of an intervention effect. In 2004, Dzewaltowski et al. noted that cost analyses of interventions to promote physical activity were rare. More recently, much effort has been and is currently being afforded to undertaking economic analyses of interventions that have been administered to promote physical activity. Sevick et al. (2007) completed a cost-effectiveness study of Project Stride, an intervention previously reported on in chapter 6. Sevick et al. (2007) noted that all previous cost assessments in relation to physical activity involved primary care or individual counselling and none had addressed the low contact, print based tailored interventions that have become increasingly popular. Project Stride involved a telephone and print motivationally tailored feedback programme on a sample of healthy sedentary adults. Costs included personnel costs, and those for an Expert system, which generated tailored feedback, as well as printing and postage, material costs, telephone costs and the use of facilities. Research costs were not included but recruitment costs to enrol participants in the intervention were considered relevant.

The print and telephone group reported similar improvements (approximately 100 minutes) at six months compared to a 55 minute increase in the control group; an intervention effect, which permitted a cost effectiveness analysis. At 12 months, the print group showed a further 30 minute increase while the telephone group decreased by 20 minutes and the control group remained relatively stable. The average cost per participant per month in the print intervention group was $50(€34), compared to approximately €26 in this study, whereas the cost per control participant was $21(€14) compared to €6 in this research. At this point, it is worth noting that a greater use of technology, including the internet and mobile phones, could substantially reduce the costs associated with this intervention; presenting an alternative communication strategy after information has been gathered. Such an approach could however lead to some loss of reach among older, more socially disadvantaged individuals.

The favourable changes in vigorous intensity activity and sitting offer some evidence of an intervention effect (these improvements cost 65 and 23 cent respectively), which provide some support for the cost effectiveness of this particular intervention and its dissemination among LSPs and other appropriate agencies. Also, an aggregate sum of costs per week per participants divided by the change in physical activity revealed that it cost 10 and 14 cent per minute to improve physical activity for women with no tertiary education and those living in rural areas, respectively. These are potentially significant findings for those charged with promoting physical activity in Ireland.

7.4.2.4 Maintenance.

The last aspect of the RE-AIM framework refers to maintenance; the long term maintenance of behaviour change at the individual level and the sustained presence of a new practice or treatment at the setting level (Glasgow et al., 2003). Sallis et al. (2006) noted that the long term maintenance of behaviour change is often poor, and as illustrated in chapter 5, attrition rates of up to 50% are common following interventions. Typically, physical activity increases post intervention but is not sustained long term, and often not even assessed long term. Indeed, Dzewaltowski et al. (2004) noted that only 30% of the studies in their review reported follow up data upon completion of the intervention, and they identified an average physical activity attrition rate of between 4% and 35%. According to Sallis et al. (2006), adopting an ecological approach to physical activity promotion may enhance maintenance due to the multi level efforts to induce behaviour change associated with the model. In accordance with this, a primary motivation for using this model in this research was to improve generalisability and thus, facilitate long term, sustained improvements in physical activity following an intial prompt to action (i.e.) participation in a mass event.

Follow up in this study was only undertaken immediately post intervention, and as discussed previously, favourable outcomes were apparent. Furthermore, no substantial differences between follow up and non follow up participants were observed, which suggests that the intervention was uniformly acceptable. Dinger et al. (2005) and Perry et al. (2007) undertook a similar once off follow up at six weeks and three months while Segar et al. (2002), Napolitano et al. (2006), Speck et al. (2007) and Keyserling et al. (2008) all engaged in at least two follow ups, one of which was some time post intervention. This is a preferable undertaking but was deemed unsuitable and un-necessary in this research for two reasons. Firstly, any longer term assessment of physical activity would be substantially confounded by the re-commencement of training for the Mini Marathon by the high proportion of participants who take part in the event annually. Indeed, almost two thirds of participants in both the intervention and control group were repeat participants. Secondly, the primary aim of this research was to develop strategies to build on the initial impact of the Mini Marathon, and prevent relapse post event. Subsequently, the observed improvement in physical activity approximately six months post participation in the event is sufficient to fulfil this aim and to help sustain year round engagement in physical activity by these individuals.

These results have led to the formal adoption of some of the endeavours in the intervention by the organisers of the Mini Marathon. A web portal with tailored information about local resources for activity, and access to the physical activity booklets used in both interventions (chapter 6 and 7) is now communicated to women upon their registration to the Mini Marathon. Charities who act as a primary motivator to participate also refer participants to this web site. This represents maintenance of the intervention at a setting level and subsequent efforts are planned to further engage LSPs and their equivalents in this process as well. Indeed in conjunction with the primary aim of this research to prevent relapse post event, it is recommended that the strategies developed in this intervention are communicated and delivered to a greater population of women, through the existing vehicles of LSPs.

7.5 Limitations

Gulliford, Ukomunne and Chinn (1999), Eldridge et al., (2004) in the CONSORT statement for cluster RCTs and Puffer et al., (2005) all recommended that sample sizes for cluster RCT designs should be established prior to the recruitment of participants using design effect and intraclass correlation coefficient (ICC) scores, which can be estimated from previous similar studies. While such an undertaking would have enhanced the credibility of this particular research, there is a dearth of published ICCs and design effects for the particular outcome data under investigation, particularly for this population.

The RE-AIM review of published studies in *Table 72-74* was carried out on a convenience sample of community and pedometer based interventions. Further work to comprehensively evaluate the RE-AIM framework and to assess the different aspects of it in a systematic review of community based interventions is required.

The previously noted limitations of self report assessment of physical activity are also applicable to this study. It is reasonable to assume that the change observed in physical activity in both intervention and control groups may be due to over reporting of physical activity at follow up after participants have been sensitised to the questionnaire. Also, there may be a potential social desirability bias apparent as participants perceive that they should communicate greater participation in physical activity than their actual true involvement. Both of these deficiencies are due to the use of a self report measurement tool and thus, an objective assessment would have been useful.

There may have been potential to use the pedometers delivered to intervention participants to record participation in physical activity. Previously, Tudor-Locke and Bassett (2004) generated guidelines for the translation of pedometer data (steps) into activity categories, such as sedentary, low active and high active, which reflect if a participant is or is not meeting minimum physical activity requirements. Pedometers are a relatively cheap and objective method of data collection that can be administered on an individual and population level, and were identified by Tudor-Locke and Myers (2001) as a practical method of physical activity assessment. Their weakness is in assessing intensity of activity and they would still have constituted self report data in this research as the disparate group of participants would have had to personally record and submit their step counts. It is also not recommended to use a measurement instrument as an intervention tool. Furthermore, the pedometers used in this study were selected because they were relatively cheap, convenient and easy to use. Resources were not available to do a validity and reliability assessment, which was acceptable in this instance because the pedometers were not being used as a measurement of outcome device.

While receipt and general recall of the intervention strategies was quite high, the actual dose used by participants was somewhat low. Almost 60% of the participants used none or just one element of the main resources or ideas to be active that were communicated to them; these included pedometers, the most popular strategy, walking routes, meet and train groups, exercise classes and training plans. This is potentially an explanation for the absence of an intervention effect and suggests that more concerted efforts are warranted to increase the use of the majority of these strategies. Communication alone was not entirely efficacious in motivating these participants to use a variety of opportunities for activity in their locality.

The cost assessment of this intervention is limited by the lack of a true intervention effect. Müller-Riemenschneider, Reinhold and Willich (2009) in their review of interventions which undertook cost effectiveness analyses noted that inability to demonstrate an intervention effect prevented a true assessment of the cost of using a particular intervention to enable a participant to become active in comparison to a standard treatment or control group.

7.6 Implications for Health Promotion

While there were no overall differences in the changes in physical activity between the intervention and control group, some positive outcomes were apparent in the intervention group that support the wider dissemination of some, if not all, of the components of the intervention in this study. These are particularly relevant to agencies charged with promoting physical activity in Ireland. Communication is essential in any effort to promote participation. In this study, three quarters of this sample were not aware of LSPs prior to the study but simple communication led to a similar proportion becoming cognisant of this local entity at follow up, which supplements positive recall rates and favourable changes in high intensity activity and sedentary behaviour. Sourcing and communicating information on existing structures and routinely and regularly informing the public on opportunities to be active within the community is not part of the standard practice and general workings of LSPs. This research would suggest that it should become a part of their work and be incorporated into current efforts to disseminate information to their respective communities. It may also be a worthwhile endeavour for LSPs to undertake needs assessments with their target population to tailor their offerings and thus enhance engagement and participation rates.

Pedometers proved the most popular resource among the intervention cohort and could be used more extensively to promote physical activity among sedentary groups of women. Pedometers primarily motivate walking, which was also enhanced by encouraging reported use of walking routes at follow up. Greater provision of safe walking routes and enhanced communication about existing ones may be a useful tactic for those charged with promoting physical activity.

The role of access to facilities to be active in predicting physical activity is somewhat unclear and it was noted in chapter 3 that a lack of facilities was not a barrier to physical activity among Irish adults (Fahey et al., 2004). Indeed, there has been increased provision of public leisure centres nationwide and a proliferation of private entities offering exercise classes, which further substantiates the finding that the absence of facilities are presenting a barrier to being active in Ireland. Rather, it appears that individuals are reluctant to use these facilities for activity. In this intervention, tailored information about local centres and exercise classes was communicated to participants and subsequent use was noted by approximately one quarter of respondents. This suggests that while communication alone initiated some engagement with these centres and classes, and should thus be a basic requirement, a greater effort is warranted. This may be the responsibility of local agencies charged with promoting physical activity or leisure centres themselves through direct contact with potential clients or users.

Only 6% of the intervention group reported using Meet and Train groups at follow up. Increasing numbers of these groups, who provide a group training forum for beginners and more advanced exercisers, exist nationwide and they are supported by the Irish Sports Council and the Athletics Association of Ireland. Participation in these initiatives was not enhanced by this intervention. It is unknown if this was due to insufficient communication about these groups or if they simply did not appeal to the participants recruited to this trial. It could be assumed that this group of insufficiently active women may not be confident enough in their athletic ability to join a primarily running oriented organisation. Indeed, only 20% of the intervention group actually reported running the Mini Marathon. Promoters and supporters of the Meet and Train scheme can learn from these findings. Perhaps greater publicising of the suitability of these groups for beginners and the organisation of a beginner only training forum/night, which would provide a safe, supportive environment for those eager to be more active could be useful endeavours to undertake.

Lastly, evaluation including basic cost assessments of programmes is recommended. This could generate a database of participant details to aid future delivery of more targeted programmes. Furthermore, evidence of effectiveness, both in terms of cost and participation can serve to increase investment in physical activity promotion.

7.7 Conclusion

Unlike claims by Dzewaltowski et al. (2004), that studies typically do not report sufficient information to assess the representativeness and transferability of findings, a thorough evaluation of this intervention, using the RE-AIM framework was undertaken. It would appear using this framework the intervention strategies used in the study may be quite generalisable, particularly at an individual level. Consideration of the most commonly reported aspect of the model – efficacy and effectiveness, indicates favourable outcomes; an improvement in physical activity in both groups, but more importantly, a significant increase in vigorous intensity physical activity, a greater decrease in sitting time, and a greater proportion of sufficiently active participants at follow up in the intervention group. Participants recruited to the trial were also more similar to the Irish female population than the average Mini Marathon participant overall and included greater proportions of women most at risk for insufficient activity levels and associated ill health. The intervention also induced improvements in physical activity among these sub groups of participants. Encouraging rates of recall and use of intervention components were also apparent as well as successful co-operation and engagement with national and regional bodies responsible for the promotion of physical activity in Ireland. Practical implications and sustained outcomes have also been identified but continued collaboration and discussion is necessary to further improve efforts to promote activity and to increase current participation to 150 minutes per week, as per current Irish and international recommendations.

Chapter 8: Conclusions and Recommendations for Future Research

8.1 Major Findings

Findings from this research have indicated that the majority of participants in three women's only mass community physical activity events in Ireland, in 2007 and 2008, were active prior to as well as on the day of the event. These events managed to foster participation in physical activity, albeit at a relatively low intensity (half intended to walk the event), among more than the habitual exerciser. A large proportion of participants maintained their activity levels post event, with only 11% of the sample being identified as relapsers. Participants who did not have tertiary education, who walked the event, lived in a rural area and reported low levels of self efficacy and social support were more likely to regress to insufficient levels of activity in the months after the events. These participants were therefore recruited to two different trials designed to re-initiate participation in physical activity.

In 2007, eligible participants were randomly allocated to an intervention or control group. Following the administration of a tailored, print booklet and a placebo treatment, increases in physical activity were reported in both groups. In 2008, relapsers were recruited to a cluster randomised controlled trial (RCT). The intervention, which was supported by the Irish Sports Council and Local Sports Partnership, incorporated the communication of existing resources for physical activity in the community and the distribution of pedometers to act as a further prompt for activity. Again, no overall intervention effect was apparent although the intervention group did report a significant increase in vigorous intensity activity and a decrease in sitting, which was not found in the control group. Results from both trials suggest that any contact at all was sufficient to instigate behaviour change or that motivated volunteers enrolled in the trials.

8.2 Strengths and Weaknesses

8.2.1Strengths

This study has many strengths. It is an original investigation as few studies have been conducted on mass events worldwide. In 2007, Murphy and Bauman observed that the health and sport sector needed to liaise with event organisers to maximise the benefits associated with mass events. The current research incorporated co-operation and planning between the Irish Sports Council, Local Sports Partnerships, and the research team. There has been little previous attempt to investigate the effectiveness of mass community participation events on participant physical activity levels pre and post event, despite the rhetoric that prevails about their usefulness as a physical activity promoting strategy. Event participants were assessed prior to and two/three months post event (and six months in 2007) using a validated instrument, which facilitated comparisons with similar data collected in a national health and lifestyle (SLÁN) survey conducted in Ireland in 2006.

The physical activity data that were gathered from the large sample of Irish females in this research is also important, as this type of information is rarely collected longitudinally in Ireland. Furthermore, a population based sample of women have never been recruited to RCTs to promote physical activity in Ireland. Also, the collection of baseline survey data was supplemented by intercept interviews that were conducted on the race day of the Dublin events in 2007 and 2008. The limitations of self report data, which will be addressed below, are well recognised, and these short intercept interviews were a strategy to cater for these deficiencies and to validate the overall data collected.

Perhaps the most unique aspect of this study was its assessment of behavioural relapse. Few studies have investigated relapse on a population sample at serial follow up studies. Furthermore, little research has identified predictors of behavioural relapse or has recruited relapsers to trials to promote physical activity. The definition of relapse used in this research was comprehensive as it incorporated two different criteria. Firstly, relapsers were identified as participants who decreased their participation by 60 minutes or more of at least moderate intensity physical activity per week, which is likely to be greater than the measurement error apparent in repeated measures. Secondly, these individuals must have regressed from the sufficient (high or moderately active) IPAQ categories to insufficiently (low) active. It was noted in chapter 3 that only high active should be used to indicate sufficiently active because IPAQ uses multiple domains in its assessment of physical activity, thus it may have been appropriate to adjust the second criterion and identify relapsers as those who moved from high only to moderate or low active. The criteria was not altered and thus the decrease in physical activity displayed was likely to be a true decline.

The translation of findings from research to practice and the generation of transferable strategies to promote physical activity is a weakness of physical activity research. Therefore, an effort was made to design and deliver interventions that could be generalised to real life settings (RCTs). This was a successful endeavour as the Irish Sports Council and Local Sports Partnerships have used the resources generated in the intervention and are eager to engage further in many of the proposals arising from this research. Finally, it is also noteworthy that the cluster RCT in 2008 was conducted during different seasons using two different cohorts of women, which adds to its generalisability.

8.2.2 Weaknesses

Data were collected using self report questionnaires, which can be influenced by recall and social desirability bias. Upon comparison of survey and intercept interview data, it appears likely that the numbers of low active participants were underestimated due to overestimation of physical activity and the lower likelihood of these individuals to respond to surveys and participate in trials. It may subsequently be assumed that the true impact of these events to target the least active women in society may be greater than survey data suggests.

Selection bias may explain why the sample in this research was not representative of the general Irish adult female population, particularly in relation to social class. Education and medical card ownership were used as indicators of social class; the measurement of the latter is problematic as there is no postcode system or local mapping of socioeconomic status. Analysis of these data revealed that there were considerably lower proportions of lower educated women and medical card holders in the sample compared to the population at large. It is possible that these participants were less likely to return the questionnaires and thus while it appears that the event only managed to attract more affluent women to be active, its wider appeal may have been underestimated due to the method of data collection. It is also likely that the rate of relapse, and those reverting to insufficient levels of physical activity post event, was underestimated due to the bias described above. The mode of data collection used in this research is evidently a limitation but was the most practical assessment tool for such a large target population and should not negate the observed impact of these events.

Relapsers were identified using one week assessments of physical activity pre and post event. It is possible that the week reported by participants may not represent a typical week due to factors such as illness or injury. Indeed some participants classified as relapsers immediately after the final follow up the 2007 Dublin event were not subsequently insufficiently active upon collection of baseline data prior to the first intervention study. This presents a concern about categorising relapsers using short term, self report assessments. Despite this, participants who regressed at short term follow up in 2007 maintained this state at long term follow up and it may be that the period between the last follow up and the start of the intervention was too long. In 2008, the cluster RCT began within six weeks of the final follow up and all participants subsequently met relapse criteria when the intervention began. Furthermore, in 2007, the intervention was scheduled when many participants may have commenced training for the 2008 Mini Marathon, thus women may have re-initiated involvement in physical activity at this time regardless of any intervention.

Non relapsers were not differentiated into adopters and maintainers, thus it is possible that some participants not classified as relapsers may have been insufficiently active pre and post event, and thus were also an 'at risk' group. To overcome this, these participants were identified and invited to participate in the trials scheduled post event. Self report bias may also have been apparent in both of these intervention studies although the lack of an intervention effect over controls in either means it is unlikely that the changes participants reported were not real. In 2007, the re-commencement of training for the 2008 event that was noted above, as well as the onset of the Summer season, and heightened sensitivity to physical activity questionnaires may be explanations for the observed improvement in physical activity in the intervention and control group. Another potential rationale for the lack of an intervention effect in the cluster RCT may be the relatively low uptake of many of the intervention strategies, such as Meet and Train groups and exercise classes. The failure to induce or detect an intervention effect also prevented a true cost effectiveness analysis, which was one of the aims of the research.

8.3 Implications of Findings

8.3.1 Implications for practice

Mass community events have potential as a physical activity promoting tool at a population level. The Women's Mini Marathon events in Dublin and Cork motivate more than 50,000 women to be active at least on the day of the event on an annual basis and furthermore, 60% of participants are repeat participants, evidence of an allegiance to the event and its consistent, annual impact on this group of women.

The altruistic motive for participation demonstrated by Mini Marathon participants has implications for physical activity event organisers. The assertion that this particular mass event, and as a consequence, other such events worldwide, can have a favourable impact on participant physical activity levels is a positive finding that must be explored and understood in greater detail to be used in this and other contexts. Thus, the ability of the event to move non elite or competitive people to trial physical activity for charitable as well as other social and personal reasons is significant. It may be that physical activity, specific to mass events and also using other strategies, could be promoted by targeting these particular motives for participation.

Such a ‘trojan horse’ approach could be adopted and physical activity promotion may benefit from packaging it as an enjoyable, beneficial and valuable venture. Physical activity is typically endorsed as a pre-requisite for fitness and health, and this does not appear to be instigating any change to the high insufficient activity levels that exist in Ireland (Morgan et al., 2008). The related tendency to link physical inactivity to obesity, heart disease and other chronic disease represents a scare tactic of sorts that is more suited to behaviours that need to be stopped or decreased, such as smoking, rather than those that need to be adopted and maintained. Generating engagement with physical activity and advocating the positives associated with being active and involved in sport through community events may be a more worthwhile endeavour in future attempts to promote physical activity. Considering the discussion thus far, more regular community physical activity events if scheduled, promoted and utilised efficiently and effectively could be a very worthwhile effort in local, regional and national attempts to promote physical activity.

In this research, insufficiently active participants and relapsers were included in a print based trial to promote physical activity. Any contact with individuals who had recently displayed some involvement in physical activity evidenced by their participation in the Mini Marathon appeared to be sufficient to instigate a renewed engagement in activity. This would suggest that simple reinforcement strategies before and after such events that extend beyond the marketing of the event itself could enhance the public health impact of these initiatives.

The enthusiasm for walking and running was manifested not only in the training and participation figures for the Mini Marathon events but also in the fact that it is heavily over subscribed and almost two thirds of participants participate repeatedly year after year. Also, participants who trained in groups prior to the Mini Marathon trained and participated in the event at a higher intensity than those who trained alone. Thus, the promotion of walking, running and perhaps cycling particularly in group settings may be a useful strategy in efforts to promote population physical activity levels. It is positive to note that the Department of Transport (2009a; 2009b) have developed cycling and walking policies and are engaged in efforts to create supportive environments for these activities. Also, there are existing vehicles for group based activity in Ireland, including Meet and Train and Fit 4 Life groups, supported by the Athletics Association of Ireland. Both offer a group forum for activity for beginners and experienced exercisers alike. In the cluster RCT in this research, communication alone about these initiatives was not sufficient to instigate engagement. More direct recruitment or publicity efforts may be required.

These last suggestions arising from this research are particularly relevant to the national network of LSPs who are the most localised physical activity promoting agency in Ireland, as well as more regional bodies such as the Health Service Executive. LSPs could develop a system to promote local amenities, clubs, sports and resources to the individuals and communities in their regions. Systematic collection of user data could assist evaluation and in efforts to tailor information to specific target groups and to provide regular prompts for activity. This research provided evidence of a potential public health impact while contact with a targeted group of Mini Marathon participants had quite favourable outcomes.

Uptake of some of the intervention components in the cluster RCT, by the Irish Sports Council and LSPs and further scheduled interaction with these same agencies suggests that the stated aim to prioritise the transferability of this research was achieved. Also, a number of LSPs have carried out evaluations, in conjunction with this research group, on some of the initiatives that they support or deliver. These included the Sean Kelly Cycle and Waterford Active Schools Project (Muldoon et al., 2008). The production and dissemination of simple, quick and straightforward guidelines (*Appendix F*) on how to evaluate events, promote physical activity etc. in a national report on this research (Lane et al., 2010) is another attempt to maximise the practical implications of this work. These favourable outcomes and support materials have implications for other groups who are tasked with promoting physical activity as they will assist efforts to generate practical, realistic and sustainable intervention strategies.

Finally, the collection of information for the cluster RCT revealed that a broad spectrum of physical activity resources exist in the community, which reflects the very worthwhile work that many agencies in Ireland are engaged in, in relation to physical activity. Unfortunately, these efforts are sometimes un-coordinated, insufficiently oriented towards physical activity, dependant on local factors and are not being communicated to individuals within the community. This is not surprising considering that physical activity promotion in Ireland is in its infancy with national guidelines only recently being published (Department of Health and Children and HSE, 2009). It is important that greater efforts are taken to generate a co-ordinated approach to physical activity promotion in Ireland. To this end, this research and the stirring of efforts at a national level have pre-empted a national review of all existing strategies to promote physical activity.

8.3.2 Implications for research

Firstly, future endeavours in this context, in light of the disparity between survey and intercept interview data, and the many limitations of self report data should incorporate some objective measurement of physical activity even in a sub sample of participants. This may have been particularly useful when collecting data before and after the RCTs, due to the smaller numbers of participants at this stage. An objective and longer measurement of physical activity pre and post event may also have facilitated a more accurate assessment of relapse.

Despite the likely under-representation of the less well educated, less well off and least active due to the data collection protocol, a more targeted recruitment protocol may be required to ensure that the reach of events and other strategies extends to all sub groups of the population. Gathering information from and engaging hard to reach sub groups of the population, such as the less well off, in health promotion related trials is traditionally difficult. More tailored, population specific data collection protocols and recruitment strategies may be required to ensure equivalent reach across population groups (Dillman, 2007). For example, as well as the demographic bias identified in the respondents in this research, non-participants in trials typically exhibit a lack of knowledge about physical activity and a fear of taking part (Chinn et al., 2006). Tailoring data collection modes, intervention efforts and programmes to cater for these factors may be a worthwhile approach. Also, upon the provision of information about existing resources for physical activity, with no related cost, to a sub sample of participants in this research, increases in physical activity were apparent among non tertiary educated respondents and other typically hard to recruit population groups. These considerations should extend to all strategies being considered to promote and collect information on physical activity.

The cluster RCT aimed to communicate to participants all of the opportunities for physical activity in their immediate locality, in an effort to enhance the generalisability of the intervention. Of primary importance in the delivery and evaluation of this intervention was the degree of external validity as well as theoretical fidelity. Thus, the RE-AIM framework was used to investigate the feasibility of delivering the intervention in different settings. Despite the lack of an intervention effect, assessment of the cluster RCT across the different elements of the framework indicated that the intervention was quite generalisable, particularly at an individual level. There is a gap between research and practice in physical activity research and this framework may be a useful evaluation strategy for investigators who wish to assess the transferability as well as the effectiveness of their interventions.

At follow up in the cluster RCT, awareness of LSPs increased considerably but uptake of the various components of the intervention was limited and only a partial intervention effect was noted. No intervention effect was apparent following the first trial. This suggests that alternative intervention strategies could be developed or the efforts in this research could be replicated, on a larger sample size and using objective assessments of physical activity. It may also be that it is not necessary to develop further interventions for this particular sub group of previously active women. Any contact appeared to induce changes in physical activity; therefore additional communication, use and evaluation of existing resources for physical activity may be the most practical, sustainable and cost effective promoting tool for this group.

While the lack of an intervention effect prevented a true assessment of the cost effectiveness of the cluster RCT, this should become a common feature of physical activity trials. Further high quality economic evaluations are warranted to evaluate and develop more cost effective strategies to promote physical activity, which can be excellent value for money from a public health perspective. Sedentarism and inactivity have connotations that extend beyond ill health as they incur considerable costs, both direct and indirect, to governments, employers, and society at large. Thus, as the National Institute for Health and Clinical Excellence (NICE, 2008) noted, increases in levels of physical activity can lead to long-term improvements in health and a consequential reduction in expenditure both for a health service and for economies as a whole. Müller-Reimenschneider et al. (2009) noted that well designed interventions could instigate sufficient activity levels among inactive adults for as little as €800 per person, per year. The authors also remarked that these costs to induce the wide and varied benefits of physical activity are likely to be significantly lower than any alternative uses of healthcare resources. To make a stronger case for investment in physical activity promotion, it is important to continuously demonstrate that it is good value for money, thus in the absence of an intervention effect (overall increase in physical activity) in this research, it is still an important finding that it cost as little as 18c per minute to initiate engagement in physical activity.

While sedentarism was only briefly assessed in this research, the discovery that Irish women spend approximately five hours per day being sedentary is worrying upon consideration of previous findings, which found that prolonged sitting time for even a duration of 90 minutes can have detrimental effects on health (Healy et al., 2008). This research represents one of the first attempts to assess sitting time and TV viewing time in a population based sample of Irish adults. Sedentarism should be assessed and included in all future physical activity/health monitoring attempts and decreasing sedentarism must also become a public health priority. This task should be added to the remit of physical activity promoters to improve the overall public health profile of Irish people. It may be that modifying sitting time is an obvious accompaniment to promoting physical activity but it is important that a clear, independent protocol to address these respective health priorities are established.

8.4 Summary

In summary, this research has provided support for the use of mass community participation events to promote physical activity. Furthermore, it appears viable to use these events as an initial prompt for activity among even the most sedentary members of society. Minor reinforcement strategies pre and post event that utilise existing resources and opportunities for physical activity in the community, and that adopt a non fitness or health oriented approach, should be instigated to maximise the public health impact of such initiatives and perhaps to promote physical activity in general.

References

Adams, J., & White, M. (2007). Health behaviours in people who respond to a web-based survey advertised on regional news media. *The European Journal of Public Health, 18*(3), 335-338.

Adamson, J., Cockayne, S., Puffer, S., & Torgerson, D.J. (2006). Review of randomised trials using the post-randomised consent (Zelen's) design. *Contemporary Clinical Trials, 27,* 305-319.

Ainsworth, B.E., Wilcox, S., Thompson, W.W., Richter, D.L., & Henderson, K.A. (2003). Personal, social and physical environmental correlates of physical activity in African-American women in South Carolina. *American Journal of Preventive Medicine*, *25*(3Si), 23-29.

Amárach Research (2008). Life Online: The Daily Life of Ireland's 2 Million Internet Users. Retrieved online 18/5/09 http://www.amarach.com/assets/files/Life%20Online%20Report%202008.pdf

Andre, D., & Wolf, D.L. (2007). Recent advances in free-living physical activity monitoring: a review. *Journal of Diabetes Science and Technology, 1*(5), 760-767.

Annear, M.J., Cushman, G., & Gidlow, B. (2009). Leisure time physical activity differences among older adults form diverse socioeconomic neighborhoods. *Health and Place*, *15*, 482-490.

Armitage, C.J. (2005). Can the theory of planned behaviour predict behaviour change? *Health Psychology, 24*(3), 235-245.

Australian Institute of Health and Welfare (AIHW, 2003). *The Active Australia Survey: A Guide and Manual for Implementation, Analysis and Reporting.* Canberra, Australia: Australian Institute of Health and Welfare.

Azjen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Process, 50*, 179-211.

Ball, K., Salmon, J., Giles-Corti, B., & Crawford, D. (2006). How can socio-economic differences in physical activity among women be explained? A qualitative study. *Women and Health, 43*(1), 93-113.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. New Jersey: Prentice-Hall.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine, 15,* 266-297.

Barnett, T.A., Gauvin, L., Craig, C.L., & Katzmarzyk, P.T. (2008). Distinct trajectories of leisure time physical activity and predictors of trajectory class membership: a 22 year cohort study. *International Journal of Behavioural Nutrition and Physical Activity, 5*. Available from BioMed Central. Accessed September 15, 2009.

Barrera, M., Strycker, L.A., MacKinnon, D.P., & Toobert, D.J. (2008). Social ecological resources as mediators of two-year diet and physical activity outcomes in Type 2 diabetes patients. *Health Psychology, 27*(2), S118-S125.

Bassett, D.R. (2000). Validity and reliability issues in objective monitoring of physical activity. *Research Quarterly for Exercise and Sport, 71*(2), 30-36.

Bauman, A., Armstrong, T., Davies, J., Owen, N., Brown, W., Bellew, B., & Vita, P. (2003a). Trends in physical activity participation and the impact of integrated campaigns among Australian adults, 1997-99. *Australia and New Zealand Journal of Public Health, 27*, 76-79.

Bauman, A., Bull, F., Chey, T., Craig, C.L., Ainsworth, B.E., Sallis, J.F.,…IPS Group (2009). The international prevalence study on physical activity: results from 20 countries. *International Society for Behavioural Nutrition and Physical Activity, 6*(21).

Bauman, A., Ford, I., & Armstrong, T. (2001). *Trends in population levels of reported physical activity in Australia 1997, 1999 ands 2000.* Australia: Australian Sports Commission.

Bauman, A., Madill, J., Craig, C.L., & Salmon, A. (2004). ParticipACTION: This mouse roared, but did it get the cheese? *Canadian Journal of Public Health, 95*(S2), S14-S20.

Bauman, A., McLean, G., Hurdle, D.,Walker, S., Boyd, J., van Aalst, I., & Carr, H. (2003b). Evaluation of the national 'Push Play' campaign in New Zealand – creating population awareness of physical activity. *Journal of the New Zealand Medical Association, 116*(1179).

Bauman, A., Murphy, N., Lane, A. (2009). The role of community programmes and mass events in promoting physical activity to patients. *British Journal of Sports Medicine, 43*,44-46.

Bauman, A.E., Sallis, J.F., Dzewaltowski, D.A., & Owen, N. (2002). Towards a better understanding of the influences on physical activity: The role of determinants, correlates, causal variables, mediators, moderators, confounders. *American Journal of Preventive Medicine, 23*(2), 5-14.

Bellows-Riecken, K.H., & Rhodes, R.E. (2008). A birth of inactivity? A review of physical activity and parenthood. *Preventive Medicine, 46,* 99-110.

Bengoechoea, E.G., Spence, J.C., & McGannon, K.R. (2005). Gender differences in perceived environmental correlates of physical activity. *International Journal of Behavioural Nutrition and Physical Activity, 2*(12).

Berlin, J.A., & Colditz, G.A. (1990). A meta-analysis of physical activity in the prevention of coronary heart disease. *American Journal of Epidemiology, 132*(4), 612-628.

Berry, T., Naylor P.J., Wharf-Higgins, J. (2005). Stages of change in adolescents: an examination of self efficacy, decisional balance, and reasons for relapse. *Journal of Adolescent Health, 37*(6), 452-459.

Bethell, H.J.N. (1999). Exercise in cardiac rehabilitation. *British Journal of Sports Medicine, 33,* 79-86.

Bicycle Victoria (2006). *Ride to Work Day 2004 Post Event Report*. Australia: Bicycle Victoria.

Biddle, S., & Mutrie, N. (2008). *Psychology of Physical Activity: Determinants, Well-Being and Interventions*. (2nd edition). USA/Canada: Routledge

Bijnen, F.C.H., Caspersen, C.J., & Mosterd, W.L. (1994). Physical inactivity as a risk factor for coronary heart disease: a WHO and International Society and Federation of Cardiology position statement. *Bulletin of the World Health Organisation, 72*(1), 1-4.

Bock, B.C., Carmona-Barros, R.E., Esler, J.L., & Tilkemeier, P.L. (2003). Program participation and physical activity maintenance after cardiac rehabilitation. *Behaviour Modification27*(1), 37-53.

Bock, B.C., Marcus, B.H., Pinto, B.M., & Forsyth, L.H. (2001). Maintenance of physical activity following an individualized motivationally tailored intervention. *Annals of Behavioural Medicine, 23*(2), 79-87.

Bouchard, C. (Ed). (2000). *Physical Activity and Obesity.* Champaign, IL: Human Kinetics.

Boutelle, K.N., Jeffery, R.W., & French, S.A. (2004). Predictors of vigorous exercise adoption and maintenance over four years in a community sample. *International Journal of Behavioural Nutrition and Physical Activity, 1.* Available from BioMed Central. Accessed September 16, 2009.

Bowles HR, Rissel C, Bauman A. (2006). Mass community cycling events: Who participates and is their behaviour influenced by participation? *International Journal of Behavioral Nutrition and Physical Activity, 3,* 39-45.

Bragg, M.A., Tucker, C.M., Kaye, L.B., & Desmond, F. (2009). Motivators of and barriers to engaging in physical activity: Perspectives of low income culturally diverse adolescents and adults. *American Journal of Health Education, 40*(3), 146-154.

British Heart Foundation (BHF) National Centre for Physical Activity and Health (2010). *Causes of Physical Inactivity Factsheet*. UK: BHF.

Brown W.J., & Trost S.G. (2003). Life transitions and changing physical activity patterns in young women. *American Journal of Preventive Medicine*; *25,*140-143

Brown, A., & Massey, J. (2001). *The impact of major sporting events. The sports development impact of the Manchester 2002 Commonwealth Games: initial baseline research*. London: UK Sport.

Brown, W.J., Heesch, K.C., & Miller, Y.D. (2009). Life events and changing physical activity patterns in women at difference life stages. *Annals of Behavioural Medicine*.

Brown, W.J., Mishra, G., Lee, C., & Bauman, A. (2000). Leisure time physical activity in Australian women: relationship with well being and symptoms. *Research Quarterly for Sport and Exercise, 71*(3), 206-216.

Brown, W.J., Trost, S.G., Bauman, A., Mummery, K., & Owen, N. (2004). Test re-test reliability of four physical activity measures used in population surveys. *Journal of Science and Medicine in Sport, 7*(2), 205-215.

Brown, W.J., Williams, L., Ford, J.H., Ball, K., & Dobson, A.J. (2005). Identifying the energy gap: magnitude and determinants of 5-year weight gain in midage women. *Obesity Research, 13,* 1431-1441.

Brownson, R.C., Baker, E.A., Housemann, R.A., Brennan, L.K., & Bacak, S.J. (2001). Environmental and policy determinants of physical activity in the United States. *American Journal of Public Health, 91*, 1995-2003.

Brownson, R.C., Eyler, A.A., King, A.C., Brown, D.R., Shyu, Y., & Sallis, J.F. (2000). Patterns and correlates of physical activity among US women 40 years and older. *American Journal of Public Health, 90*, 264-270.

Bull, F.C., Bellew, B., Schöppe, S., & Bauman, A.E. (2004). Developments in national physical activity policy: an international review and recommendations towards better practice. *Journal of Science and Medicine in Sport, 7,* (1), S93-S104.

Bull, F., & Lovell, J. (2007). The impact of hosting major sporting events on local residents: an analysis of the views and perceptions of Canterbury residents in relation to the Tour de France 2007. *Journal of Sport and Tourism, 12*(3-4), 229-248.

Camacho, T.C., Roberts, R.E., Lazarus, N.B., Kaplan, G.A., & Cohen, R.D. (1999). Physical activity and depression: evidence from the Alameda county study. *American Journal of Epidemiology, 134*(2), 220-231.

Campbell, M.K., Elbourne, D.R., & Altman, D.G. (2004). CONSORT statement: extension to cluster randomsied trials. *British Medical Journal, 328,* 702-708.

Carnethon, M.R., Sternfield, B., Schreiner, P.J., Jacobs, D.J., Lewis, C.E., Liu, K., & Sidney, S. (2009). Association of 20 year changes in cardiorespiratory fitness with incidence type 2 diabetes: the CARDIA fitness study. *Diabetes Care, 32*(7), 1284-1288.

Casagrande, S.S., Whitt-Glover, M., Lancaster, K.J., Odoms-Young, A.M., & Gary, T.L. (2009). Built environment and health behaviours among African Americans: A systematic review. *American Journal of Preventive Medicine, 36*(2), 174-181.

Central Statistics Office (2006). Retrieved online 22/05/08 http://www.cso.ie/statistics/Population.htm

Centre for Disease Control (CDC) (2007). US Physical Activity Statistics. Retrieved online 7/6/09 http://apps.nccd.cdc.gov/PASurveillance/DemoCompareResultV.asp#result

Centre for Disease Control (CDC) (2008). Prevalence of self-reported physically active adults – United States 2007. *Morbidity and Mortality Weekly Report, 57*(48), 1297-1300.

Cerin, E., & Leslie, E. (2008). How socioeconomic status contributes to participation in leisure time physical activity. *Social Science and Medicine, 66*(12), 2596-2609.

Chalip, L. (2006). Towards social leverage of sport events. *Journal of Sport and Tourism, 11*(2), 109-127.

Champion, V.L., & Skinner, C.S. (2008). The Health Belief Model. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Charities Aid Foundation (2006). *International Comparisons of Charitable Giving*. UK: Charities Aid Foundation.

Chinn, D.J., White, M., Harland, J., Drinkwater, C., & Raybould, S. (1999). Barriers to physical activity and socioeconomic position: implications for health promotion. *Journal of Epidemiology and Community Health, 53*, 191-192.

Chinn, D.J., White, M., Howel, D., Harland, J.O.E., & Drinkwater, C.K. (2006). Factors associated with non-participation in a physical activity promotion trial. *Public Health, 120*, 309-319.

Chrisite, J., O'Halloran, P., & Stevenson, M. (2009). Planning a cluster randomised controlled trial. *Nursing Research, 58*(2), 128-134.

Clarke, K.K., Freeland-Graves, J., Klohe-Lehman, D.M., Milani, T.J., Nuss, H.J., & Laffrey, S. (2007). Promotion of physical activity in low income mothers using pedometers. *Journal of the American Dietetic Association, 107,* 962-967.

Cleland, V.J., Ball, K., Magnussen, C., Dwyer, T., & Venn, A. (2009). Socioeconomic position and the tracking of physical activity and cardiorespiratory fitness from childhood to adulthood. *American Journal of Epidemiology, 170*(9), 1069-1077.

Cochrane, T., & Davey, R.C. (2008). Increasing uptake of physical activity: a social ecological approach. *Journal of the Royal Society for the Promotion of Health, 128*(1),31-40.

Colditz, G.A. (1999). Economic costs of obesity and inactivity. *Medicine and Science in Sports and Exercise, 31*, S663-S667.

Collins, B.S., Marshall, A.L., Miller, Y.D. (2007). Physical activity in women with young children: 'how can we assess anything that is not sitting'? *Women and Health, 45*(2), 95-116.

Conn, V.S., Burks, K.J., Pomeroy, S.H., Ulbrich, S.L., & Cochran, J.E. (2003). Older women and exercise: explanatory concepts. *Women's Health Issues, 13*, 158-166.

Conn, V.S. (2010). Depressive symptom outcomes of physical activity interventions: meta-analysis findings. *Annals of Behavioural Medicine, 39*, 128-138.

Conroy, M.B., Simkin-Sliverman, L.R., Pettee, K.K., Hess, R., Kuller, L.H., & Kriska, A.M. (2007). Lapses and psychosocial factors related to physical activity in early postmenopause. *Medicine and Science in Sports and Exercise, 39*(10), 1858-1866.

Courneya, K.S., Segal, R.L., Reid, R.D., Jones, L.W., Malone, S.C., Venner, P.M.,..Wells, G.A. (2004). Three independent factors predicted adherence in a randomised controlled trial of resistance exercise training among prostate cancer survivors. *Journal of Clinical Epidemiology, 57*, 571-579.

Craig, C.L., Marshall, A.L., Sjostrom, M., et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise. 2003, 35,* 1381-1395.

Craig, C.L., Russell, S.J., Cameron, C., & Bauman, A. (2004). Twenty year trends in physical activity among Canadian adults. *Canadian Journal of Public Health, 95*(1), 59-63.

Craig, R., & Mindell, J. (Eds). (2008). *Health Survey for England 2006*. UK: The Information Centre.

Cramp, A.G., & Bray, S.R. (2009). A prospective examination of exercise and barrier self efficacy to engage in leisure time physical activity during pregnancy. *Annals of Behavioural Medicine, 37*(3), 325-334.

Daugbjerg, S.B., Kahlmeier, S., Racioppi, F., Martin-Diener, E., Martin, B., Oja, P., & Bull, F. (2009). Promotion of physical activity in the European region: content analysis of 27 national policy documents. *Journal of Physical Activity and Health, 6*, 805-817.

DeBourdeaudhuij, I., Sallis, J.F., & Saelens, B.E. (2003). Environmental correlates of physical activity in a sample of Belgian adults. *American Journal of Health Promotion, 18*(1), 83-92.

DeCocker, K.A., De Bourdeaudhuij, I.M., Brown, W.J., & Cardon, G.M. (2008). The effect of a pedometer based physical activity intervention on sitting time. *Preventive Medicine, 47*, 179-181.

Department of Arts, Sport and Tourism (2008). *Report to the Minister for Arts, Sport and Tourism of the London 2012 Olympics and Paralympics Taskforce*. Dublin: Department of Arts, Sport and Tourism.

Department of Health and Children, Health Promotion Unit (1995). *A Health Promotion Strategy: Making the Healthier Choice the Easier Choice.* Dublin: Hawkins House.

Department of Health and Children, Health Service Executive (2009). *The National Guidelines on Physical Activity for Ireland*. Dublin, Ireland: Department of Health and Children, Health Service Executive.

Department of Transport (2009a). *Smarter Travel: A Sustainable Transport Future*. Dublin, Ireland: Department of Transport.

Department of Transport (2009b). *Ireland's First National Cycle Policy Framework*. Dublin, Ireland: Department of Transport.

Dietz, W.H., & Bellizzi, M.D. (1999). Introduction: the use of body mass index to assess obesity in children. *American Journal of Clinical Nutrition.* Retrieved online 27/5/09 http://66.102.1.104/scholar?hl=en&lr=&client=firefox-a&q=cache:y1x8yZiacdkJ:https://www.okkioallasalute.it/docs/Dietz_UseBMI_1999.pdf+body+mass+index,+reliability

Dillman, D.A. (2007). *Mail and Internet Surveys: The Tailored Design Method*. New Jersey, US: John Wiley and Sons.

Dinger, M.K., Heesch, K.C., & McClary, K.R. (2005). Feasibility of a minimal contact intervention to promote walking among insufficiently active women. *American Journal of Health Promotion, 20*(1), 1-6.

Dishman, R.K. (1988). *Exercise Adherence: Its Impact on Public Health*. Champaign IL: Human Kinetics.

Dishman, R.K. (1994). *Advances in Exercise Adherence*. Champaign, IL: Human Kinetics.

Dishman, R.K., DeJoy, D.M., Wilson, M.G., & Vandenberg, R.J. (2009). Move to improve: a randomised workplace trial to increase physical activity. *American Journal of Preventive Medicine, 36*(2), 133-141.

Donovan, R.J., & Henley, N. (2003). *Social Marketing: Principles and Practice*. Melbourne: IP Communications.

Dowda, M., Ainsworth, B.E., Addy, C.L., Saunders, R., & Riner, W. (2003). Correlates of physical activity among U.S. young adults, 18-30 years of age, from NHANES III. *Annals of Behavioural Medicine, 26*(1), 15-23.

Dumville, J.C., Torgerson, D.J., Hewitt, C.E. (2006). Reporting attrition in randomised controlled trials. *British Medical Journal, 332,* 969-971.

Duncan, G.E., Sydeman, S.J., Perri, M.G., Limacher, M.C., & Martin, A.D. (2001). Can sedentary adults accurately recall the intensity of their physical activity? *Preventive Medicine, 33,* 18-26.

Duncan, M., & Mummery, K. (2005). Psychosocial and environmental factors associated with physical activity among city dwellers in regional Queensland. *Preventive Medicine, 40*(4), 363-372.

Dunn, A.L. (1996). Getting started – a review of physical activity adoption studies. *British Journal of Sports Medicine, 30*, 193-199.

Dunn, A.L., Garcia, M.E., Marcus, B.H., Kampert, J.B., Kohl, H.W., & Blair, S.N. (1998). Six month physical activity and fitness changes in Project Active: a randomised trial. *Medicine and Science in Sports and Exercise, 30,* 1076-1083.

Dunn, A.L., Marcus, B.H., Kampert, J.B., Garcia, M.E., Kohl, H.W., & Blair, S.N. (1999). Comparison of lifestyle and structured interventions to increase physical activity and cardio-respiratory fitness. *Journal of the American Medical Association, 281*(4), 327-334.

Dunn, A.L., Trivedi, M.H., & O'Neal, A.H. (2001). Physical activity dose response effects on outcomes of depression and anxiety. *Medicine and Science in Sports and Exercise, 33*(6), S587-S597.

Dunton, G.F., & Vaughan, E. (2008). Anticipated affective consequences of physical activity adoption and maintenance. *Health Psychology, 27*(6), 703-710.

Dutton, G,R., Provost, B.C., Tan, F., Smith, D. (2008b). A tailored print-based physical activity intervention for patients with type 2 diabetes. *Preventive Medicine, 47,* 409-411.

Dutton, G.R., Napolitano, M.A., Whiteley, J.A., & Marcus, B.H. (2008a). Is physical activity a gateway behaviour for diet? Findings from a physical activity trial. *Preventive Medicine, 46,* 216-221.

Dzewaltowski, D.A., Estabrooks, P.A., Klesges, L.M., Bull, S., & Glasgow, R.E. (2004). Behavior change intervention research in community settings: how generalizable are the results? *Health Promotion International, 19*(2), 235-245.

Eakin, E.G., Lawler, S.P., Vandelanotte, C., & Owen, N. (2007a). Telephone interventions for physical activity and dietary behaviour change. *American Journal of Preventive Medicine, 32*(5), 419-434.

Eakin, E.G., Mummery, K., Reeves, M.M., Lawler, S.P., Schofield, G., Marshall, A.L., & Brown, W.J. (2007b). Correlates of pedometer use: results from a community based physical activity intervention trial (10,000 Steps Rockhampton). *International Journal of Behavioural Nutrition and Physical Activity, 4*(31).

Eaton, C.B., Lapanem K.L., Garber, C.E., Gans, K.M., Lasater, T.M., & Carleton, R.A. (1999). Effects of a community-based intervention on physical activity: the Pawtucket Heart Health Program. *American Journal of Public Health, 89*(11), 1741-1744.

Eaton, C.B., Reynes, J., Assaf, A.R., Feldman, H., Lasater, T., Carleton, R.A. (1993). Predicting physical activity change in men and women in two New England communities. *American Journal of Preventive Medicine, 9*(4), 209-219.

Elder, J.P., Ayala, G.X., & Harris, S. (1999). Theories and intervention approaches to health-behaviour change in primary care. *American Journal of Preventive Medicine, 17*(4), 275-284.

Eldridge, S., Ashby, D., Bennett, C., Wakelin, M., & Feder, G. (2008). Internal and external validity of cluster randomised trials: systematic review of recent trials. *British Medical Journal, 336, 876-880.*

European Opinion Research Group (2003). *The Eurobarometer Physical Activity Survey*. Brussels, European Commission.

Eyler, A., Matson-Koffman, D., Young, D.R., Wilcox, S., Wilbur, J., Thompson, J.L.,…Evenson, K.R. (2003). Quantitative study of correlates of physical activity in women from diverse ethnic/racial groups. *American Journal of Preventive Medicine, 25*(3S), 93-103.

Eyler, A.A., & Vest, J.R. (2002). Environmental and policy factors related to physical activity in rural white women. *Women and Health, 36*(2), 109-119.

Eyler, A.A., Brownson, R.C., Donatelle, R.J., King, A.C., Brown. D., & Sallis, J.F. (1999). Physical activity social support and middle and older aged minority women: results from a US survey. *Social Science and Medicine, 49*, 781-789.

Fahey, T., Delaney, L., & Gannon, B. (2005). *School Children and Sport in Ireland.* Dublin: Economic and Social Research Institute.

Fahey, T., Layte, R. & Gannon, B. (2004). *Sports Participation and Health Among Adults in Ireland*. Dublin, The Economic and Social Research Institute.

Fewtrell, M.S., Kennedy, K., Singhal, A., Martin, R.M., Ness, A., Hadders-Algra, M., Koletzko, B., & Lucas, B. (2008). How much loss to follow up is acceptable in long term randomised trials and prospective studies? *Archives of Disease in Childhood, 93*, 458-461.

Field, A.E., Aneja, P., & Rosner, B. (2007). The validity of self-reported weight change among adolescents and young adults. *Obesity, 15*, 2357-2364.

Filo, K., Funk, D.C., & O'Brien, D. (2008). It's really not about the bike: exploring attraction and attachment to the events of the Lance Armstrong Foundation. *Journal of Sports Management, 22*, 501-525.

Filo, K., Funk, D.C., & O'Brien, D. (2009). The meaning behind attachment: exploring camaraderie, cause, and competency at a charity sport event. *Journal of Sport Management, 23*, 361-387.

Finfacts (2007). Survey says national average for Irish workplace absenteeism is 3.8% or 9 working days. Retrieved online 15/2/10 http://www.finfacts.com/irelandbusinessnews/publish/article_10009697.shtml

Finkelstein, E.A., Brown, D.S., Brown, D.R., & Buchner, D.M. (2008). A randomised study of financial incentives to increase physical activity among sedentary older adults. *Preventive Medicine, 47,* 182-187.

Fletcher, G.F., Balady, G., Blair, S.N., Blumenthal, J., Caspersen, C., Chaitman, D., Epstein S., …Pollock, M.L. (1996). Statement on Exercise: Benefits and Recommendations for Physical Activity Programs for All Americans. *Circulation, 94*, 857-862.

Fleury J., & Lee, S.M. (2006). The social ecological model and physical activity among African American women. *American Journal of Community Psychology, 37*(1/2), 129-140.

Freedson, P.S., & Miller, K. (2000). Objective monitoring of physical activity using motion sensors and heart rate. *Research Quarterly for Exercise and Sport, 71*(2), 21-29.

Friel, S., Nic Gabhainn, S., & Kelleher, C. (1999). *The National Health and Lifestyle Surveys.* Ireland: Department of Health and Children.

Funk, D. C., & James, J. (2001). The psychological continuum model: A conceptual framework for understanding an individual's psychological connection to sport. *Sport Management Review, 4*, 119-150.

Glasgow, R., Lichtenstein, E., & Marcus, A.C. (2003). Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American Journal of health Promotion, 93*(8), 1261-1267.

Giles-Corti, B., & Donovan, R.J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54*(12), 1793-1812

Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Glasgow, R., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: The RE-AIM Framework. *American Journal of Public Health, 89*, 1322-1327.

Godin, G. (1994). Social-Cognitive Models. In Dishman, R.K. (1994). *Advances in Exercise Adherence*. Champaign, IL: Human Kinetics.

Gordon, D., & Hart, J. (2001). The rising of the couch potatoes. *Adelaide Advertiser,* 32.

Gulliford, M.C., Ukomunne, O.C., & Chinn, S. (1999). Components of variance and intraclass correlations for the design of community based surveys and intervention studies. *American Journal of Epidemiology, 149*(9), 876-883.

Guthold, R., Ono, T., Strong, K.L., Chatterji, S., & Morabia, A. (2008). Worldwide variability in physical inactivity: a 51 country survey. *American Journal of Preventive Medicine, 34*(6), 486-494.

Haapanen, N., Miilunpalo, S., Vuori, I., Oja, P., & Pasanen, M. (1996). Characteristics of leisure time physical activity associated with decreased risk of premature all-cause and cardiovascular disease mortality in middle-aged men. *American Journal of Epidemiology, 143*(9), 870-880.

Hamer, M., Stamatakis, E., & Steptoe, A. (2008). Dose response relationship between physical activity and mental health: the Scottish Health Survey. *British Journal of Sports Medicine, 43,* 1111-1114.

Haskell, W.L., Lee, I., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A.,…Bauman, A. (2007). Physical activity and public health. Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*.

Healy, G.N., Dunstan, D.W., Salmon, J., Shaw, J.E., Zimmet, P.Z., & Owen, N. (2008). Television time and continuous metabolic risk in physically active adults. *Medicine and Science in Sports and Exercise, 40*(4), 639-645.

Heaney, C.A., & Israel, B.A. (2008). Social Networks and Social Support. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Helmrich, S.P., Ragland, D.R., Leung, R.W., & Paffenberger, R.S. (1991). Physical activity and reduced occurrence of non-insulin dependant diabetes. *The New England Journal of Medicine, 325*, 147-152.

Henderson, K.A. (2009). A paradox of sport management and physical activity interventions. *Sports Management Review, 12*, 57-65.

Hill, A., Roberts, J., Ewings, P., & Gunnell, D. (1997). Non-response bias in a lifestyle survey. *Journal of Public Health Medicine, 19*(2), 203-207.

Hillsdon, M., Foster, C., & Thorogood, M. (2005). Interventions for promoting physical activity. *Cochrane Database Systematic Review, 25*(1).

Hindson, A., Gidlow, B., & Peebles, C. (1994). The "trickle-down" effect of top-level sport: myth or reality? A case-study of the Olympics. *Australian Journal of Leisure and Recreation, 4*(1), 16-24.

Hogan, K., & Norton, K. (2000). The 'price' of Olympic gold. *Journal of Science and Medicine in Sport, 3* (2), 203-18.

Homer, C.S.E. (2002). Using the Zelen design in randomised controlled trials: debates and controversies. *Journal of Advanced Nursing, 38*(2), 200-207.

Horne, J. (2007). The four 'knowns' of sport mega events. *Leisure Studies, 26*(1), 81-96.

Hu, F.B., Sigal, R.J., Rich-Edwards, J.W., Coldtiz, G.A., Solomon, C.G., Willett, W.C., Speizer, FE., & Manson, J.E. (1999). Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study. *Journal of the American Medical Association, 282*, 1433-1439.

Hultquist, C.N., Albright, C., & Thompson, D.L. (2005). Comparison of walking recommendations in previously inactive women. *Medicine and Science in Sports and Exercise,* 676-683.

Humpel, N., Marshall, A.L., Iverson, D., Leslie, E., & Owen, N. (2004). Trial of print and telephone delivered interventions to influence walking. *Preventive Medicine, 39,* 635-641.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adult's participation in physical activity: a review. *American Journal of Preventive Medicine, 22*(3), 188-199.

Hunt, W.A., Barnett, L.W., & Branch, L.G. (1977). Relapse rates in addiction programs. *Journal of Clinical Psychology, 27*(4), 455-456.

International Physical Activity Questionnaire (2005). *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)*. Retrieved 9/10/2007 www.ipaq.ki.se

Irish Sports Council (2000). *A New Era for Sport 2000-2002*. Dublin : The Irish Sports Council.

Irish Sports Council (2006). *Building Sport for Life (2006-2008)*. Dublin: The Irish Sports Council.

Irish Sports Council (2008). *Local Sports Partnerships : SPEAK Report 2008*. Dublin : Irish Sports Council.

Izawa, K.P., Watanabe, S.P., Omiya, K., Hirano, Y., Yasuyuki, P.T., Oka, K.,..Iijima, S. (2005). Effect of the self monitoring approach on exercise maintenance during cardiac rehabilitation: a randomised controlled trial. *American Journal of Physical Medicine and Rehabilitation, 84*(5), 313-321.

Izawa, K.P., Yasuyuki, P.T., Yamada, S, Oja, K., Omiya, K., & Iijima, S. (2004). Improvement in physiological outcomes and health-related quality of life following cardiac rehabilitation in patients with acute myocardial infarction. *Circulation Journal, 68*, 315-320.

Jacobs, D.R., Ainsworth, B.E., Hartman, T.J., & Leon, A.S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and Science in Sports and Exercise, 25*(1), 81-91.

Jacobson, B.H., & Aldana, S.G. (2001). Relationship between frequency of aerobic activity and illness related absenteeism in a large employee sample. *Journal of Occupation and Environmental Medicine, 43*(12), 1019-1025.

Jenum, A.K., Anderssen, S.A., Birkeland, K.I., Holme, I., Graff-Iversen, S., Lorentzen, C., Ommundsen, Y., Raastad, T., Odeggard, A.K., & Bahr, R. (2006). Promoting physical activity in a low-income multiethnic district: effects of a community intervention study to reduce risk factors for type 2 diabetes and cardiovascular disease. *Diabetes Care, 29*(7), 1605-1612.

Jenum, A.K., Lorentzen, C.A.N., & Ommundsen, Y. (2009). Targeting physical activity in a low socioeconomic status population: observations from the Norwegian 'Romsas in Motion' study. *British Journal of Sports Medicine, 43*, 64-49.

Jewson, E., Spittle, M., & Casey, M. (2008). A preliminary analysis of barriers, intentions, and attitudes towards moderate physical activity in women who are overweight. *Journal of Science and Medicine in Sport, 11*, 558-561.

Kahn, E.B., Ramsey, L.T., Brownson, R.C., Heath, G.W., Howze, E.H., Powel, K.E.,..Task Force on Community Preventive Services (2002). The effectiveness of interventions to increase physical activity: a systematic review. *American Journal of Preventive Medicine*, *22*(4S), 73-107.

Kaleta, D., & Jeiger, A. (2007). Predictors of inactivity in the working age population. *International Journal of Occupational Medicine and Environmental Medicine, 20*(2), 175-182.

Kamphuis, C.B.M., Van Lenthe, F.J., Giskes, K., Huisman, M., Brug, J., & M., J.P. (2008). Socioeconomic status, environmental and individual factors, and sports participation. *Medicine and Science in Sports and Exercise, 40*(1), 71-81.

Kaplan, G.A., Strawbridge, W.J., Cohen, R.D., & Hungerford, L.R. (1996). Natural history of leisure time physical activity and its correlates: associations with mortality from all causes and cardiovascular disease over 28 years. *American Journal of Epidemiology, 144*(8), 793-797.

Kaplan, M.S., Newson, J.T., McFarland, B.H., & Lu, L. (2001). Demographic and psychosocial correlates of physical activity in late life. *American Journal of Preventive Medicine*, *21*(4), 306-312.

Katzmarzyk, P.T., Gledhill, N., & Shephard, R.J. (2000). The economic burden of physical inactivity in Canada. *Canadian Medical Association Journal, 163*(11), 1435-1440.

Katzmarzyk, P.T., Church, T.S., Craig, C.L., & Bouchard, C. (2009). Sitting time and mortality from all causes, cardiovascular disease and cancer. *Medicine and Science in Sports and Exercise, 41*(5), 998-1005.

Kelishadi, R., Sarrafzadegan, N., Sadri, G.H., Pashmi, R., Mohammadifard, N., Tavasoli, A.,..Bahonar, A. (2009). Short term results of a community-based program on promoting healthy lifestyles for prevention and control of chronic diseases in a developing country setting: Isfahan Heart Healthy Program. *Asia Pacific Journal of Public Health* (in press).

Kelleher, C., Nolan, G., Murrin, C., Magoche, N., Friel, S., & Walsh, O. (2003). *The National Health and Lifestyle Surveys*. Ireland: Department of Health and Children.

Kesaniemi, Y.A., Danforth, E., Jensen, M.D., Kopelman, P.G., Lefebvre, P., & Reeder, B.A. (2001). Dose-response issues concerning physical activity and health: an evidence based symposium. *Medicine and Science in Sports and Exercise*.

Keyserling, T.C., Samuel Hodge, C.D., Jilcott, S.B., Johnston, L.F., Garcia, B.A. Gizlice, Z. et al (2008). Randomized trial of a clinic-based, community supported, lifestyle intervention to improve physical activity and diet: the North Carolina enhanced WISEWOMAN project. *Preventive Medicine, 46,* 499-510.

Kiely, D.K., Wolf, P.A., Cupples, L.A., Beiser, A.S., & Kannel, W.B. (1994). Physical activity and stroke risk. *American Journal of Epidemiology, 140*(7), 608-620.

King, A.C., Kiernan, M., Ahn, D.K., & Wilcox, S. (1998). The effects of marital transitions on changes in physical activity: results from a 10 year community study. *Annals of Behavioural Medicine, 20*(2), 64-69.

Knapp, D.N. (1988). Behavioural management techniques and exercise promotion. In Dishman, R.K. (Ed), *Exercise Adherence: Its Impact on Public Health*. Champaign IL: Human Kinetics.

Kriska, A.M., & Caspersen, C.J. (1997). Introduction to a collection of physical activity questionnaires. *Medicine and Science in Sports and Exercise, 29*(6), S5-S9.

Kuczmarski, M.F., Kuczmarski, R.J., & Najjar, M. (2001). Effects of age on validity of self reported height, weight and body mass index: findings from the third National Health and Nutrition Examination Survey, 1988-1994. *Journal of the American Dietetic Association, 101*, 28-34.

Laitakari, J., Vuori, I., & Oja, P. (1996). Is long-term maintenance of health related physical activity possible? *Health Education Research, 11*, 463-477.

Lane, A., Murphy, N., Bauman, A., & Chey, T. (in press). Randomised controlled trial to increase physical activity among insufficiently active women following their participation in a mass event. *Health Education Journal* (in press).

Lane, A., Murphy, N.M., & Bauman A. (2008). *The Impact of Participation in the Flora Women's Mini Marathon on Physical Activity Behaviour in Women. Research Report 1.* Ireland: Centre for Health Behaviour Research, Department of Health Sport and Exercise Sciences, Waterford Institute of Technology and Irish Sports Council.

Lane, A., Murphy, N.M., Smyth, P., & Bauman, A. (2010). *Do Mass Participation Sporting Events Have a Role in Making Populations More Active? Research Report 2.* Ireland: Centre for Health Behaviour Research, Waterford Institute of Technology and Irish Sports Council.

Larimer, M.E., Palmer, R.S., & Marlatt, A. (1999). Relapse prevention: an overview of Marlatt's cognitive behavioural model. *Alcohol Research and Health, 23*, 151-160.

Lee, I., & Skerrett, P.J. (2001). Physical activity and all cause mortality: what is the dose response relation? *Medicine and Science in Sports and Exercise, 33*(6), S459-S471.

Lee, LL., Avis, M., & Artur, A. (2007b). The role of self efficacy in older people's decision to initiate and maintain regular walking as exercise – findings from a qualitative study. *Preventive Medicine, 45*, 62-65.

Lee, R.E., Cubbin, C., & Winkleby, M. (2007a). Contribution of neighbourhood socio-economic status and physical activity resources to physical activity among women. *Journal of Epidemiology and Community Health, 61,* 882-890.

Lee, S., Cho, E., Grodstein, F., Kawachi, I., Hu, F.B., & Coldotz, G.A. (2004). Effects of marital transitions on changes in dietary and other health behaviours in US women. *International Journal of Epidemiology, 34*(1), 69-78.

Levy, S.S., & Cardinal, B.J. (2006). Factors associated with transitional shifts in college students' physical activity behaviour. *Research Quarterly for Sport and Exercise, 77*(4), 476-485

Lewis, B.A., Forsyth, L.H., Pinto, B.M., Bock, B.C., Roberts, M., & Marcus, B.H. (2006). Psychosocial mediators of physical activity in a randomised controlled intervention trial. *Journal of Sport and Exercise Psychology, 28*, 193-204.

Lewis, B.A., Marcus, B.H., Pate, R.R., & Dunn, A.L. (2002). Psychosocial mediators of physical activity behaviour among adults and children. *American Journal of Preventive*

Locke, E.A., & Latham, G.P. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist, 57*(9), 705-717.

London 2012 (2005). *Candidate File*. Retrieved 15/11/2005 www.london2012.org/en/news/publications/Candidate

London East Research Institute (2007). *A Lasting Legacy for London? Assessing the Legacy of the Olympic Games and Paralympic Games.* London: Greater London Authority.

Luepker, R.V., Murray, D.M., Jacobs, D.R., Mittlemark, M.B., Bracht, N., Carlaw, R.,..Folson, A.R. (1994). Community education for cardiovascular disease prevention: risk factor changes in the Minnesota Heart Health program. *American Journal of Public Health, 84*(9), 1383-1393.

Lunn, P. (2007a). *Fair Play? Sport and Social Disadvantage in Ireland,* Dublin, The Economic and Social Research Institute.

Lunn, P. (2007b). *Ballpark Figures: Key Research for Irish Sports Policy*. Dublin, The Irish Sports Council.

Lunn, P., & Layte, R. (2008). *Sporting Lives: An Analysis of a Lifetime of Irish Sport*. Dublin: The Economic and Social Research Institute. Research Series, Number 2.

Lunn, P., & Layte, R. (2009). *The Irish Sports Monitor: Second Annual Report 2008*. Dublin: The Economic and Social Research Institute.

Lunn, P., & Layte, R., & Watson, D. (2009). *The Irish Sports Monitor: First Annual Report 2007*. Dublin: The Economic and Social Research Institute.

Luszczynska, A., & Sutton, S. (2006). Physical activity after cardiac rehabilitation: Evidence that different types of self efficacy are important in maintainers and relapsers. *Rehabilitation Psychology, 51*(4), 314-321.

MacKinnon, D.P., & Luecken, L.J. (2008). How and for whom? Mediation and moderation in health psychology. *Health Psychology, 27*(2), S99-S100.

Maddock, J., Takeuchi, L., Nett, B., Tanaka, C., Irvin, L., Matsuoka, C., & Wood, B. (2006). Evaluation of a statewide program to reduce chronic disease: the Healthy Hawaii Initiative, 2000-2004. *Evaluation Program and Planning, 29*(3), 293-300.

Manson, J.E., Greenland, P., LaCroix, A.Z., Stefanick, M.L., Mouton, C.P., Oberman, A.,..Siscovick, D.S. (2002). Walking compared with vigorous exercise for the prevention of cardiovascular events in women. *The New England Journal of Medicine, 347*, 716-725.

Manson, J.E., Hu, F.B., Rich-Edwards, J.W., Colditz, G.A., Stamper, M.J., & Willett, W.C. (1999). A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *New England Journal of Medicine, 26*, 650-658.

Manson, J.E., Rimm, E.B., Stampfer, M.J., Colditz, G.A., Willett, W.C., Krolewski, A.S., Rosner, B.,…Speizer, F.E. (1991). Physical activity and incidence of non-insulin dependant diabetes mellitus in women. *The Lancet, 338*, 774-778.

Marcus, B.H., & Forsyth, L.H. (1998). Tailoring interventions to promote physically active lifestyles in women. *Women's Health Issues, 8*(2), 104-111.

Marcus, B.H., & Owen, N. (1992) Motivational readiness, self-efficacy, decision-making for exercise. *Journal of Applied Social Psychology 22*, 3–16.

Marcus, B.H., & Simkin, L.R. (1994). The transtheoretical model: applications to exercise behaviour. *Medicine and Science in Sports and Exercise, 26*(11), 1400-1404.

Marcus, B.H., Bock, B.C., Pinto, B.M., Forsyth, L.H., Roberts, M.B., & Traficante, R.M. (1998a). Efficacy of an individualised, motivationally tailored physical activity intervention. *Annals of Behavioural Medicine, 20*(3), 174-180.

Marcus, B.H., Emmons, K.M., Simkin-Silverman, L.R., Linnan, L.A., Taylor, E.R., Bock, B.C., Roberts, M.B., Rossi, J.S., & Abrams, D.B. (1998b). Evaluation of motivationally tailored vs. standard self-help physical activity interventions in the workplace. *American Journal of Health Promotion, 12*(4), 346-253.

Marcus, B.H., Forsyth L.H., Stone, E.J., Dubbert, P.M., McKenzie, T.L., Dunn, A.L., & Blair, S.N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology, 19*(S), 32–41.

Marcus, B.H., Lewis, B.H., Williams, D.M., Dunsiger, S., Jakicic, J.M., Whiteley, J.A., Albrecht, A.E., Napolitano, M.A., Bock, B.C., Tate, D.F., Sciamanna, C.N., & Parisi, A.F., (2007b). A comparison of internet and print-based physical activity interventions. *Archives of Internal Medicine, 167,* 944–949.

Marcus, B.H., Napolitano, M.A., King, A.C., Lewis, B.A., Whiteley, J.A., Albrecht, A. et al (2007a). Telephone versus print delivery of an individually motivationally tailored physical activity intervention: project STRIDE. *Health Psychology, 26*(4), 401-409.

Marcus, B.H., Owen, N., Forsyth, L.H., Cavill, N.A., & Fridinger, F. (1998c). Physical activity interventions using mass media, print media and information technology. *American Journal of Preventive Medicine, 15*(4), 362-378.

Marcus, B.H., Rakowski, W. & Rossi, J.S. (1992b). Assessing motivational readiness and decision making for exercise. *Health Psychology, 11*(4), 257-261.

Marcus, B.H., Rossi, J.S., Selby, V.C., Niaura, R.S., & Abrams, D.B. (1992a). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychology, 11*(6), 386-395.

Marquez, D.X., & McAuley, E. (2006). Social cognitive correlates of leisure time physical activity among Latinos. *Journal of Behavioural Medicine, 29*(3), 281-289.

Marshall, A.L., Bauman, A., Owen, N., Booth, M., Crawford, D., & Marcus, B. (2004a). Reaching Out to Promote Physical Activity in Australia: A Statewide Randomized Controlled Trial of a Stage-targeted Intervention. *American Journal of Health Promotion, 18*, 4, 283-287.

Marshall, A.L., Bauman, A.E., Owen, N., Booth, M.L., Crawford, D., & Marcus, B.H. (2003a). Population-based randomised controlled trial of a stage-targeted physical activity intervention. *Annals of Behavioural Medicine, 25*(3), 194-202.

Marshall, A.L., Leslie, E.R., Bauman, A.E., Marcus, B.H., & Owen, N. (2003b). Print versus website physical activity programs: a randomised trial. *American Journal of Preventive Medicine, 25*(2), 88-94.

Marshall, A.L., Owen, N., & Bauman, A.E. (2004b). Mediated approaches for influencing physical activity: update on the evidence on mass media, print, telephone and website delivery of interventions. *Journal of Science and Medicine in Sport, 7(1),* 74-80.

Marshall, S.J., Levy, S.S., Tudor-Locke, C., Kolkhorst, F.W., Wooten, K.M., Ming, J.,..Ainsworth, B.E. (2009). Translating physical activity recommendations into a pedometer-based step goal. *American Journal of Preventive Medicine, 36*(5), 410-415.

Martin, K.A., Bowen, D.J., Dunbar-Jacob, J., & Perri, M.G. (2000b). Who will adhere? Key issues in the study and prediction of adherence in randomised controlled trials. *Controlled Clinical Trials, 21*, S195S-S199.

Martin, S.B., Morrow, J.R., Jackson, A.W., & Dunn, A.L. (2000a). Variables related to meeting the CDC/ACSM physical activity guidelines. *Medicine and Science in Sports and Exercise, 32*(12), 2087-2092.

Martínez, M.E., Giovanucci, E., Spiegelman, D., Hunter, D.J., Willett, W.C., & Colditz, G.A. (1997). Leisure time physical activity, body size, and colon cancer in women. *Journal of the National Cancer Institute, 89*(13), 948-955.

Martinez-Gonzalez, M.A., Varo, J.J., Santos, J.L, de Irala, J., Gibney, M., Kearney, J., & Martinez, J.A. (2001). Prevalence of physical activity during leisure time in the European Union. *Medicine and Science in Sports and Exercise, 33*(7), 1142-1146.

Martinsen, E.W. (1994). Physical activity and depression: clinical experience. *Acta Psychiatrica Scandinavica,* Supplement 377, 23-27.

Martinson, B.C., Crain, A.L., Sherwood, N.E., Hayes, M., Pronk, N.C., & O'Connor, P.J. (2008). Maintaining physical activity among older adults: six month outcomes of the Keep Active Minnesota randomised controlled trial. *Preventive Medicine, 46*, 111-119.

Mathews, C.E., Chen, K.Y., Freedson, P.S., Buchowski, M.S., Beech, B.M., Pate, R.R., & Troiano, R.P. (2008). Amount of time spent in sedentary behaviours in the United States, 2003-2004. *American Journal of Epidemiology, 167*(7), 875-871.

Matsudo, S.M, Matsudo, V.R., Andrade, D.R., Araújo, T.L., Andrade, E., de Oliveria, L., & Braggion, G. (2004). Physical activity promotion: experiences and evaluation of the Agita São Paulo Program using the ecological mobile model. *Journal of Physical Activity and Health, 1*, 81-97.

Matsudo, S.M.., Matsudo, V.K.R., Andrade, D.R., Araújo, T.L., & Pratt, M. (2006). Evaluation of a physical activity promotion program: the example of Agita São Paulo. *Evaluation and Program Planning, 29*(3), 301-311.

Mayer, A., Evenson, K.R., Couper, D.J., Stevens, J., Pereira, M.A., & Heiss, G. (2008). Television, physical activity, diet and body weight status: the ARIC cohort. *International Journal of Behavioural Nutrition and Physical Activity, 5*(68).

McAlister, A.L., Perry, C.L., & Parcel, G.S. (2008). How Individuals, Environments, and Health Behaviours Interact: Social Cognitive Theory. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

McAuley, E., Jerome, G.J., Elavsky, S., Marquez, D.X., & Ramsey, S.N. (2003). Predicting long term maintenance of physical activity in older adults. *Preventive Medicine, 37*(2), 110-118.

McCartney, G., Thomas, S., Thomson, H., Scott, J., Hamilton, V., Hanlon, P.,…Bond, L. (2010). The health and socioeconomic impacts of multi-sports events: a systematic review. *British Medical Journal, 340*.

McDermott, L., Dobson, A., & Owen, N. (2009). Determinants of continuity and change over 10 years in young women’s smoking. *Addiction, 104*, 478-487.

McLeroy, K.R., Norton, B.L., Kegler, M.C., Burdine, J.N., & Sumaya, C.V. (2003). Community-based interventions. *American Journal of Public Health, 93*(4), 529-533.

MacPhail, A., Halbert, J., McEvilly, N., Hutchinson, C., & MacDonncha, C. (2005). The constraints on school provision of post-primary physical education in Ireland: principals’ and teachers’ views and experiences. *Irish Educational Studies, 24*(1), 77-91.

Merom, D., Miller, Y., Lymer, S., & Bauman, A. (2005a). Effect of Australia's Walk to Work Day Campaign on Adults' Active Commuting Behavior. *American Journal of Health Promotion, 19*(3),159-62.

Merom, D., Rissel, C., Mahmic, A., & Bauman, A (2005b). Process evaluation of the New South Wales Walk Safely to School Day. *Health Promotion Journal of Australia, 16*(2), 100-6.

Merom, D., Rissel, C., Phongsavan, P., Smith, B.J., Van Kemenade, C., Brown, W.J., Bauman, A.E. (2007). Promoting walking with pedometers in the community: the Step by Step Trial. *American Journal of Preventive Medicine, 32*(4), 290-197.

Merzel, C., & D'Afflitti, J. (2003). Reconsidering community-based health promotion: promise, performance and potential. *American Journal of Public Health, 93*(4), 557-574.

Miller, Y.D., Trost, S.G., & Brown, W.J. (2002). Mediators of physical activity behaviour change among women with young children. *American Journal of Preventive Medicine, 23*(2S), 98-103.

Molloy, G.J., Stamatakis, E., Randall, G., & Hamer, M. (2009). Marital status, gender and cardiovascular mortality: Behavioural, psychological distress and metabolic explanations. *Social Science and Medicine*, *69*, 223-228.

Montano, D.E., & Kasprzyk, D. (2008). Theory of Reasoned Action and Theory of Planned Behaviour, and the Integrated Model. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Moore, L.V., Fulton, J., Kruger, J., & McDivitt, J. (2010). Knowledge of physical activity guidelines among adults in the United States, HealthStyles 2003-2005. *Journal of Physical Activity and Health, 7*, 141-149.

Moore, S.M., Charvat, J.M., Gordon, N.H., Roberts, B.L., Pashkow, F., Ribisl, P., & Rocco, M. (2006). Effect of a CHANGE intervention to increase exercise maintenance following cardiac events. *Annals of Behavioural Medicine, 31*(1), 53-62.

Morgan, K., McGee, H., Watson, D., Perry, I., Barry, M., Shelley, E.,..Brugha, R. (2008). *SLÁN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland. Main Report*. Dublin, Department of Health and Children.

MORI (2004). *The Sports Development of the Commonwealth Games 2002: Final Report*. London: MORI.

Morris, J.N., & Heady, J.A. (1953). Mortality in relation to the physical activity of work. *British Journal of Industrial Medicine, 10*, 245-254.

Morris, J.N., & Hardman, A.E. (1997). Walking to health. *Sports Medicine, 23*(5), 306-332.

Muldoon, A., Lane, A., Murphy, N., Power, M., Kealy, R. & O'Dwyer, J. (2008). *Waterford Active Schools Programme: An Evaluation.* Ireland: Waterford Sports Partnership and Centre for Health Behaviour Research, Waterford Institute of Technology.

Müller-Riemenschneider, F., Reinhold, T., & Willich, S.N. (2009). Cost-effectiveness of interventions promoting physical activity. *British Journal of Sports Medicine, 43*, 70-76.

Müller-Riemenschneider, F., Reinhold, T., Nocon, M., & Willich, S.N. (2008). Long term effectiveness of interventions promoting physical activity: A systematic review. *Preventive Medicine, 47*, 354-368.

Müller-Riemenschneider, F., Reinhold, T., & Willich, S.N. (2009). Cost-effectiveness of interventions promoting physical activity. *British Journal of Sports Medicine, 43,* 70-76.

Murphy, N.M., & Bauman, A. (2007). Mass sporting and physical activity events: are they bread and circuses or public health interventions to increase population levels of physical activity? *Journal of Physical Activity and Health, 4*, 193-202.

Napolitano, M.A., & Marcus, B.H. (2002). Targeting and tailoring physical activity information using print and information technologies. *Exercise and Sport Science Reviews*, *30*(3), 122-128.

Napolitano, M.A., Fotheringham, M., Tate, D., Sciamanna, C., Leslie, E., Owen, N.,..Marcus, B. (2003). Evaluation of an internet-based physical activity intervention: a preliminary investigation. *Annals of Behavioural Medicine, 25*(2), 92-99.

Napolitano, M.A., Whiteley, J.A., Papandonatos, G., Dutton, G., Farrell, N.C., Albrecht, A.,..Marcus, B.H. (2006). Outcomes from the women's wellness project: A community focused physical activity trial for women. *Preventive Medicine, 43,* 447-453.

National Council for Curriculum and Assessment (2010). *Curriculum and Assessment.* Retrieved online 1/6/10 http://www.ncca.ie/en/Curriculum_and_Assessment/

National Institute for Health and Clinical Excellence (NICE) (2008). *Physical Activity and the Environment Costing Report.* UK: NICE.

Nic Gabhainn, S., Kelly, C. & Molcho, M. (2007). *HBSC Ireland 2006: National Report of the 2006 Health Behaviour in School-aged Children in Ireland*. Dublin: Department of Health and Children.

Nies, M.A., & Partridge, T. (2006). Comparisons of 3 interventions to increase walking in women. *American Journal of Health Behaviour, 30*(4), 339-352.

Nigg, C.R. (2008). A theory of physical activity maintenance. *Applied Psychology, 57*(4), 544-560.

Nomaguchi, K.M., & Bianchi, S.M. (2004). Exercise time: gender differences in the effects of marriage, parenthood and employment. *Journal of Marriage and Family, 66*, 413-430.

Ockene, J.K., Mermelstein, R.J., Bonollo, D.S., Emmons, K.M., Perkins, K.A., Voorhees, C.C, & Hollis, J.F. (2000). Relapse and maintenance issues for smoking cessation. *Health Psychology, 19*(1), S17-S31.

Ogden, C.L., Carroll, M.D., Curtin, L.R., McDowell, M.A., Tabak, C.J., & Flegal, K.M. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *Journal of American Medical Association, 295*, 1549-1555.

Ogilvie, D., Foster, C.E., Rothnie, H., Cavill, N., Hamilton, V., Fitzsimons, C.F., & Mutrie, H. (2007). Interventions to promote walking: a systematic review. *British Medical Journal, 334*, 1-10.

Oguma, Y., Sesso, H.D., Paffenberger, R.S., & Lee, I. (2002). Physical activity and all cause mortality in women: a review of the evidence. *British Journal of Sports Medicine, 36*, 162-172.

Ohmann, S., Jones, I., & Wilkes, K. (2006). The perceived social impacts of the 2006 football world cup on Munich residents. *Journal of Sport and Tourism, 11*(2), 129-152.

Orleans, C.T. (2000). Promoting the maintenance of health behavior change: recommendations for the next generation of research and practice. *Health Psychology, 19*(1), S76-S83.

Owen, J.G. (2005). Estimating the cost and benefit of hosting Olympic Games: what can Beijing expect from its 2008 games? *The Industrial Geographer, 3*(1), 1-18.

Owen, N., Bauman, A., & Brown, W. (2009). Too much sitting: a novel and important predictor of chronic disease risk? *British Journal of Sports Medicine, 43*, 81-83.

Owen, N., Bauman, A., Booth, M., Oldenburg, B., & Magnus, P. (1995). Serial mass media campaigns to promote physical activity: reinforcing or redundant? *American Journal of Public Health, 85*, 244-248.

Paavola, M., Vartiainen, E., & Haukkala, A. (2004). Smoking, alcohol use and physical activity: A 13 year longitudinal study ranging from adolescence to adulthood. *Journal of Adolescent Health, 35*, 238-244.

Paffenbarger, R.S., Hyde, R.T., & Wing, A.L. (1987). Physical activity and incidence of cancer in diverse populations: a preliminary report. *The American Journal of Clinical Nutrition, 45*, 312-317.

Paffenbarger, R.S., Hyde, R.T., Wing, A.L., Lee, I., Jung, D.L., & Kampert, J.B. (1993). The association of changes in physical activity level and other lifestyle characteristics with mortality among men. *New England Journal of Medicine, 328*(8), 538-545.

Paffenbarger, R.S., Wing, A.L., Hyde, R.T., & Jung, D.L. (1983). Physical activity and incidence of hypertension in college alumni. *American Journal of Epidemiology, 117*, 245-257.

Parks, S.E., Housemann, R.A., & Brownson, R.C. (2003). Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology and Community Health, 57*, 29-35.

Parsons, T.J., Thomas, C., & Power, C. (2009). Estimated physical activity patterns in British 45 year olds: cross sectional findings from the 1958 British birth cohort. *European Journal of Clinical Nutrition, 63*, 978-985.

Pate, R.R., Pratt, M., Blair, S.N., Haskell, W.L., Macera, C.A., Bouchard, C….King, A.C. (1995). Physical activity and public health. A recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273*(5), 402-407.

Payne, W., Reynolds, M., Brown, S., & Fleming, A. (2002). *Sports Role Models and their Impact on Participation in Physical Activity: a Literature Review*. Victoria: University of Ballarat.

Perry, C.K., Rosenfeld, A.G., Bennett, J.A., & Potempa, K. (2007). Promoting walking in rural women through motivational interviewing and group support. *Journal of Cardiovascular Nursing, 22*(4), 304-312.

Pettee, G.L., McClain, J.L., Lee, C.D., Swan, P.D., Alvar, B.A., Mitros, M.R., & Ainsworth, B.E. (2009). Evaluation of physical activity measures used in middle-aged women. *Medicine and Science in Sports and Exercise, 41*(7), 1403-1412.

Pettee, K.K., Brach, J.S., Kriska, A.M., Boudreau, R., Richardson, C.R., Colbert, L.H.,…Newman, A.B. (2006). Influence of marital status on physical activity among older adults. *Medicine and Science in Sports and Exercise, 38*(3), 541-546.

Phongsavan, P., McClean, G., & Bauman, A. (2007). Gender differences in influences of perceived environmental correlates on recommended levels of physical activity among New Zealanders. *Psychology of Sport and Exercise, 8*, 939-950.

Pinto, B.M., Friedman, R., Marcus, B.H., Kelley, H., Tennstedt, S., & Gillman, M.W. (2002). Effects of a computer based, telephone counselling system on physical activity. *American Journal of Preventive Medicine, 23*(2), 113-120.

Plotnikoff, R.C., Hotz, S.B., Birkett, N.J., & Courneya, K.S. (2001). Exercise and the transtheoretical model: a longitudinal test in a population sample. *Preventive Medicine, 33,* 441-452.

Plotnikoff, R.C., Lippke, S., Courneya, K.S., Birkett, N., & Sigal, R.N. (2008). Physical activity and social cognitive theory: A test in a population sample of adults with type 1 or type 2 diabetes. *Applied Psychology, 57*(4), 628-643.

Plotnikoff, R.C., Mayhew, A., Birkett, N., Loucaides, C.A., & Fodor, G. (2004). Age, gender, and urban-rural differences in the correlates of physical activity. *Preventive Medicine, 39*, 1115-1125.

Poortinga, W. (2007). Associations of physical activity with smoking and alcohol consumption: A sport or occupation effect. *Preventive Medicine, 45*, 66-70.

Powell, K.E., Thompson, P.D., Caspersen, C.J., & Kendrick, J.S. (1987). Physical activity and the incidence of coronary heart disease. *Annual Review of Public Health, 8*, 253-287.

Prentice, A., & Jebb, S. (2004). Energy intake/physical activity interactions in the homeostasis of body weight. *Nutrition Reviews, 62*(S2), S98-S104.

Prentice, A.M. (2006). The emerging epidemic of obesity in developing countries. *International Journal of Epidemiology, 35,* 93-99.

Preuss, H. (2007). The conceptualisation and measurement of mega sport event legacies. *Journal of Sport and Tourism, 12*(3-4), 207-227.

Priest, N., Armstrong, R., Doyle, J., & Waters, E. (2009). Interventions implemented through sporting organizations for increasing participation in sport (review). *The Cochrane Library, 4*.

Prochaska, J.O., & DiClemente, C.C. (1983). Stages and processes of self-change of smoking: towards an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*, 390-395.

Prochaska, J.O., & Marcus, B.E. (1994). The Transtheoretical Model: Applications to Exercise. In Dishman, R.K. (1994). *Advances in Exercise Adherence*. Champaign, IL: Human Kinetics.

Prochaska, J.O., Redding, C.A., & Evers, K.E. (2008). The Transtheoretical Model and Stages of Change. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Psaty, B.M., Cheadle, A., Koepsell, T.D., Diehr, P., Wickizer, T., Curry, S.,…Wagner, E.H. (1994). Race and ethnicity specific characteristics of participants lost to follow up in a telephone cohort. *American Journal of Epidemiology, 140*(2), 161-171.

Pucher, J., & Buehler, R. (2008). Making cycling irresistible: lessons from the Netherlands, Denmark and Germany. *Transport Reviews, 28*(4), 495-528.

Puffer, S., Torgerson, D., & Watson, J. (2003). Evidence for risk of bias in cluster randomised controlled trials : review of recent trials published in three general medical journals. *British Medical Journal, 327,* 785-789.

Rejeski, W.J., & Mihalko, S.L. (2001). Physical activity and quality of life in older adults. *Journals of Gerontology, 56A*, 23-25.

Riebe, D., Blissmer, B.,Greene, G., Caldwell, M., Ruggiero, L., Stillwell, K.M., Nigg, C.R. (2005). Long term maintenance if exercise and healthy behaviours in overweight adults. *Preventive Medicine, 40*, 769-778.

Rimmer, J.H., Braddock, D., & Pitetti, K.H. (1996). Research on physical activity and disability: an emerging national priority. *Medicine and Science in Sports and Exercise, 28*(11), 1366-1372.

Rosamond, W.D., Ammermann, A.S., Holliday, J.L., Tawney, K.W., Hunt, K.J., Keyserling, T.C.,..Mokdad, A.H. (2000). Cardiovascular disease risk factor intervention in low income women: the North Caroline WISEWOMAN project. *Preventive Medicine, 31*, 370-379.

Rose, G., & Marfurt, H. (2007). Travel behavior change impacts of a major ride to work day event. *Transportation Research Part A, 41*, 351-364.
Rose, G., Marfurt, H., & Harbutt, P. (2003). Using a ride to work day event to promote travel behavior change. *26th Australasian Transport Research Forum*. Wellington, New Zealand.
Rosenberg, D.E., Bull, F.C., Marshall, A.L., Sallis, J.F., & Bauman, A.E. (2008). Assessment of sedentary behavior with the International Physical Activity Questionnaire. *Journal of Physical Activity and Health, 5*(1), S30-S44.
Rothman, A.J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology, 19*(1), S64-S69.
Rovniak, L.S., Anderson, E.S., Winett, R.A., & Stephens, R.S. (2002). Social cognitive determinants of physical activity in young adults: a prospective structural equation analysis. *Annals of Behavioural Medicine, 24*(2), 149-156.
Rzewnicki, R., Auweele, Y.A., & de Bourdeaudhuij, I. (2003). Addressing overreporting on the International Physical Activity Questionnaire (IPAQ) telephone survey within a population sample. *Public Health Nutrition, 6*(3), 299-305.
Sallis, J.F., & Owen, N. (1999). *Physical Activity and Behavioural Medicine.* Thousand Oaks, CA: Sage.
Sallis, J.F., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine, 15*(4), 379-397.
Sallis, J.F., Bowles, H.R., Bauman, A.E., Ainsworth, B.E., Bull, F.C., Craig, C.L.,..Bergman, P. (2009). Neighborhood environments and physical activity among adults in 11 countries. *American Journal of Preventive Medicine, 36*(6), 484-490.
Sallis, J.F., Cervero, R.B., Ascher, W., Henderson, K.A., Kraft, M.K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27,* 297-322.
Sallis, J.F., Grossman, R.M., Pinski, R.B., Patterson, T.L., & Nader, P.R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*(6), 825-836.
Sallis, J.F., Haskell, W.L., Fortmann, S.P., Vranizan, K.M., Taylor, C.B., & Solomon, D.S. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Preventive Medicine, 15,* 331-341.

Sallis, J.F., Hovell, M.F., Hofstetter, C.R. (1992). Predictors of adoption and maintenance of vigorous physical activity in men and women. *Preventive Medicine, 21*, 237-251.

Sallis, J.F., Hovell, M.F., Hofstetter, C.R., Elder, J.P., Faucher, P., Spry, V.M., Barrington, E., & Hackley, M. (1990). Lifetime history of relapse from exercise. *Addictive Behaviors, 15*, 573–579.

Sallis, J.F., Hovell, M.F., Hofstetter, C.R., Faucher, P., Elder, J.P., Blanchard, J., Caspersen, C.J., Powell, K.E., & Christenson, G.M. (1989). A multivariate study of determinants of vigorous exercise in a community sample. *Preventive Medicine, 18*(1), 20-34.

Sallis, J.F., Johnson, M.F., Calfas, K.J., Caparosa, S., & Nichols, J. (1997). Assessing perceived physical environment variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68*, 345-351.

Sallis, J.F., Owen, N., & Fisher, E.B. (2008). Ecological Models of Health Behaviour. In Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health Behaviour and Health Education: Theory, Research and Practice* (4th edition). USA: John Wiley and Sons Inc.

Scharff, D.P., Homan, S., Kreuter, M., & Brennan, L. (1999). Factors associated with physical activity in women across the lifespan: implications for program development. *Women and Health, 29*(2), 115-134.

Schöppe, S., Bauman, A., & Bull, F. (2004). *International Review of National Physical Activity Policy: A Literature Review*. Australia: CPAH.

Schwarzer, R., Schüz, B., Ziegelmann, J.P., Lippke, S., Luszczynska, A., & Scholz, U. (2007). Adoption and maintenance of four health behaviours: theory guided longitudinal studies on dental flossing, seat belt use, dietary behaviour, and physical activity. *Annals of Behavioural Medicine, 33*(2), 156-166.

Segar, M., Jayaratne, T., Hanlon, J., & Richardson, C.R. (2002). Fitting fitness into women's lives: effects of a gender tailored physical activity intervention. *Women's Health Issues, 12*(6), 338-347.

Seo, D., & Torabi, M. (2007). Differences in vigorous and moderate physical activity by gender, race/ethnicity, age, education and income among U.S. adults. *American Journal of Health Education, 38*(3), 122-129.

Sevick. M.A., Napolitano, M.A., Papandonatos, G.D., Gordon, A.J., Reiser, L.M., & Marcus, B.H. (2007). Cost-effectiveness of alternative approaches for motivating activity in sedentary adults: results of Project STRIDE. *Preventive Medicine, 45*, 54-61.

Shephard, R.J. (2003). Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine, 37*(3), 197-206.

Sherman, S.E., D'Agostino, R.B., Cobb, J.L., & Kannel, W.B. (1994). Physical activity and mortality in women in the Framingham Heart Study. *American Heart Journal, 128,* 879-884.

Sherwood, N.E., Martinson, B.C., Crain, L.A., Hayes, M.G., Pronk, N.P., & O'Connor, P.J. (2008). A new approach to physical activity maintenance: rationale, design, and baseline data from the Keep Active Minnestota trial. *BMC Geriatrics, 8*(17).

Simkin, L.R., & Gross, Z.M. (1994). Assessment of coping with high-risk situations for exercise relapse among healthy women. *Health Psychology*, *13*(3), 274-277.

Sjöström, M., Oja, P., Hagströmer, M., Smith, B.J., & Bauman, A. (2006). Health enhancing physical activity across European Union countries: the Eurobarometer study. *Journal of Public Health, 14*, 291-300.

Slattery, M.L., Edwards, S.L., Ma, K., Friedman, G.D., & Potter, J.D. (1997). Physical activity and colon cancer: a public health perspective. *Annals of Epidemiology, 7*, 137-145.

Sniehotta, F.F., Scholz, U., Schwarzer, R. (2005). Bridging the intention behaviour gap: planning, self efficacy and action control in the adoption and maintenance of physical exercise. *Psychology and Health*, *20*(2), 143-160.

Sonstroem, R.J. (1988). Psychological models. In Dishman, R.K. (Ed). *Exercise Adherence: Its Impact on Public Health*. Champaign IL: Human Kinetics.

SØrenson, M., & Gill, D.L. (2008). Perceived barriers to physical activity across Norwegian adult age groups, gender and stages of change. *Scandinavian Journal of Medicine and Science in Sports, 18*, 651-663.

Speck, B.J., & Harrell, J.S. (2003). Maintaining regular physical activity in women: evidence to date. *The Journal of Cardiovascular Nursing, 18*(4), 282-293.

Speck, B.J., Hines-Martin, V., Stetson, B.A., & Looney, S.W. (2007). An environmental intervention aimed at increasing physical activity levels in low-income women. *Journal of Cardiovascular Nursing, 22*(4), 263-271.

Spencer, L., Adams, T.B., Malone, S., Roy, L., & Yost, E. (2006). Applying the transtheoretical model to exercise: a systematic and comprehensive review of the literature. *Health Promotion Practice, 7*(4), 428-443.

Spittaels, H., De Bourdeaudhuij, I., Brug, J., & Vandelanotte, C. (2007). Effectiveness of an online computer-tailored physical activity intervention in a real life setting. *Health Education Research, 22*(3), 385-396.

Sport and Recreation Victoria (2006). *Warming Up for the Games Report*. Victoria: Department for Victorian Communities.

Sport England (2009). *Sport Playing Its Part: The Contribution of Sport to Healthier Communities*. UK: Sport England.

Stadler, G., Oettingen, G., & Gollwitzer, P.M. (2009). Physical activity in women: effects of a self-regulation intervention. *American Journal of Preventive Medicine,* in press.

Stephens, T. (1988). Physical activity and mental health in the United States and Canada: evidence from four population surveys. *Preventive Medicine, 17,* 35-47.

Sullum, J., Clark, M.M., & King, T.K. (2000). Predictors of exercise relapse in a college population. *Journal of American College Health, 48*(4), 175-180.

Swales, C. (2001). *A Health Economics Model: The Cost Benefits of the Physical Activity Strategy of Northern Ireland – a Summary of Key Findings*. Northern Ireland: Health Promotion Agency.

Tammelin, T., Näyhä, S., Hills, A.P., & Järvelin, M. (2003). Adolescent participation in sports and adult physical activity. *American Journal of Preventive Medicine, 24*(1), 22-28.

Task Force on Community Preventive Services (2002). Recommendations to increase physical activity in communities. *American Journal of Preventive Medicine, 22,* (4S), 67-72.

The Economic and Social Research Institute - ESRI (2007). *Irish sports monitor*. Retrieved 30/11/2007, http://www.esri.ie/research/current_research_projects/search_results/index.xml?Area=12

Thune, I., & Furberg, A. (2001). Physical activity and cancer risk: dose response and cancer, all sites and site-specific. *Medicine and Science in Sports and Exercise, 33*(6), S530-S550.

Thune, I., Brenn, T., Lund, E., & Gaard, M. (1997). Physical activity and the risk of breast cancer. *The New England Journal of Medicine*, *336*(18), 1269-1275.

Titze, S., Stronegger, W., & Owen, N. (2005). Prospective study of individual, social and environmental predictors of physical activity: women's leisure running. *Psychology of Sport and Exercise, 6*, 363-376.

TNS Opinion and Social (2010). *Special Eurobarometer: Sport and Physical Activity*. European Commission.

Tobias, M.I., & Roberts, M.G. (2001). Modelling physical activity: a multi state life table approach. *Australia and New Zealand Journal of Public Health, 25*(2), 141-148.

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T, & McDowell, M. (2008).Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise, 40*(1), 181-188.

Trost, S.G., Owen, N., Bauman, A.E., Sallis, J.F., & Brown W. (2002). Correlates of adults participation in physical activity: review and update. *Medicine and Science in Sports and Exercise, 34*(12), 1996-2001.

Tucker, P., & Gilliland, J. (2007). The effect of season and weather on physical activity: A systematic review. *Journal of the Royal Institute of Public Health*, *12*, 909-922.

Tudor-Locke, C., & Bassett, D.R. (2004). How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine, 34*(1), 1-8.

Tudor-Locke, C., & Myers, A.M. (2001). Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Medicine, 31*(2), 91-100.

U.S. Department of Health and Human Services (1996). *Physical activity and health: a report of the Surgeon General*. Atlanta, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

UK Department of Health (2009). *Be Active Be Healthy: A Plan for Getting the Nation Moving.* UK: Department of Health.

UK Department of Health, Physical Activity, Health Improvement and Prevention (2004). *At least five a week. Evidence on the impact and physical activity and its relationship to health. A report from the Chief Medical Officer.* UK: Department of Health.

US Department of Health and Human Services (2008). *2008 Physical Activity Guidelines for Americans*. Atlanta, GA: US Department of Health and Human Services, Centres for Disease Control and Prevention.

Van Amelsvoort, L.G.P.M., Spigt, M.G., Swaen, G.M.H., & Kant, I. (2006). Leisure time physical activity and sickness absenteeism; a prospective study. *Occupational Medicine, 56*, 210-212.

Van Sluijs EMF, van Poppel MNM, Twisk JWR & van Mechelen W (2006). Physical activity measurements affected participants' behaviour in a randomised controlled trial. *Journal of Clinical Epidemiology, 59*(4), 404-411.

Vandelanotte, C., Spathonis, M., Eakin, E.G, & Owen, N. (2007). Website delivered physical activity interventions: a review of the literature. *American Journal of Preventive Medicine*, *33*(1), 54-64.

Verhoef, M., Love, E.L., & Rose, S.A. (1993). Women's social roles and their exercise participation. *Women and Health, 19*(4), 15-29.

Vuillemin, A., Oppert, J.., Guillemin, F., Essermeant, L., Fontvieille, A., Galan, P., Kriska, A.M., & Hercberg, S. (2003). Self-administered questionnaire compared with interview to assess past-year physical activity. *Medicine and Science in Sports and Exercise, 32*(6), 1119-1124.

Walker, A.R.P., Walker, B.F., & Adam, F. (2003). Nutrition, diet, physical activity, smoking and longevity: from primitive hunter gatherer to present passive smoker – how far can we go? *Nutrition, 19,* 169-173.

Walters, S.D., Barr-Anderson, D.J., Wall, M., & Neumark-Sztainer, D. (2009). Does participation in organised sports predict future physical activity for adolescents from diverse economic backgrounds? *Journal of Adolescent Health, 44*, 268-274.

Wang, S., Moss, J.R., & Hiller, J.E. (2005). Applicability and transferability of interventions in evidence-based public health. *Health Promotion International, 21*(1), 76-83.

Wannamethee, S.G., Shaper, A.G., & Walker, M. (2000). Physical activity and mortality in older men with diagnosed coronary heart disease. *Circulation, 102*, 1358-1363.

Warburton, D.E.R., Nicol, C.W., & Bredin, S.S.D. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal, 174*(6), 801-809.

Warren, B.S., Maley, M., Sugarwala, L.J., Wells, M.T., & Devine, C.M. (2010). Small steps are easier together: A goal based ecological intervention to increase walking by women in a rural worksite. *Preventive Medicine* (in press).

Weed, M., Coren, E., Fiore, J., Mansfield, L., Wellard, I., & Chatziefstathiou, D. (2009). *A Systematic Review of the Evidence Base for Developing a Physical Activity and Health Legacy from the London 2010 and Paralympic Games.* UK: Department of Health.

Wen, L.M., Thomas, M., Jones, H., Orr, N., Moreton, R., King, L., Hawe, P., Bindon, J., Humphries, J., Schicht, K., Corne, S., & Bauman, A. (2002). Promoting physical activity in women: evaluation of a 2-year community based intervention in Sydney, Australia. *Health Promotion International, 17*(2), 127-137.

Wendel-Vos, G.C.W., Dutman, A.E., Verschuren, M., Ronckers, E.T., Ament, A., van Assema, P.,..Schuit, A.J. (2009). Lifestyle factors of a five-year community intervention program: the Hartslag Limburg Intervention. *American Journal of Preventive Medicine, 37*(1), 50-56.

Wijndaele, K., Healy, G.N., Dunstan, D.W., Barnett, A.G., Salmon, J., Shaw, J.E., Zimmet, P.Z., & Owen, N. (2010). Increased cardio-metabolic risk is associated with increased TV viewing time. *Medicine and Science in Sports and Exercise* (in press).

Wilcox, S., Castro, C., King, A.C., Housemann, R., Brownson, R.C. (2000). Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. *Journal of Epidemiology and Community Health, 54*, 667-672.

Wilcox, S., Dowda, M., Griffin, S.F., Rheaume, C., Ory, M.G., Leviton, L. et al (2006). Results of the first year of Active for Life: translation of 2 evidence-based physical activity programs for older adults into community settings. *American Journal of Public Health, 96*(7), 1201-1209.

Williams, D.M., Anderson, E.S., & Winnet, R.A. (2005). A review of the outcome expectancy construct in physical activity research. *Annals of Behavioural Medicine, 29*(1), 70-79.

Williams, D.M., Lewis, B.A, Dunsiger, S., Whiteley, J.A., Papandonatos, G.D., Napolitano, M.A.,..Marcus, B.H. (2008a). Comparing psychosocial predictors of adoption and maintenance. *Annals of Behavioural Medicine. 36*, 186-194.

Williams, D.M., Matthews, C.E., Rutt, C., Napolitano, M.A., & Marcus, B.H. (2008b). Interventions to increase walking behaviour. *Medicine and Science in Sports and Exercise,* 567-573.

Williams-Piehotta, P.A., McCormack, L.A., Bann, C.M., O'Toole, M., Burton, J., Karns, S.,…Kamerow, D. (2009). Physical activity levels among participants in the Robert Wood Johnson Foundation Diabetes initiative. *Diabetes Spectrum, 22*(3), 170-177.

Wilson, M.G., Basta, T.B., Bynum, B.H., DeJoy, D.M., Vandenberg, R.J., Dishman, R.K. (2009). Do intervention fidelity and dose influence outcomes? Results from the Move to Improve worksite physical activity program. *Health Education Research* (in press).

Winchester, L., Dobbinson, S., Rissel, C., & Bauman, A. (1996). Anonymous record linkage using respondent-generated ID codes – a tool for health promotion research. *Health Promotion Journal of Australia, 6*, 52-54.

Wing, R.R. (2000). Cross-cutting themes in maintenance of behaviour change. *Health Psychology, 19*(1), 84-88.

Winkleby, M.A., Taylor, C.B., Jatulis, D., & Fortmann, S.P. (1996). The long term effects of a cardiovascular disease prevention trial: The Stanford Five-City project. *American Journal of Public Health, 86*(12), 1773-1779.

Women's Mini Marathon (2009). Facts and Figures. Retrieved Online September 28, 2009
http://www.womensminimarathon.ie/race_information/race_information.5.LE.asp

World Cancer Research Fund and American Institute for Cancer Research (2007). *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective*. Washington DC: AICR.

World Health Organisation (1986). *Ottawa Charter for Health Promotion.* Canada: WHO.

World Health Organisation (2004). *Global Strategy on Diet, Physical Activity and Health.* France: WHO.

World Health Organisation (2007). *A Guide for Population Based Approaches to Increasing Levels of Physical Activity: Implementation of the WHO Global Strategy on Diet, Physical Activity and Health.* Switzerland: WHO.

World Health Organisation (2008a). *Review of Best Practice in Interventions to Promote Physical Activity in Developing Countries.* Switzerland: WHO.

World Health Organisation (2008b). *The Global Burden of Disease: 2004 Update*. France: WHO.

World Health Organisation (2009). *Global Health Risks: Mortality and Burden of Disease Attributable to Major Risk Factors.* Switzerland: WHO.

Yu, S., Yarnell, J.W.G., Sweetnam, P.M., & Murray, L. (2003). What level of physical activity protects against premature cardiovascular death? The Caerphilly study. *Heart, 89*, 502-506.

Zaninotto, P., Wardle, H., Stamatakis, E., Mindell, J., & Head, J. (2006). *Forecasting Obesity to 2010.* UK: Join Health Surveys Unit.

Zelen, M. (1990). Randomised consent designs for clinical trials: an update. *Statistics in Medicine, 9*4, 645-656.

Appendix A

Research Question 2 – Baseline Physical Activity Participation

Table 1

Participation in Physical Activity in Previous Seven Days: Baseline Surveys

		Yes (%)	No (%)
Any Vigorous Activity	Dublin 2007 (n=11,205)	49.8	50.2
	Dublin 2008 (n=9,523)	55.1	44.9
	Cork 2008 (n=1,029)	56.2	43.8
Any Moderate Activity	Dublin 2007 (n=11,205)	47.3	52.7
	Dublin 2008 (n=9,523)	51.4	48.6
	Cork 2008 (n=1,029)	47.2	52.8
Any Walking	Dublin 2007 (n=11,205)	96	4
	Dublin 2008 (n=9,523)	96.9	3.1
	Cork 2008 (n=1,029)	92.3	7.7

Table 2

Cross tabulation of IPAQ Category and Duration and Intensity of Physical Activity (n = 11,205: Dublin 2007)

	Vigorous Days/wk (M, SD)	Vigorous Minutes/wk (M, SD)	Moderate Days/wk (M, SD)	Moderate Minutes/wk (M, SD)	Walking Days/wk (M, SD)	Walking Minutes/wk (M, SD)
High Active (n=3,508)	3.4 (1.9)	79.9 (53.4)	2.7 (2.5)	58.8 (61.9)	5.7 (1.8)	81.2 (53.9)
Moderate (n=4,984)	1.1 (1.5)	22.8 (32.2)	1.4 (1.9)	24.5 (37.4)	5.7 (1.6)	53.2 (27.7)
Low Active (n=2,650)	.3 (.9)	7.2 (22.9)	0.6 (1.4)	10.9 (28.5)	3.4 (2.1)	35.7 (32.7)

Table 3

Cross tabulation of IPAQ Category and Duration and Intensity of Physical Activity (n = 9,523: Dublin 2008)

	Vigorous Days/wk (M, SD)	Vigorous Minutes/wk (M, SD)	Moderate Days/wk (M, SD)	Moderate Minutes/wk (M, SD)	Walking Days/wk (M, SD)	Walking Minutes/wk (M, SD)
High Active (n=3,854)	3.5 (2.6)	87.6 (51.1)	3.3 (2.3)	82.5 (59.1)	6 (1.5)	87.3 (67.3)
Moderate (n=3,894)	1.4 (1.4)	35.8 (35.4)	1.6 (1.8)	36 (40)	5.6 (1.9)	55.4 (30.1)
Low Active (n=1,594)	.8 (1.1)	34.7 (45.8)	.5 (1)	20.3 (40.1)	3.1 (1.9)	43.8 (36.9)

Table 4

Cross tabulation of IPAQ Category and Duration and Intensity of Physical Activity (n = 1,029: Cork 2008)

	Vigorous Days/wk (M, SD)	Vigorous Minutes/wk (M, SD)	Moderate Days/wk (M, SD)	Moderate Minutes/wk (M, SD)	Walking Days/wk (M, SD)	Walking Minutes/wk (M, SD)
High Active (n=361)	3.6 (2)	78.7 (51.2)	2.9 (2.7)	60.4 (61.8)	5.9 (1.9)	82.9 (56)
Moderate (n=477)	1.2 (1.5)	24 (31.3)	1.3 (1.8)	21.9 (32.1)	5.7 (1.7)	49.2 (27.8)
Low Active (n=189)	.3 (.8)	12.1 (29.2)	.5 (1.2)	8.2 (25.4)	2.6 (2.3)	27.4 (31)

Table 5

Age Comparison of IPAQ Activity Category (n = 11,205: Dublin 2007)

	High Active (%)	Moderate (%)	Low Active (%)
<30 years old (n=3,479)	30.3	45	24.7
30-50 years old (n=5,346)	31.6	46.3	22.1
>50 years old (n=1,747)	35.3	46	18.7

Table 6

Age Comparison of IPAQ Activity Category (n = 9,523: Dublin 2008)

	High Active (%)	Moderate (%)	Low Active (%)
<30 years old (n=2,656)	41.7	45.1	13.2
30-50 years old (n=4,011)	41.5	44.9	13.6
>50 years old (n=1,426)	43.4	43.6	13

Table 7

Age Comparison of IPAQ Activity Category (n = 1,029: Cork 2008)

	High Active (%)	Moderate (%)	Low Active (%)
<30 years old (n=245)	38	42	20
30-50 years old (n=579)	34.5	46.5	19
>50 years old (n=202)	33.7	52	14.4

Table 8

Duration and Intensity of Physical Activity by Parenthood (n = 11,205: Dublin 2007)

	No Children (n=5,467) (M,SD)	Children (n=5,091) (M,SD)
Vigorous MET-minutes/wk	1036.1 (1652.9)	1023.6 (1638.8)
Moderate MET-minutes/wk	417.9 (793.5)	517.2 (998.3)*
Walking MET-minutes/wk	1039.7 (945.9)	1162.6 (963.7)*
Total MET-minutes/wk	2319.4 (2191.5)	2537.6 (2429.2)*

* $p < 0.05$ No Children v Children

Table 9

Duration and Intensity of Physical Activity by Parenthood (n = 9,253: Dublin 2008)

	No Children (n=4,155) (M,SD)	Children (n=4,048) (M,SD)
Vigorous MET-minutes/wk	1429.8 (1596)	1419.9 (1878.4)
Moderate MET-minutes/wk	709.1 (964.9)	794.4 (1131.3)*
Walking MET-minutes/wk	1224.8 (1011.8)	1344.9 (1182.1)*
Total MET-minutes/wk	3051.3 (2490.9)	3227.3 (2857.5)*

* $p < 0.05$ No Children v Children

Table 10

Sedentary Behaviour and BMI at Short Term Follow Up by Parenthood

		Sitting Minutes/day (M, SD)	TV Minutes/day (M,SD)	BMI (M, SD)
No Children	Dublin (n=4,155)	350.1 (169.5)	107.3 (72.9)	23.6 (4.1)
	Cork (n=431)	327.2 (164.9)	105.9 (74.7)	23.5 (3.9)
Children	Dublin (n=4,048)	233.8 (147.9)*	104.2 (74.5)	25.2 (4.2)*
	Cork (n=588)	206.9 (130.8)*	102.9 (70.2)	24.6 (3.8)*

* $p < 0.05$ No Children v Children

Table 11

Sedentary Behaviour and BMI at Short Term Follow Up by Level of Education

		Sitting Minutes/day (M, SD)	TV Minutes/day (M,SD)	BMI (M, SD)
No Tertiary Education	Dublin (n=3,099)	240.4 (154.8)	116.6 (80.6)	24.9 (4.5)
	Cork (n=327)	209.3 (139.6)	122.8 (80.9)	24.7 (4.1)
Tertiary Education	Dublin (n=5,129)	316.4 (174.4)*	99.2 (67.4)*	24.1 (4)*
	Cork (n=624)	275.4 (161.5)*	94.9 (65.7)*	23.9 (3.6)*

* $p < 0.05$ No Tertiary v Tertiary

Table 12

Sedentary Behaviour and BMI at Short Term Follow Up by Age

		Sitting Minutes/day (M, SD)	TV Minutes/day (M,SD)	BMI (M, SD)
<30	Dublin (n=2,656)	346.7 (170.3)	106 (67.1)	23.3 (4)
	Cork (n=245)	322.4 (152.4)	108.9 (65.2)	23.1 (3.8)
30-50	Dublin (n=4,011)	271.1 (169.6)	103.1 (74.8)	24.8 (4.2)
	Cork (n=579)	244.2 (159.2)	95.1 (71.6)	24.4 (3.9)
>50	Dublin (n=1,426)	219.5(141.1)* †‡	112.8 (77.8) †‡	25.3 (3.9)* †‡
	Cork (n=202)	219.8 (136.7)* ‡	125.4 (77.3)* †	24.9 (3.7)* ‡

* p < 0.05 <30 v 30-50, † p < 0.05 30-50 v >50, ‡ p < 0.05 <30 v >50

Research Question 3 – Self Efficacy of Participants

Table 13

Confidence in Ability to be Active when family demands a lot of time - % Agree: Baseline Surveys

	Dublin 2007 n=11,205 (%)	Dublin 2008 n=9,523 (%)	Cork 2008 n=1,029 (%)
High Active	66	74	78
Moderate	65	62	65
Low Active	55	49	45

Table 14

Confidence in Ability to be Active when tired - % Agree: Baseline Surveys

	Dublin 2008 n=9,523 (%)	Cork 2008 n=1,029 (%)
High Active	66	71
Moderate	55	64
Low Active	40	41

Research Question 4 – Self Reported v Self Perceived Levels of Physical Activity

Table 15

Self Reported v Self Perceived Levels of Physical Activity (n = 9,523: Dublin 2008)

	I am not regularly physically active and do not intend to be so in the next 6 months (%)	I am not regularly physically active but am thinking about starting to do so in the next 6 months (%)	I do some physical activity but not enough to meet the description of regular physical activity (%)	I am regularly physically active but only began in the last 6 months (%)	I am regularly physically active and have been so for longer than 6 months (%)
High Active (n=3,854)	4.2	16.5	43.3	12.6	23
Moderate (n=3,894)	1	4.9	27.7	18	48.4
Low Active (n=1,594)	0.6	2.2	14.5	17.3	65.3

Table 16

Self Reported v Self Perceived Levels of Physical Activity (n = 1,029: Cork 2008)

	I am not regularly physically active and do not intend to be so in the next 6 months (%)	I am not regularly physically active but am thinking about starting to do so in the next 6 months (%)	I do some physical activity but not enough to meet the description of regular physical activity (%)	I am regularly physically active but only began in the last 6 months (%)	I am regularly physically active and have been so for longer than 6 months (%)
High Active (n=361)	3.7	19.8	38	11.8	26.7
Moderate (n=477)	0.6	4.2	24.2	14.7	56
Low Active (n=189)	0.8	1.7	10	12.5	75

Intercept Interview Results

Table 17

Participation in Physical Activity in Previous Seven Days in Intercept Interview Sample (n = 414: Dublin 2007) compared with Baseline Sample (n = 11,205: Dublin 2007)

	Intercept Interview Yes (%)	Total Baseline Yes (%)	Intercept Interview No (%)	Total Baseline No (%)
Any Vigorous Activity	32	50	68	50
Any Moderate Activity	49	47	51	53
Any Walking	93	96	7	4

Table 18

Participation in Physical Activity in Previous Seven Days in Intercept Interview Sample (n = 300: Dublin 2008) compared with Baseline Sample (n = 9,523: Dublin 2008)

	Intercept Interview Yes (%)	Total Baseline Yes (%)	Intercept Interview No (%)	Total Baseline No (%)
Any Vigorous Activity	39.9	55.1	60.1	44.9
Any Moderate Activity	52.3	51.4	47.7	48.6
Any Walking	87.6	96.9	12.4	3.1

Appendix B

Table 1

Target Population at Short Term Follow Up

	Total Target Population (n)	Undelivered Mail (n)	Undelivered Email (n)	Adjusted Target Population (n)
2007 Dublin	9,686	28	723	8,935
2008 Dublin	8,644	10	16	8,618
2008 Cork	955	-	-	-

Table 2

Target Population at Long Term Follow Up

	Total Target Population (n)	Undelivered Mail (n)	Undelivered Email (n)	Adjusted Target Population (n)
2007 Dublin	7,490	7	530	6,953

Research Question 2a – Changes in Physical Activity between Baseline, Short and Long Term Follow Up

Table 3

Participation in Physical Activity in Previous Seven Days: Matched Analysis (n = 2,020: Dublin 2007)

	Yes (%)			No (%)		
	Baseline	Short Term	Long Term	Baseline	Short Term	Long Term
Any Vigorous Activity	56	59	46	44	41	54
Any Moderate Activity	52	88	77	48	12	23
Any Walking	97	96	93	3	4	7

Table 4

Change in Duration and Intensity of Physical Activity by Level of Education between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020: Dublin 2007)

	No Tertiary Education n=339 (M,SD)			Tertiary Education n=1,142 (M,SD)			
	Baseline	Long Term	Change in PA	Baseline	Long Term	Change in PA	p-value
Vigorous MET-minutes/wk	1219.5 (1953.7)	947.7 (1775.4)	-280.6 (2465.9)	1196.7 (1928.5)	1169 (1713)	-52.7 (2474.4)	.152
Moderate MET-minutes/wk	544.4 (1148.4)	1086.4 (1287.4)	553.5 (1375.9)	454.7 (987)	886.5 (993.7)	403.9 (1214.7)	.104
Walking MET-minutes/wk	1354.7 (1490.4)	1012 (974.1)	-294.1 (1451.3)	1052.8 (1339)	810.4 (819.7)	-242.1 (1268.1)	.594
Total MET-minutes/wk	2894.2 (2939.5)	2799.8 (2978.3)	-101.7 (3549.2)	2559.5 (2694.6)	2744.1 (2580.8)	161.1 (3272.6)	.208

* $p < 0.05$ Change in MET-minutes/wk No Tertiary v Tertiary

Table 5

Change in Duration and Intensity of Physical Activity between Baseline and Long Term Follow Up by Demographic and Event Characteristics: Matched Analysis (n = 2,020: Dublin 2007)

	Change in Vigorous MET-minutes/wk	Change in Moderate MET-minutes/wk	Change in Walking MET-minutes/wk	Change in Total MET-minutes/wk
Married (n = 829)	-182.1(2533.2)	467.9(1236.7)	-264.4(1247.9)	43.8(3269.3)
Single (n = 637)	-27.6(2451.1)	382.6(1264.4)	-241.6(1380.3)	135.3(3449.2)
Urban (n=1,054)	-141.4(2446.5)	426.6(1233.4)	-248(1366)	68.7(3340)
Rural (n=103)	15.3(2564.9)	463.5(1314.5)	-258.3(1149.6)	222.8(3340)
Repeat Event (n=362)	670.6(2791.4)	402.6(1239.3)	-47.8(1095.9)	966.9(3511.1)
No Repeat Event (n=1,118)	-361.8(2327.3)*	441.1(1257.3)	-316.9(1360.6)*	-169.4(3244.5)*
First Time Participant (n=539)	-146.2(2372.7)	431.5(1164.6)	-298.4(1477.5)	48.2(3311.2)
Repeat Participant (n=931)	-87(2558.9)	435.4(1300.4)	-225.3(1194.6)	121.5(3366.5)
Walk (n=1,009)	-259.7(2274.1)	442.9(1326.5)	-301.4(1306.4)	-93.1(3239.8)
Run/Jog (n=461)	218.1(2881.5)*	413.7(1068.3)	-143(1296.7)*	505.6(3534.6)*
Train Continuously (n=941)	-74.1(2277.3)	457.3(1293.8)	-266(1253.2)	116.8(3176.2)
Do NotTrain/Irregularly(n=470)	-269.2(2869.2)	413(1153.3)	-240.4(1345.6)	30.9(3565.4)

* $p < 0.05$ Change in MET-minutes/wk Urban v Rural, Repeat Event v No Repeat Event, First Time v Repeat Participant, Walk v Run/Jog, Train Continuously/Do Not Train/ Irregularly

Changes in Physical Activity between Baseline and Short Term Follow Up

Table 6

Participation in Physical Activity in Previous Seven Days: Matched Analysis (n = 3,803: Dublin 2007)

	Yes (%)		No (%)	
	Baseline	Follow Up	Baseline	Follow Up
Any Vigorous Activity	53	53.8	47	46.2
Any Moderate Activity	50.3	77.6	49.7	22.4
Any Walking	96.4	95.8	3.6	4.2

Table 7

Participation in Physical Activity in Previous Seven Days: Matched Analysis (n = 3,505: Dublin 2008)

	Yes (%)		No (%)	
	Baseline	Follow Up	Baseline	Follow Up
Any Vigorous Activity	58.6	59.8	41.4	40.2
Any Moderate Activity	54	82.9	46	17.1
Any Walking	97	93.4	3	6.6

Table 8

Participation in Physical Activity in Previous Seven Days: Matched Analysis (n = 348: Cork 2008)

	Yes (%)		No (%)	
	Baseline	Follow Up	Baseline	Follow Up
Any Vigorous Activity	60.9	55	39.1	45
Any Moderate Activity	51.9	75.8	48.1	24.2
Any Walking	93.1	93.2	6.9	6.8

Table 9

Change in Duration and Intensity of Physical Activity by Age: Matched Analysis (n = 3,803: Dublin 2007)

	<30 years (n=1,244) (M,SD)			30-50 years (n=1,962) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1102.4 (1822.5)	1083.6 (1506.9)	-18.7 (2325.3)	1172.9 (1949.5)	1089.4 (1524.9)	-69.6 (2249.2)	.554
Moderate MET-minutes/wk	445.1 (972.5)	775.8 (891.3)	313.1 (1169.5)	496.1 (1096.2)	835.8 (963.3)	344.7 (1237.3)	.515
Walking MET-minutes/wk	1043.9 (1232.6)	930.2 (918.6)	-129.8 (1263)	1106.9 (1293.3)	914.1 (880.6)	-215.5 (1288.7)	.103
Total MET-minutes/wk	2420.5 (2509.7)	2583.5 (2379.6)	159.3 (3084)	2621.2 (2832.9)	2639 (2398.7)	31.7 (3080.2)	.261

* $p < 0.05$ Change in MET-minutes/wk <30 years v 30-50 years

Table 10

Change in Duration and Intensity of Physical Activity by Age: Matched Analysis (n = 3,505: Dublin 2008)

	<30 years (n=1,244) (M,SD)			30-50 years (n=1,962) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1515.5 (1519.9)	1300.5 (1571.1)	-160.8 (1681.8)	1498.9 (1645.2)	1289.6 (1632.3)	-201.8 (1806.2)	.580
Moderate MET-minutes/wk	694.7 (876.4)	880.4 (981.5)	227.6 (1168)	749.9 (1040.3)	936.6 (1075.2)	219.3 (1268.9)	.882
Walking MET-minutes/wk	1189.5 (1002.8)	962.9 (1014.2)	-220.7 (1101.3)	1168.4 (954.3)	935.3 (952.8)	-230.4 (1051.9)	.831
Total MET-minutes/wk	3093.9 (2355.9)	3066.9 (2593.4)	-6.9 (2545.6)	3097.2 (2511)	3043.5 (2714.8)	-84 (2730.5)	.471

* $p < 0.05$ Change in MET-minutes/wk <30 years v 30-50 years

Table 11

Change in Duration and Intensity of Physical Activity by Parenthood: Matched Analysis (n = 3,505: Dublin 2008)

	No Children (n=1,711) (M,SD)			Children (n=1,639) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1546.1 (1593.9)	1315.6 (1607.3)	-188.9 (1748.1)	1449.8 (1799.9)	1256.6 (1683.9)	-184.8 (1940.4)	.952
Moderate MET-minutes/wk	723.2 (953.4)	916.2 (1010.9)	237.8 (1175.7)	802.2 (1133.7)	994.3 (1135.8)	211.3 (1356.3)	.606
Walking MET-minutes/wk	1174 (972.1)	975.4 (991.3)	-186.9 (1093)	1297.2 (1020.2)	1010.7 (1001.7)	-282.1 (1079.2)*	.018
Total MET-minutes/wk	3120.1 (2450.5)	3118.7 (2643.3)	12.1 (2634.6)	3213.3 (2682.9)	3106.6 (2824.4)	-138.6 (2901.6)	.122

* $p < 0.05$ Change in MET-minutes/wk No children v Children

Table 12

Change in Duration and Intensity of Physical Activity by Parenthood: Matched Analysis (n = 348: Cork 2008)

	No Children (n=149) (M,SD)			Children (n=199) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1393.1 (1667.9)	1251.9 (1612.5)	-93.9 (1536.4)	1017.5 (1525.2)	1061.5 (1673.5)	32.1 (1931.2)	.532
Moderate MET-minutes/wk	503.8 (921.8)	815.6 (1015.2)	297 (1377.2)	570.6 (1073.1)	775.9 (969.5)	226.3 (1294.5)	.647
Walking MET-minutes/wk	880.4 (831.1)	769.4 (783.9)	-126.2 (933.1)	1081.5 (1040.2)	910.1 (997.3)	-179.6 (1244.6)	.675
Total MET-minutes/wk	2698.4 (2410.6)	2661.2 (2506.1)	54 (2562.4)	2591.3 (2588.7)	2634.8 (2655.3)	53.4 (3008.7)	.999

* $p < 0.05$ Change in MET-minutes/wk No children v Children

Table 13

Change in Duration and Intensity of Physical Activity by Level of Education: Matched Analysis (n = 3,803: Dublin 2007)

	No Tertiary Education (n=1,123) (M,SD)			Tertiary Education (n=2,163) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1129.9 (1939.1)	1185.1 (1855.8)	49.9 (2459.9)	1149.4 (1933.7)	1053.9 (1465.9)	-81.9 (2304.7)	.132
Moderate MET-minutes/wk	523.2 (1069.3)	917.7 (1107.5)	371.8 (1401.8)	491.5 (1096.5)	806.2 (896.6)	319.2 (1179.8)	.320
Walking MET-minutes/wk	1294.1 (1281.9)	1139.4 (1022.5)	-175.6 (1255.8)	1053.2 (1233.5)	905.8 (884.9)	-172.4 (1268.5)	.951
Total MET-minutes/wk	2755 (2832.7)	2971.7 (2895.7)	201.9 (3330.9)	2538.7 (2738.6)	2578.1 (2287.3)	52.6 (3072.2)	.206

* $p < 0.05$ Change in MET-minutes/wk No Tertiary v Tertiary

Table 14

Duration and Intensity of Physical Activity by Level of Education at Short Term Follow Up: Matched Analysis (n = 348: Cork 2008)

	No Tertiary Education (n=88) (M,SD)			Tertiary Education (n=237) (M,SD)			
Type of PA	Baseline	Short Term	Change in PA	Baseline	Short Term	Change in PA	p-value
Vigorous MET-minutes/wk	1037.6 (1627.1)	1207.1 (1766.9)	148.6 (1658.9)	1232 (1616.8)	1125 (1601.9)	-74.1 (1845.3)	.348
Moderate MET-minutes/wk	673.3 (1262.6)	758.4 (1023.6)	103.8 (1558.3)	474.7 (856.8)	771.5 (972.3)	300.5 (1212.1)	.262
Walking MET-minutes/wk	1196.8 (1984.1)	956.9 (997.3)	-208.5 (1262.8)	913.6 (897.3)	813.2 (899.7)	-129.2 (1075.3)	.593
Total MET-minutes/wk	2709.4 (2814.5)	2770.6 (2695.3)	81.3 (2845.4)	2574.1 (2452.9)	2578.5 (2559.9)	62.1 (2868.4)	.957

* $p < 0.05$ Change in MET-minutes/wk No Tertiary v Tertiary

Table 15

Change in Duration and Intensity of Physical Activity between Baseline and Short Term Follow Up by Demographic and Event Characteristics: Matched Analysis (n =3,803: Dublin 2007)

	Change in Vigorous MET-minutes/wk	Change in Moderate MET-minutes/wk	Change in Walking MET-minutes/wk	Change in Total MET-minutes/wk
Married(n=2,080)	-17(2316.6)	356.1(1269.5)	-185.8(1166.3)	127.9(3089.6)
Not Married(n=1,541)	-71.1(2405.2)	304.7(1226.4)	-153.9(1386.4)	58.5(3236.9)
Urban(n=2,504)	-39.9(2375)	352.4(1223.2)	-154.7(1307.7)-	145.1(3107.7)
Rural (n=1,111)	-47.1(2303.5)	282.9(1304)	212.4(1163.2)	-12.7(3243.8)
First Time Participant (n=1,337)	-102.1(3272.7)	377.3(1162.8)	-201.4(1287.7)	73.7(3121.8)
Repeat Participant (n=2,310)	.54(2350.8)	311.7(1391.9)	-154.5(1209.4)	122.8(3177.4)
Walk (n=2,671)	-112.1(2274.7)	350.5(1280.4)	-206.1(1232.8)	-7.4(3069.8)
Run/Jog (n=975)	165(2564.8)*	294.4(1148.8)	-78.6(1341.4)*	411(3367.5)*
Train Continuously (n=3,038)	-46.6(2346.3)	334.4(1254.4)	-188.1(1244.2)	87.8(3172.9)
Do Not Train/ Irregularly (n=484)	-90.2(2404.6)	348.7(1137.9)	-100.8(1362.7)	180.5(3015.3)

$p < 0.05$ Change in MET-minutes/wk Urban v Rural, First Time v Repeat Participant, Walk v Run/Jog, Train Continuously/Do Not Train/Train Irregularly

Table 16

Change in Duration and Intensity of Physical Activity between Baseline and Short Term Follow Up by Demographic and Event Characteristics: Matched Analysis (n =3,505: Dublin 2008)

	Change in Vigorous MET-minutes/wk	Change in Moderate MET-minutes/wk	Change in Walking MET-minutes/wk	Change in Total MET-minutes/wk
Married (n=1,919)	-197.2(1850.9)	246.4(1284.1)	-269.3(1063.3)	-99.7(2787.7)
Not Married (n=1,316)	-172.4(1835.9)	193.5(1244.4)	-181.5(1118.8)*	-8.1(2745.1)
Urban (n=2,229)	-136.6(1747.7)	237.6(1245)	-212.1(1087.4)	38.2(2661.2)
Rural (n=972)	-312.4(2037.5)*	183.1(1323.7)	-287.7(1068.5)	-322(2982.7)*
First Time Participant (n=1,291)	-147.5(1681.3)	252.9(1156.9)	-217.9(1074.9)	57.6(2637.9)
Repeat Participant (n=2,062	-219.5(1934.5)	196.6(1329.3)	-252.3(1095.9)	-114.4(2832.6)
Walk (n=2,397)	-209.9(1909.8)	247.4(1311.5)	-288.8(1114.4)	-99.5(2861.4)
Run/Jog (n=947)	-141.9(1656.7)	153.2(1135.4)	-105.9(1006.9)*	102.7(2474.8)*
Train Continuously(n=2,018)	-184.3(1881.5)	216(1235.5)	-259.9(1070.9)	-53.5(2781.3)
Do Not Train/ Irregularly (n=1,321)	-199.9(1772.3)	224.4(1313.3)	-206.7(1108.8)	-29.2(2699.7)

$p < 0.05$ Change in MET-minutes/wk Urban v Rural, First Time v Repeat Participant, Walk v Run/Jog, Train Continuously/Do Not Train/Train Irregularly

Table 17

Change in Duration and Intensity of Physical Activity between Baseline and Short Term Follow Up by Demographic and Event Characteristics: Matched Analysis (n =348: Cork 2008)

	Change in Vigorous MET-minutes/wk	Change in Moderate MET-minutes/wk	Change in Walking MET-minutes/wk	Change in Total MET-minutes/wk
Married (n=215)	100.8(1941)	277.2(1416.6)	-138.8(1259.3)	212.1(3055.9)
Not Married (n=216)	-223(1438.6)	218.9(1165.5)	-189.7(841.1)	-216.7(2362.3)
Urban (n=218)	-37.6(1803.4)	308.5(1263.6)	-105.4(1109.4)	121.1(2863.8)
Rural (n=122)	-.85(1545.5)	158.9(1438.9)	-240.4(1148.3)	-61.4(2769.3)
First Time Participant (n=140)	-32.1(1587.7)	400.2(1202.4)	-192.5(1013.5)	175.4(2525.8)
Repeat Participant (n=201)	-14(1894.4)	157.2(1401.4)	-132.4(1197.8)	-31.1(3016.9)
Walk (n=235)	66.9(1836)	305.4(1399.1)	-206.3(1193.7)	126.2(2846.1)
Run/Jog (n=106)	-211.1(1621.2)	140(1143.4)	-44.1(938.8)	-107.1(2779.5)
Train Continuously (n=161)	-128.1(1730.1)	117.5(1221.2)	-192.6(1089.2)	-144.4(2803.1)
Do Not Train/Irregularly (n=173)	132.5(1806.2)	384.9(1431.1)	-140.9(1172.8)	277.6(2837.4)

$p < 0.05$ Change in MET-minutes/wk Urban v Rural, First Time v Repeat Participant, Walk v Run/Jog, Train Continuously/Do Not Train/Train Irregularly

Research Question 2b – Change in proportion deemed sufficient/insufficiently active

Baseline and Long Term Follow Up

Table 18

Age Comparison of Change in IPAQ Activity Category between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020, Dublin 2007)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
<30 years old (n=520)	30.8	37.7	69.2	62.3*
30-50 years old (n=788)	31.9	35.8	68.1	64.2
>50 years old (n=180)	45.6	44.9	54.4	55.1

* $p < 0.05$ Change in IPAQ Category <30, † $p < 0.05$ Change in IPAQ Category 30-50, ‡ $p < 0.05$ Change in IPAQ Category >50

Table 19

Change in IPAQ Category by Level of Education between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Tertiary Education (n=332)	35.7	36.1	64.3	63.9
Tertiary Education (n=1,131)	32.3	37.9	67.7	62.1†

* $p < 0.05$ Change in IPAQ category No Tertiary, † $p < 0.05$ Change in IPAQ Category Tertiary

Table 20

Change in IPAQ Category by Parenthood between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Children (n=846)	31.5	38.8	68.5	61.2*
Children (n=620)	35.7	36	64.3	64

* $p < 0.05$ Change in IPAQ Category No Children, † $p < 0.05$ Change in IPAQ Category Children

Table 21

Change in IPAQ Category by Repeat Event Participation between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
Yes Repeat Event (n=472)	32.6	58.1	67.4	41.9*
No Repeat Event (n=1,569)	33.5	31	66.8	69

* $p < 0.05$ Change in IPAQ Category Yes Repeat Event, † $p < 0.05$ Change in IPAQ Category No Repeat Event

Table 22

Change in IPAQ Category by Demographic and Event Characteristics between Baseline and Long Term Follow Up: Matched Analysis (n = 2,020)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
Married (n=829)	33.7	36.3	66.3	63.7
Single (n=637)	32.8	39.2	67.2	60.8*
Urban (n=1,056)	34	38.4	66	61.6*
Rural (n=405)	30.3	35.6	69.7	64.4
First Time Participant (n=540)	33.8	35.4	66.2	64.6
Repeat Participant (n=934)	32.6	38.8	67.4	61.2*
Walk (n=1,012)	32.5	32.3	67.5	67.7
Run/Jog (n=462)	34.4	48.9	65.6	51.1*
Train Continuously (n=942)	34	38.9	66	61.1*
Do Not Train/Irregularly (n=473)	31.2	34.7	68.8	65.3

* $p < 0.05$ Change in IPAQ Category Single, Urban, Repeat Participant, Run/Jog, Train

Baseline and Short Term Follow Up

Table 23

Age Comparison of Change in IPAQ Activity Category between Baseline and Short Term Follow Up: Matched Analysis (n = 3,803, Dublin 2007)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
<30 years old (n=1,244)	28.9	32.9	71.1	67.1*
30-50 years old (n=1,962)	32.1	35.2	67.9	64.8 †
>50 years old (n=943)	39	40.2	61	59.8

* $p < 0.05$ Change in IPAQ Category <30, † $p < 0.05$ Change in IPAQ Category 30-50, ‡ $p < 0.05$ Change in IPAQ Category >50

Table 24

Age Comparison of Change in IPAQ Activity Category between Baseline and Short Term Follow Up: Matched Analysis (n = 3,505: Dublin 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
<30 years old (n=987)	43.9	40.5	56.1	59.5
30-50 years old (n=1,683)	42.5	42.1	57.5	57.9
>50 years old (n=538)	44.3	46.1	55.7	53.9

* $p < 0.05$ Change in IPAQ Category <30 and 30-50, † $p < 0.05$ Change in IPAQ Category 30-50 and >50, ‡ $p < 0.05$ Change in IPAQ Category <30 and >50

Table 25

Age Comparison of Change in IPAQ Activity Category between Baseline and Short Term Follow Up: Matched Analysis (n = 348: Cork 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
<30 years old (n=88)	45.5	35.7	54.5	64.3
30-50 years old (n=193)	26.4	31.6	73.6	68.4
>50 years old (n=66)	36.4	37.9	63.6	62.1

* $p < 0.05$ Change in IPAQ Category <30 and 30-50, † $p < 0.05$ Change in IPAQ Category 30-50 and >50, ‡ $p < 0.05$ Change in IPAQ Category <30 and >50

Table 26

Change in IPAQ Category by Level of Education between Baseline and Short Term Follow Up: Matched Analysis (n = 3,803: Dublin 2007)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Tertiary Education (n=1,096)	34.4	38.4	65.6	61.6
Tertiary Education (n=2,541)	30.9	33.7	69.1	66.3†

* $p < 0.05$ Change in IPAQ category No Tertiary, † $p < 0.05$ Change in IPAQ Category Tertiary

Table 27

Change in IPAQ Category by Level of Education between Baseline and Short Term Follow Up: Matched Analysis (n = 3,505: Dublin 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Tertiary Education (n=1,066)	45.7	43.7	54.3	56.3
Tertiary Education (n=2,199)	42.1	41.7	57.9	58.3

* $p < 0.05$ Change in IPAQ category No Tertiary, † $p < 0.05$ Change in IPAQ Category Tertiary

Table 28

Change in IPAQ Category by Level of Education between Baseline and Short Term Follow Up: Matched Analysis (n = 346: Cork 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Tertiary Education (n=87)	35.2	36.8	64.8	63.2
Tertiary Education (n=234)	31.4	32.5	68.6	67.5

* $p < 0.05$ Change in IPAQ category No Tertiary, † $p < 0.05$ Change in IPAQ Category Tertiary

Table 29

Change in IPAQ Category by Parenthood between Baseline and Short Term Follow Up: Matched Analysis (n = 3,803: Dublin 2007)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Children (n=1,920)	30.1	35.2	69.9	64.8*
Children (n=1,716)	34.2	31.4	65.8	68.6

* $p < 0.05$ Change in IPAQ Category No Children, † $p < 0.05$ Change in IPAQ Category Children

Table 30

Change in IPAQ Category by Parenthood between Baseline and Short Term Follow Up: Matched Analysis (n = 3,505: Dublin 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Children (n=1,640)	42.9	42	57.1	58
Children (n=1,612)	43.9	42.9	56.1	57.1

* p < 0.05 Change in IPAQ Category No Children, † p < 0.05 Change in IPAQ Category Children

Table 31

Change in IPAQ Category by Parenthood between Baseline and Short Term Follow Up: Matched Analysis (n = 346: Cork 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
No Children (n=145)	37.6	35.2	62.4	64.8
Children (n=198)	29.8	32.8	70.2	67.2

* p < 0.05 Change in IPAQ Category No Children, † p < 0.05 Change in IPAQ Category Children

Table 32

Change in IPAQ Category by Demographic and Event Characteristics between Baseline and Long Term Follow Up: Matched Analysis (n = 3,803: Dublin 2007)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
Married (n=2,086)	32.5	35.8	67.5	64.2*
Single (n=1,550)	31.4	34.1	68.6	65.9
Urban (n=2,513)	31.9	36.2	68.1	63.88
Rural (n=1,116)	31.8	32.3	68.2	67.7
First Time Participant (n=1,340)	29.6	32.2	70.4	67.8
Repeat Participant (n=2,322)	33.2	37	66.8	63*
Walk (n=2,683)	30.8	31.4	69.2	68.6
Run/Jog (n=978)	34.9	45.5	65.1	54.5*
Train Continuously (n=3,049)	32.7	35.9	67.3	64.1*
Do Not Train/ Irregularly (n=488)	27.7	29.7	72.3	70.3

* p < 0.05 Change in IPAQ category Married, Urban, Repeat Participant, Run/Jog, Train

Table 33

Change in IPAQ Category by Demographic and Event Characteristics between Baseline and Long Term Follow Up: Matched Analysis (n = 3,505: Dublin 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
Married (n=1,933)	42	40.7	58	59.3
Single (n=1,319)	45.4	45	54.6	55
Urban (n=2,239)	42.5	42.6	57.5	57.4
Rural (n=981)	44.7	41.5	55.3	58.5*
First Time Participant (n=1,304)	39.6	40.2	60.4	59.8
Repeat Participant (n=2,091)	45.4	44	54.6	56
Walk (n=2,425)	40.2	39.5	59.8	60.5
Run/Jog (n=960)	50.5	50.1	49.5	49.9
Train Continuously (n=2,036)	50.1	48.5	49.9	51.5
Do Not Train/Irregularly(n=1,343)	32.8	33.5	67.2	66.5

* $p < 0.05$ Change in IPAQ Category Rural

Table 34

Change in IPAQ Category by Demographic and Event Characteristics between Baseline and Long Term Follow Up: Matched Analysis (n = 346: Cork 2008)

	Sufficiently Active (%)		Insufficiently Active (%)	
	Baseline	Follow Up	Baseline	Follow Up
Married (n=216)	31.5	36.6	68.5	63.4
Single (n=127)	35.9	29.1	64.1	70.9
Urban (n=219)	33.5	34.2	66.5	65.8
Rural (n=123)	32.8	33.3	67.2	66.7
First Time Participant (n=141)	28.1	31.2	71.9	68.8
Repeat Participant (n=202)	36.8	35.6	63.2	64.4
Walk (n=236)	29.8	30.1	70.2	69.9
Run/Jog (n=107)	40.4	42.1	59.6	57.9
Train Continuously (n=163)	44.8	41.7	55.2	58.3
Do Not Train/Irregularly (n=173)	21.1	26.6	78.9	73.4

* $p < 0.05$ Change in IPAQ Category

Research Question 2c – Change in Sedentary Behaviour

Table 35

Change in Sedentary Behaviour between Baseline and Short Term Follow Up by IPAQ Category: Matched Analysis (n=3,505; Dublin 2008, n=348; Cork 2008)

		Sitting Minutes/day		TV Minutes/Day	
		Baseline (M, SD)	Follow Up (M, SD)	Baseline (M, SD)	Follow Up (M, SD)
High Active	2008 D	163.8	176.9	112.3	120.6
	(n=243)	(102.4)	(104.5)	(67.6)	(75.3)*
	2008 C	241.5	265.3	98.7	116.9
	(n=103)	(140.2)	(141.6)*	(61.3)	(64.6)*
Moderate	2008 D	205.1	235.2	110.2	116.8
	(n=208)	(131.1)	(142)*	(67.5)	(66)*
	2008 C	263.5	270.3	108.6	118.4
	(n=154)	(148.9)	(151.3)	(78.5)	(61.4)*
Low Active	2008 D	197.1	223.6	108.9	113.8
	(n=51)	(143.5)	(109.3)	(90.6)	(82.1)
	2008 C	293.5	301.7	103.7	124.5
	(n=61)	(175.6)	(179.6)	(60.7)	(24.2)*

* $p < 0.05$ Change in Sitting/TV Low/Moderate/High Active Baseline to Follow Up

Table 36

Change in Sedentary Behaviour Per Day between Baseline and Short Term Follow Up by Age: Matched Analysis (n=3,505; Dublin 2008, n=348; Cork 2008)

		Sitting Minutes/day		TV Minutes/Day	
		Baseline (M, SD)	Follow Up (M, SD)	Baseline (M, SD)	Follow Up (M, SD)
<30	2008 D	279.3	278.6	111.9	110.9
	(n=42)	(150.6)	(175.7)	(68.1)	(73.6)
	2008 C	309.8	333.9	105	125.5
	(n=81)	(145.2)	(144.7)*	(60.8)	(67.4)*
30-50	2008 D	172.9	199.2	105.2	111.4
	(n=265)	(114.9)	(131.9)*	(67.1)	(67.9)
	2008 C	243.4	254.1	96.4	107.9
	(n=180)	(160.8)	(158.1)	(71.5)	(57.2)
>50	2008 D	178.6	201.9	120.4	129.9
	(n=197)	(112.3)	(115.8)*	(74)	(76.3)*
	2008 C	252.5	255.8	129.3	145.9
	(n=60)	(120.4)	(134.5)	(71.8)	(75.7)*

* $p < 0.05$ Change in Sitting/TV <30/30-50/>50 Baseline to Follow Up

Table 37

Change in Sedentary Behaviour Per Day between Baseline and Short Term Follow Up by Parenthood: Matched Analysis (n=3,505; Dublin 2008, n=348; Cork 2008)

		Sitting Minutes/day		TV Minutes/day	
		Baseline (M, SD)	Follow Up (M, SD)	Baseline (M, SD)	Follow Up (M, SD)
No Children	2008 D	265.1	253.6	116.7	118.2
	(n=120)	(138.5)	(158.4)	(67.9)	(71.7)
	2008 C	318.4	333.3	101.9	113.9
	(n=134)	(159.1)	(151.1)	(79.1)	(64.8)*
Children	2008 D	167.5	189.9	108.6	117.4
	(n=374)	(108.4)	(115.4)*	(68.5)	(71.7)*
	2008 C	220.1	231.3	106.3	122.7
	(n=185)	(132.8)	(141.8)	(62.9)	(64.9)*

* $p < 0.05$ Change in Sitting/TV Children/No Children Baseline to Follow Up

Table 38

Change in Sedentary Behaviour Per Day between Baseline and Short Term Follow Up by Level of Education: Matched Analysis (n=3,505; Dublin 2008, n=348; Cork 2008)

		Sitting Minutes/day		TV Minutes/day	
		Baseline (M, SD)	Follow Up (M, SD)	Baseline (M, SD)	Follow Up (M, SD)
No Tertiary	2008 D	176.9	201.3	117.3	121.3
	(n=350)	(118)	(129.7)*	(72.6)	(71.4)
	2008 C	226.9	233.7	119.2	135.7
	(n=81)	(146.9)	(140.8)	(66.6)	(72.6)*
Tertiary	2008 D	199.5	215.1	100	111.9
	(n=169)	(124.9)	(136)*	(63.8)	(73.3)*
	2008 C	270.4	281.8	97.5	110.9
	(n=218)	(152.6)	(157.8)	(69.5)	(57.8)*

* $p < 0.05$ Change in Sitting/TV No Tertiary/Tertiary Education Baseline to Follow Up

Research Question 2d – Proportion that Increased, Decreased or Maintained their PA Levels

Table 39

Characteristics of Increasers, Decreasers and Maintainers at Short Term Follow Up: Matched Analysis (n=348; Cork 2008)

		Increasers (n=146)	Maintainers (n=45)	Decreasers (n=150)
Age	<30	26.7	15.6	24.7
	30-50	54.8	73.3	52.7
	>50	18.5	11.1	22.7
Children	No Children	41.1	51.1	41.3
	Children	58.9	48.9	58.7
Education	No Tertiary	27.9	26.2	27
	Tertiary	72.1	73.8	73
Live	Urban	63	57.8	67.1
	Rural	37	42.2	32.9
Marital Status	Married	63	62.2	63.3
	Single	37	37.8	36.7
Previous Participation	First Time	41.8	48.9	38
	Repeat	58.2	51.1	62
Mode of Participation	Walk	67.8	66.7	70.7
	Run/Jog	32.2	33.3	29.3
Training	Do not train/week or two	49.3	40.9	49.3
	Train Continuously	50.7	59.1	50.7

* $p < 0.05$ Increasers v Maintainers v Decreasers

Table 40

Perception of Status of Activity at Short Term Follow Up among Increasers, Maintainers and Decreasers: Matched Analysis (n=3,505; Dublin 2008)

	More active (%)	About the same (%)	Less active (%)
Increasers (n=1,429)	30.8	55.5	13.7
Maintainers (n=411)	19.2	53.8	26.9
Decreasers (n=1,515)	18.5	51.9	29.6*

* $p < 0.05$ Increasers v Maintainers v Decreasers

Table 41

Perception of Status of Activity at Short Term Follow Up among Increasers, Maintainers and Decreasers: Matched Analysis (n=348; Cork 2008)

	More active (%)	About the same (%)	Less active (%)
Increasers (n=146)	24.5	60.1	15.4
Maintainers (n=45)	11.1	68.9	20
Decreasers (n=150)	17.7	64.6	17.7

* $p < 0.05$ Increasers v Maintainers v Decreasers

Table 42

Reported v Perceived Levels of Physical Activity (n = 3,505: Dublin 2007)

	I am not regularly physically active and do not intend to be so in the next 6 months (%)	I am not regularly physically active but am thinking about starting to do so in the next 6 months (%)	I do some physical activity but not enough to meet the description of regular physical activity (%)	I am regularly physically active but only began in the last 6 months (%)	I am regularly physically active and have been so for longer than 6 months (%)
High Active (n=1,444)	0.4	2.4	13.3	15.6	68.3
Moderate (n=1,336)	0.6	5.8	32.3	17.2	44.2
Low Active (n=587)	3.9	23.9	44.3	8.3	19.6

Social Support and Physical Environment Items – Descriptive Analysis at Short Term Follow Up

At short term follow up, in both 2008 events, approximately 80% of respondents indicated that they had someone to be active with. Approximately 79% felt that their family and friends encouraged them to be active and approximately 20% did not feel that their family and friends would mind their children so they could be active. A higher proportion of single in comparison to married people (p>.05) disagreed that they had someone to be active with; this was also particularly apparent among women with no children compared to those with children (p<.05, Dublin only) and women with tertiary education in contrast to those without tertiary education (p<.05, Dublin only). It was notable that the youngest and oldest age groups indicated more strongly that they had someone to be active with compared to their middle aged counterparts (p<.05, Dublin only). A greater proportion of women with tertiary education (p<.05, Cork only), women with children (p>.05) and married women (p<.05, Dublin only) reported that their family and friends encouraged them to be active; there was no relationship with age or place of residence.

A significantly (p<.05) greater proportion of middle aged women and married women agreed that their family and friends look after their children so they could be active; this is likely due to the fact that women in this age group and women who are married are more likely to have children. Also, women who lived in a rural location compared to an urban area received greater support from their family and friends to be active (p<.05, Dublin only). Furthermore, approximately 90% of respondents to both events felt that they could be active in their local area and approximately three quarters reported that there was a green area in their locality where they could be active. This was not consistently associated with where people resided; indeed a greater proportion of people who lived in an isolated location or a village felt they did not have a green area where they could be active than those who lived in cities or towns (p<.05, in both Dublin and Cork events).

Appendix C

Research Question 1 – Rates of Relapse

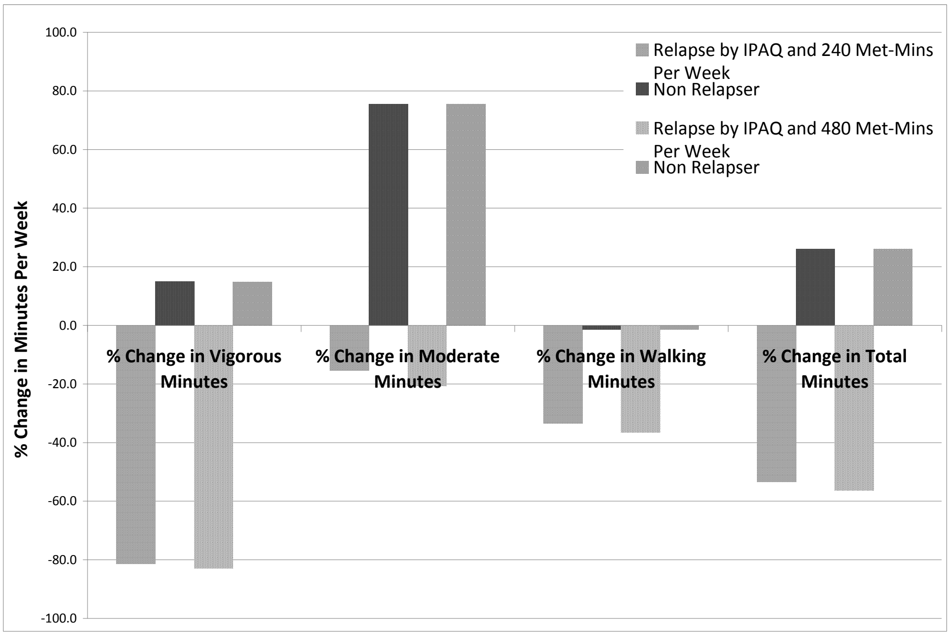


Figure 1

Change in participation in physical activity among relapsers and non relapsers at short term follow up (n = 3,803: Dublin 2007)

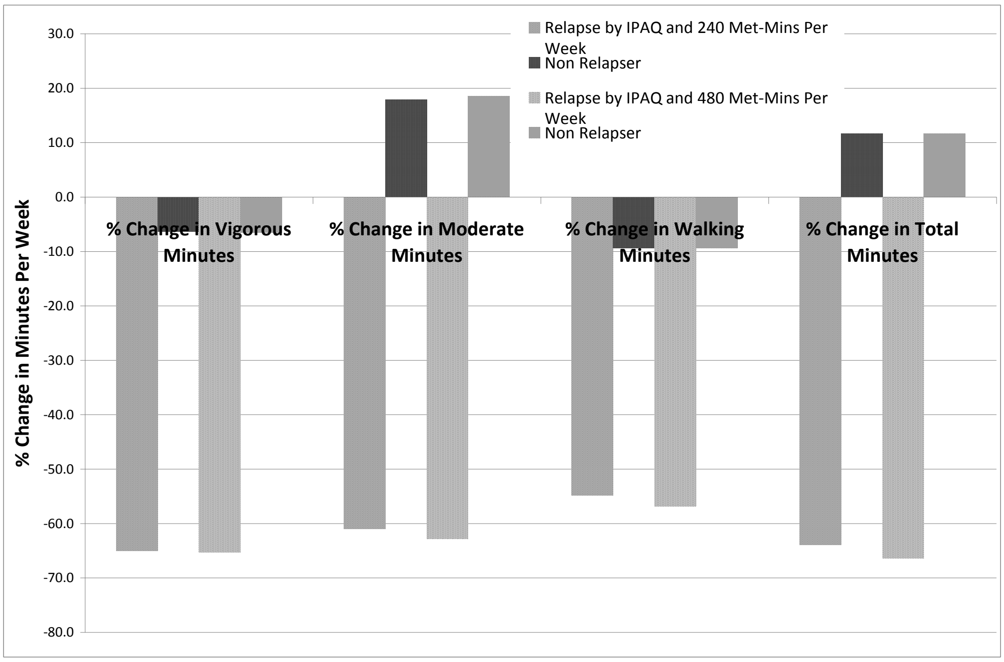


Figure 2

Change in participation in physical activity among relapsers and non relapsers at short term follow up (n = 3,505: Dublin 2008)

Table 1

Changes in Stage of Change between Baseline and Follow Up (n = 369: Dublin 2008, n = 49: Cork 2008)

Stage	Baseline (%)		Short Term Follow Up (%)	
	Dub	Cork	Dub	Cork
I am not regularly physically active and do not intend to be so in the next six months	.8	.6	1.1	.6
I am not regularly physically active but am thinking about starting to do so in the next six months	4.1	5.8	7.5	7
I do some physical activity but not enough to meet the description of regular physical activity	21.5	19.7	26.3	28.4
I am regularly physically active but only began in the last six months	17.7	13	15	8.7
I am regularly physically active and have been so for longer than six months	56	61	50.2	55.4

Participants in the shaded section are deemed sufficiently active and those in the un-shaded insufficiently active. Regression was defined as moving from the shaded to un-shaded (sufficiently to insufficiently active).

Research Question 2 – Predictors of Relapse

Correlation between Predictor Variables

Table 2

Correlations of Predictor Variables (n = 3,803: Dublin 2007)

	1	2	3	4	5	6	7	8
Age	1	-.235*	.121*	-.031	-.336*	.504*	-.183*	.246*
Education		1	-.068*	.176*	.076*	-.138*	.123*	-.063*
Live			1	-.075*	-.139*	.156*	-.089*	-.009
Medical Card				1	-.06*	-.110*	.084*	.048*
Marital Status					1	-.567*	.087*	-.114*
Children						1	.157*	-.179*
Mode of Participation							1	.044*
Previous Participation								1

Table 3

Correlations of Predictor Variables (n = 3,505: Dublin 2008)

	1	2	3	4	5	6	7	8	9
Age	1	-.274*	.073*	-.046	-.347*	.5*	.148*	-.202*	.341*
Education		1	-.088*	.189*	.112*	-.257*	-.074*	.197*	.136*
Live			1	-.012	-.139*	.15*	.064*	-.033	.02
Medical Card				1	-.023	.130*	-.027	.077	.071
Marital Status					1	-.571*	-.062*	.078*	-.178*
Children						1	.129*	-.160*	.222
BMI							1	-.203*	.059*
Mode of Participation								1	.009
Previous Participation									1

Table 4

Correlations of Predictor Variables (n = 348: Cork 2008)

	1	2	3	4	5	6	7	8	9
Age	1	-.365*	.05	-.044	-.328*	.444*	.161*	-.203*	.253*
Education		1	-.088	.109	.125*	-.289*	-.081	.178*	.141*
Live			1	.032	-.077	.04	-.055	.027	.014
Medical Card				1	-.034	-.018	-.048	.052	-.026
Marital Status					1	-.622*	-.051	.127*	-.205*
Children						1	.119*	-.204*	.229*
BMI							1	-.324*	.056
Mode of Completion								1	-.066
Previous Participation									1

Short Term Follow Up 2007

Table 5

Predictors of Relapse (Decrease by at least 240 Met-Mins per week) at Short Term Follow Up 2007 (n = 1,482: Dublin 2007)

		Relapser (n = 1,482)	Non Relapser (n = 2,196)	Adjusted OR (95% CI)
Age	Aged > 40	37.2	36.2	1.00
	Aged < 40	62.8	63.8	1.04 (.89-1.24)
Children	Children	49.6	45.6	1.00
	No Children	50.4	54.4*	.86 (.72-1.03)
Education	Tertiary	69.8	70.1	1.00
	No Tertiary	30.2	29.9	.91 (.73-1.14)
Medical Card	No	86.1	86.4	1.00
	Yes	13.9	13.6	1 (.82-1.23)
Live	Rural	32.7	29.4	1.00
	Urban	67.3	70.6*	.89 (.77-1.03)
Marital Status	Single	41.1	43.5	1.00
	Married	58.9	56.5	1.02 (.87-1.21)
Previous Participation	Previous Participant	62.6	63.8	1.00
	First Time Participant	37.4	36.2	1.04 (.9-1.2)
Mode of Participation	Run/Jog	23.8	28.7	1.00
	Walk	76.2	61.3	1.28(1.09-1.49)^
Training	Do not train/week or two	12.4	14.6	1.00
	Train Continuously	87.6	85.4	1.25(1.02-1.53)^
Repeat Event Participation	No	80	73.6	1.00
	Yes	2	26.4	.73 (.61-.86)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 6

Predictors of Relapse (Decrease by at least 480 Met-Mins per week) at Short Term Follow Up 2007 (n = 1,301: Dublin 2007)

		Relapser (n = 1,301)	Non Relapser (n = 2,377)	Adjusted OR (95% CI)
Age	Aged > 40	36.8	36.5	1.00
	Aged < 40	63.2	63.5	1.08 (.91-1.28)
Children	Children	49.3	46	1.00
	No Children	50.7	54	.83 (.69-1.01)
Education	Tertiary	69.1	70.5	1.00
	No Tertiary	30.9	29.5	.94 (.74-1.17)
Medical Card	No	86.5	86.2	1.00
	Yes	13.5	13.8	.93 (.75-1.14)
Live	Rural	32.5	29.8	1.00
	Urban	67.5	70.2	.9 (.78-1.05)
Marital Status	Single	42.2	42.8	1.00
	Married	57.8	57.2	.94 (.79-1.11)
Previous Participation	Previous Participant	62.8	63.6	1.00
	First Time Participant	37.2	36.4	1 (.87-1.17)
Mode of Participation	Run/Jog	23.5	28.5	1.00
	Walk	76.5	71.5*	1.29 (1.1-1.53)^
Training	Do not train/week or two	12.6	14.4	1.00
	Train Continuously	87.4	85.6	1.2 (.98-1.47)
Repeat Event Participation	No	80.4	73.9	1.00
	Yes	19.6	26.1*	.72 (.6-.86)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 7

Predictors of Relapse (low active at follow up) at Short Term Follow Up 2007 (n = 434: Dublin 2007)

		Relapser (n = 478)	Non Relapser (n = 3,204)	Adjusted OR (95% CI)
Age	Aged > 40	32	37.3	1.00
	Aged < 40	68	62.7*	1.51(1.18-1.93)^
Children	Children	48.2	47	1.00
	No Children	51.8	53	.84 (.65-1.09)
Education	Tertiary	66	70.5	1.00
	No Tertiary	34	29.5*	1.12 (.82-1.55)
Medical Card	No	84.5	86.6	1.00
	Yes	15.5	13.4	1.08 (.82-1.44)
Live	Rural	36.6	29.9	1.00
	Urban	63.4	70.1*	.75 (.61-.93)^
Marital Status	Single	43.4	42.4	1.00
	Married	56.6	57.6	.96 (.75-1.22)
Previous Participation	Previous Participant	59.4	63.9	1.00
	First Time Participant	40.6	36.1	1.08 (.88-1.34)
Mode of Participation	Run/Jog	16	28.4	1.00
	Walk	84	71.6*	2.16(1.66-2.82)^
Training	Do not train/week or two	12.8	13.9	1.00
	Train Continuously	87.2	86.1	1.16 (.86-1.56)
Repeat Event Participation	No	86.7	74.6	1.00
	Yes	13.3	25.4*	.52 (.39-.69)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 8

Predictors of Relapse (Decrease by at least 480 Met-Mins per week and to low active) at Short Term Follow Up 2007 (n = 434: Dublin 2007)

		Relapser (n = 410)	Non Relapser (n = 3,272)	Adjusted OR (95% CI)
Age	Aged > 40	31.2	37.3	1.00
	Aged < 40	68.8	62.7*	1.67(1.27-2.17)^
Children	Children	49.6	46.9	1.00
	No Children	50.4	53.1	.75 (.57-.99)^
Education	Tertiary	64.8	70.6	1.00
	No Tertiary	35.2	29.4*	1.21 (.87-169)
Medical Card	No	83.7	86.6	1.00
	Yes	16.3	13.4	1.14 (.85-1.54)
Live	Rural	35.8	30.1	1.00
	Urban	64.2	69.9*	.79 (.63-.99)^
Marital Status	Single	43	42.5	1.00
	Married	57	57.5	.94 (.72-1.21)
Previous Participation	Previous Participant	59.5	63.8	1.00
	First Time Participant	40.5	36.2	1.07 (.86-1.34)
Mode of Participation	Run/Jog	16.2	28.1	1.00
	Walk	83.8	71.9*	2.08(1.57-2.77)^
Training	Do not train/week or two	12.2	14	1.00
	Train Continuously	87.8	86	1.24 (.89-1.71)
Repeat Event Participation	No	88.6	74.6	1.00
	Yes	11.4	25.4	.42 (.3-.59)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Short Term Follow Up Dublin 2008

Table 9

Predictors of Relapse (Decrease by at least 240 Met-Mins per week) at Short Term Follow Up 2008 (n = 1,515: Dublin 2008)

		Relapser (n = 1,515)	Non Relapser (n = 1,840)	Adjusted OR (95% CI)
Age	Aged > 40	39.5	38.8	1.00
	Aged < 40	60.5	61.2	1.11 (.93-1.32)
Children	Children	51.2	48	1.00
	No Children	48.8	52	.89 (.73-1.07)
Education	Tertiary	64.8	69.5	1.00
	No Tertiary	35.2	30.5*	1.24(1.06-1.45)^
Medical Card	No	83.3	84.5	1.00
	Yes	16.7	15.5	1.07 (.88-1.31)
Live	Rural	33.4	27.8	1.00
	Urban	66.6	62.2*	.78 (.67-.92)^
Marital Status	Single	40	41.2	1.00
	Married	60	58.8	.98 (.83-1.17)
Previous Participation	Previous Participant	62.4	60.7	1.00
	First Time Participant	37.6	39.3	.94 (.81-1.1)
Mode of Participation	Run/Jog	27.5	29	1.00
	Walk	72.5	71	1.05 (.89-1.24)
Training	Do not train/week or two	38.6	40.4	1.00
	Train Continuously	61.4	59.6	1.11 (.95-1.29)
BMI	Overweight/Obese	23.7	20.9	1.00
	Underweight/Normal	76.3	79.1	.87 (.71-1.05)
Follow Up Sedentary Behaviour	> 4.5 hours per day	51.2	47.7	1.00
	≤ 4.5 hours per day	48.8	52.3	.76 (.53-1.1)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 10

Predictors of Relapse (Decrease by at least 480 Met-Mins per week) at Short Term Follow Up 2008 (n = 1,317: Dublin 2008)

		Relapser (n = 1,317)	Non Relapser (n = 2,038)	Adjusted OR (95% CI)
Age	Aged > 40	39.6	38.8	1.00
	Aged < 40	60.4	61.2	1.11 (.93-1.33)
Children	Children	51.2	48.3	1.00
	No Children	48.8	51.7	.89 (.74-1.08)
Education	Tertiary	64.3	69.6	1.00
	No Tertiary	35.7	30.6*	1.25(1.06-1.47)^
Medical Card	No	83.3	84.4	1.00
	Yes	16.7	15.6	1.06 (.86-1.29)
Live	Rural	33.9	28	1.00
	Urban	66.1	72*	.78 (.67-.91)^
Marital Status	Single	40.1	41.1	1.00
	Married	59.9	58.9	.97 (.81-1.16)
Previous Participation	Previous Participant	63.1	60.5	1.00
	First Time Participant	36.9	39.5	.9 (.77-1.05)
Mode of Participation	Run/Jog	27	29.2	1.00
	Walk	73	70.8	1.09 (.93-1.29)
Training	Do not train/week or two	38.4	40.3	1.00
	Train Continuously	61.6	59.7	1.12 (.96-1.31)
BMI	Overweight/Obese	24	21	1.00
	Underweight/Normal	76	79	.87 (.72-1.06)
Follow Up Sedentary Behaviour	> 4.5 hours per day	50.4	49	1.00
	≤ 4.5 hours per day	49.6	51	.86 (.59-1.23)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 11

Predictors of Relapse (low active at follow up) at Short Term Follow Up 2008 (n = 410: Dublin 2008)

		Relapser (n = 410)	Non Relapser (n = 2,495)	Adjusted OR (95% CI)
Age	Aged > 40	39.7	39	1.00
	Aged < 40	60.3	61	1.28 (.99-1.65)
Children	Children	53.5	48.9	1.00
	No Children	46.5	51.1	1.03 (.78-1.36)
Education	Tertiary	59.5	68.5	1.00
	No Tertiary	40.5	31.5*	1.4 (1.11-1.77)
Medical Card	No	81.4	84.3	1.00
	Yes	18.6	15.7	1.14 (.85-1.52)
Live	Rural	35.6	29.6	1.00
	Urban	64.4	70.4*	.8 (.64-1)
Marital Status	Single	35	41.5	1.00
	Married	65	58.5*	1.34(1.02-1.75)^
Previous Participation	Previous Participant	62.4	61.4	1.00
	First Time Participant	37.6	38.6	.94 (.74-1.18)
Mode of Participation	Run/Jog	19.1	29.6	1.00
	Walk	80.9	70.4*	1.71 (1.3-2.25)
Training	Do not train/week or two	50.9	38	1.00
	Train Continuously	49.1	62*	.62 (.49-.78)^
BMI	Overweight/Obese	27.3	21.5	1.00
	Underweight/Normal	72.7	78.5*	.81 (.62-1.1)
Follow Up Sedentary Behaviour	> 4.5 hours per day	59.1	46.5	1.00
	≤ 4.5 hours per day	40.1	53.5*	.58 (.38-.89)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 12

Predictors of Relapse (Decrease by at least 480 Met-Mins per week and to low active) at Short Term Follow Up 2008 (n = 348: Dublin 2008)

		Relapser (n = 348)	Non Relapser (n = 3,007)	Adjusted OR (95% CI)
Age	Aged > 40	40.5	38.9	1.00
	Aged < 40	59.5	61.1	1.25 (.95-1.65)
Children	Children	53.1	49	1.00
	No Children	49.9	51	1.06 (.79-1.44)
Education	Tertiary	57.1	68.6	1.00
	No Tertiary	42.9	31.4*	1.58(1.24-2.03)^
Medical Card	No	80.4	84.3	1.00
	Yes	19.6	15.7	1.19 (.88-1.61)
Live	Rural	36.1	29.7	1.00
	Urban	63.9	70.3*	.78 (.61-.99)^
Marital Status	Single	35.7	41.3	1.00
	Married	64.3	58.7*	1.27 (.95-1.69)
Previous Participation	Previous Participant	63.5	61.3	1.00
	First Time Participant	36.5	38.7	.89 (.69-1.14)
Mode of Participation	Run/Jog	18.4	29.5	1.00
	Walk	81.6	70.5*	1.72(1.28-2.32)^
Training	Do not train/week or two	59.9	38.1	1.00
	Train Continuously	48.1	61.9*	.61 (.48-.78)^
BMI	Overweight/Obese	27.8	21.5	1.00
	Underweight/Normal	72.2	78.5*	.79 (.59-1.07)
Follow Up Sedentary Behaviour	> 4.5 hours per day	59.5	46.7	1.00
	≤ 4.5 hours per day	40.5	53.3*	.57 (.37-.88)^

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 13

Predictors of Relapse (stage regression) at Short Term Follow Up 2008 (n = 541: Dublin 2008)

		Relapser (n = 541)	Non Relapser (n = 2,314)	Adjusted OR (95% CI)
Age	Aged > 40	36.3	41	1.00
	Aged < 40	63.7	59*	1.29(1.02-1.64)^
Children	Children	48.2	50	1.00
	No Children	51.8	50	1.09 (.85-1.42)
Education	Tertiary	66	66.9	1.00
	No Tertiary	34	33.1	1.09 (.88-1.35)
Medical Card	No	84.5	84	1.00
	Yes	15.5	16	.88 (.67-1.17)
Live	Rural	32.8	30.3	1.00
	Urban	67.2	69.7	.87 (.71-1.08)
Marital Status	Single	40.3	41.6	1.00
	Married	59.7	58.4	1.22 (.95-1.55)
Previous Participation	Previous Participant	58.4	62.8	1.00
	First Time Participant	41.6	37.2	1.15 (.94-1.41)
Mode of Participation	Run/Jog	26.3	30.2	1.00
	Walk	73.7	69.8	1.32(1.04-1.67)^
Training	Do not train/week or two	37.3	37.7	1.00
	Train Continuously	62.7	62.3	1.13 (.91-1.39)
BMI	Overweight/Obese	22.6	20	1.00
	Underweight/Normal	77.4	80	.87 (.66-1.13)
Follow Up Sedentary Behaviour	> 4.5 hours per day	52.8	46.9	1.00
	≤ 4.5 hours per day	47.2	53.1	.80 (.47-1.37)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Short Term Follow Up Cork 2008

Table 14

Predictors of Relapse (Decrease by at least 240 Met-Mins per week) at Short Term Follow Up 2008 (n = 150: Cork 2008)

		Relapser (n = 150)	Non Relapser (n = 191)	Adjusted OR (95% CI)
Age	Aged > 40	45.3	39.3	1.00
	Aged < 40	54.7	60.7	.75 (.44-1.26)
Children	Children	58.7	56.5	1.00
	No Children	41.3	43.5	1.03 (.56-1.91)
Education	Tertiary	73	72.5	1.00
	No Tertiary	27	27.5	.86 (.49-1.48)
Medical Card	No	81.3	83.7	1.00
	Yes	18.7	16.3	1.02 (.55-1.87)
Live	Rural	32.9	38.2	1.00
	Urban	67.1	61.8	1.21 (.75-1.93)
Marital Status	Single	36.7	37.2	1.00
	Married	63.3	62.8	.87 (.48-1.56)
Previous Participation	Previous Participant	62	56.5	1.00
	First Time Participant	38	43.5	.83 (.52-1.33)
Mode of Participation	Run/Jog	29.3	32.5	1.00
	Walk	70.7	67.5	1.03 (.63-1.69)
Training	Do not train/week or two	50.7	52.7	1.00
	Train Continuously	49.3	47.3	1.08 (.67-1.74)
BMI	Overweight/Obese	39.3	34.6	1.00
	Underweight/Normal	60.7	65.4	.87 (.53-1.43)
Follow Up Sedentary Behaviour	> 6 hours per day	48.6	48.7	1.00
	≤ 6 hours per day	51.4	51.3	.97 (.61-1.55)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 15

Predictors of Relapse (Decrease by at least 480 Met-Mins per week) at Short Term Follow Up 2008 (n = 132: Cork 2008)

		Relapser (n = 132)	Non Relapser (n = 209)	Adjusted OR (95% CI)
Age	Aged > 40	43.9	40.7	1.00
	Aged < 40	56.1	59.3	.86 (.5-1.47)
Children	Children	59.1	56.5	1.00
	No Children	40.9	43.5	.83 (.44-1.56)
Education	Tertiary	72.4	73	1.00
	No Tertiary	27.6	27	.97 (.56-1.69)
Medical Card	No	80.3	84.4	1.00
	Yes	19.7	15.6	1.12 (.61-2.08)
Live	Rural	34.4	36.8	1.00
	Urban	65.6	63.2	1.04 (.65-1.69)
Marital Status	Single	37.9	36.4	1.00
	Married	62.1	63.6	.76 (.42-1.38)
Previous Participation	Previous Participant	60.6	57.9	1.00
	First Time Participant	39.4	42.1	.92 (.57-1.49)
Mode of Participation	Run/Jog	31.8	30.6	1.00
	Walk	68.2	69.4	.81 (.49-1.35)
Training	Do not train/week or two	49.2	53.4	1.00
	Train Continuously	50.8	46.6	1.16 (.71-1.88)
BMI	Overweight/Obese	37	36.5	1.00
	Underweight/Normal	63	63.5	.99 (.60-1.65)
Follow Up Sedentary Behaviour	> 6 hours per day	47.7	49.3	1.00
	≤ 6 hours per day	52.3	50.7	1.05 (.65-1.68)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 16

Predictors of Relapse (low active at follow up) at Short Term Follow Up 2008 (n = 60: Cork 2008)

		Relapser (n = 60)	Non Relapser (n = 281)	Adjusted OR (95% CI)
Age	Aged > 40	43.3	41.6	1.00
	Aged < 40	56.7	58.4	.83 (.42-1.65)
Children	Children	56.7	57.7	1.00
	No Children	43.3	42.3	.81 (.35-1.85)
Education	Tertiary	72.7	72.7	1.00
	No Tertiary	27.3	27.3	.95 (.46-1.94)
Medical Card	No	73.3	84.6	1.00
	Yes	26.7	15.4*	1.91 (.93-3.95)
Live	Rural	38.3	35.4	1.00
	Urban	61.7	64.6	.74 (.4-1.36)
Marital Status	Single	41.7	35.9	1.00
	Married	58.3	64.1	.72 (.33-1.56)
Previous Participation	Previous Participant	51.7	60.5	1.00
	First Time Participant	48.3	39.5	1.58 (.86-2.92)
Mode of Participation	Run/Jog	26.7	32	1.00
	Walk	73.3	68	1.19 (.61-2.32)
Training	Do not train/week or two	55	51.1	1.00
	Train Continuously	45	48.9	1.04 (.56-1.94)
BMI	Overweight/Obese	43.9	35.2	1.00
	Underweight/Normal	56.1	64.8	.84 (.44-1.59)
Follow Up Sedentary Behaviour	> 6 hours per day	56.9	47	1.00
	≤ 6 hours per day	43.1	53	.78 (.42-1.44)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 17

Predictors of Relapse (Decrease by at least 480 Met-Mins per week and to low active) at Short Term Follow Up 2008 (n = 46: Cork 2008)

		Relapser (n = 46)	Non Relapser (n = 295)	Adjusted OR (95% CI)
Age	Aged > 40	41.3	42	1.00
	Aged < 40	58.7	58	.99 (.46-2.13)
Children	Children	58.7	57.3	1.00
	No Children	41.3	42.7	.64 (.25-1.63)
Education	Tertiary	76.2	72.2	1.00
	No Tertiary	23.8	27.8	.75 (.33-1.7)
Medical Card	No	78.3	83.3	1.00
	Yes	21.7	16.7	1.33 (.57-3.12)
Live	Rural	41.3	35	1.00
	Urban	58.7	65	.64 (.33-1.26)
Marital Status	Single	41.3	36.3	1.00
	Married	58.7	62.7	.66 (.28-1.57)
Previous Participation	Previous Participant	54.3	59.7	1.00
	First Time Participant	45.7	40.3	1.37 (.69-2.72)
Mode of Participation	Run/Jog	26.1	31.9	1.00
	Walk	73.9	68.1	1.29 (.61-2.75)
Training	Do not train/week or two	54.3	51.4	1.00
	Train Continuously	45.7	48.6	1.09 (.55-2.19)
BMI	Overweight/Obese	47.7	35	1.00
	Underweight/Normal	52.3	65	.71 (.35-1.44)
Follow Up Sedentary Behaviour	> 6 hours per day	56.8	47.4	1.00
	≤ 6 hours per day	43.2	52.6	.75 (.38-1.52)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 18

Predictors of Relapse (stage regression) at Short Term Follow Up 2008 (n = 57: Cork 2008)

		Relapser (n = 57)	Non Relapser (n = 239)	Adjusted OR (95% CI)
Age	Aged > 40	45.6	43.5	1.00
	Aged < 40	54.4	56.5	1.42 (.68-2.95)
Children	Children	71.5	54.4	1.00
	No Children	28.8	45.6*	.25 (.09-.66)^
Education	Tertiary	70	71.7	1.00
	No Tertiary	30	28.3	.88 (.42-1.84)
Medical Card	No	80.7	82.8	1.00
	Yes	19.3	17.2	.82 (.33-2.02)
Live	Rural	38.6	37.8	1.00
	Urban	61.4	62.2	1.04 (.54-2.02)
Marital Status	Single	33.3	37.7	1.00
	Married	66.7	62.3	.61 (.25-1.47)
Previous Participation	Previous Participant	56.1	58.6	1.00
	First Time Participant	43.9	41.4	1.38 (.70-2.73)
Mode of Participation	Run/Jog	21.1	33.5	1.00
	Walk	78.9	66.5	1.78 (.79-4.01)
Training	Do not train/week or two	49.1	48.9	1.00
	Train Continuously	50.9	51.1	1.32 (.67-2.58)
BMI	Overweight/Obese	46.3	32	1.00
	Underweight/Normal	53.7	68*	.59 (.29-1.17)
Follow Up Sedentary Behaviour	> 6 hours per day	50	48.3	1.00
	≤ 6 hours per day	50	51.7	.69 (.35-1.35)

Odds ratios adjusted for age, level of education, marital status, children, previous participation and mode of participation. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 19

Self Efficacy as a Predictor of Relapse – Definition A (n = 49: Cork 2008)

		Relapser (n = 49)	Non Relapser (n = 292)	Adjusted OR (95% CI)
Cork 2008 Short Term (n = 341)				
Confident in ability to be active when stressed	Disagree	14.9	15.3	1.00
	Agree	85.1	84.7	.98 (.36-2.69)
Confident in ability to be active when weather is bad	Disagree	35.6	24.8	1.00
	Agree	64.4	75.2	.51 (.23-1.09)
Confident in ability to be active when tired	Disagree	32.6	38.1	1.00
	Agree	67.4	61.9	1.61 (.70-3.67)
Confident in ability to be active when family takes up time	Disagree	28.3	30.6	1.00
	Agree	71.7	69.4	1.05 (.46-2.37)

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and self efficacy items. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 20

Social Support as a Predictor of Relapse – Definition A (n = 49: Cork 2008)

		Relapser (n = 49)	Non Relapser (n = 292)	Adjusted OR
Cork 2008 Short Term (n = 341)				
Someone else to be active with	Disagree	7.1	15.1	1.00
	Agree	92.9	84.9	2.1 (.38-11.7)
Encouragement to be active from family and friends	Disagree	13.2	12.9	1.00
	Agree	86.3	87.1	3.45 (.36-32.8)
Someone to look after children	Disagree	42.9	41.9	1.00
	Agree	57.1	58.1	.71 (.22-2.3)

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and social support items. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Table 21

Physical Environment as a Predictor of Relapse – Definition A (n = 369: Dublin 2008)

		Relapser (n = 369)	Non Relapser (n = 2,986)	Adjusted OR (95% CI)
Dublin 2008 Short Term (n = 3,355)				
Can be active on streets/roads in the locality	Disagree	10.6	7.3	1.00
	Agree	89.4	92.7*	.68 (.45-1.04)
Green areas where you can be active	Disagree	23.7	19.1	1.00
	Agree	76.3	80.9	.81 (.59-1.11)

Odds ratios adjusted for age, level of education, marital status, children, previous participation, mode of participation and physical environment items. * = x^2 (bivariate) is significant ($p < 0.05$), ^ = odds ratio is significant ($p < 0.05$)

Research Question 3 – PA and Sedentary Behaviour at Follow Up

Table 22

BMI and Sedentary Behaviour of Relapsers at Follow Up (n = 369: Dublin 2008, n = 49: Cork 2008)

		240 MET-minutes/wk (M, SD)		480 MET-minutes/wk (M, SD)		Relapse to low active (M, SD)	
		R	NR	R	NR	R	NR
BMI	08 D	24.4(3.9)	24.3(4.1)	24.4(4)	24.3(4)	25(4.2)	24.3(4)*
	08 C	25.2(4.5)	23.9(3.4)*	24.6(4)	23.9(3.3)	24.6(4.1)	24(3.3)
Sitting Minutes Per Day	08 D	212.7(134.9)	198.6(126.4)	209.7(129.8)	203.3(133.6)	239.8(139.5)	195.3(126.9)*
	08 C	272.7(149.8)	276.4(156)	266.3(147.9)	280(156.4)	281.5(154.2)	273.5(153.3)
TV Minutes Per Day	08 D	122.7(74.7)	112.1(68.7)	123.3(74.6)	112.5(69.5)	127.7(73.3)	115.1(71.9)
	08 C	118.3(68.1)	122.6(82.6)	118.1(64.5)	122.4(80.4)	132.9(76.7)	118.1(74.1)

Appendix D

Table 1

Summary of Community Based Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Eaton et al. (1999)	TTM	Cross sectional and CIT	Random sample of adults in intervention and comparison community in US (n=15,261)	PA, physical inactivity	Pawtucket Heart Health Program I: 7 year campaign, PA specific element, partnerships, worksite interventions, self help materials, development of clubs. C: no contact	Annual	At 7 years, I+C: 3% increase in attempts to be active (p<.05), 8% decrease in inactivity (p<.05) No between group differences
Winkleby et al. (1996)	Social learning, persuasion theories, social marketing	CIT and Cross Sectional	Random sample of adults in intervention and comparison communities in US (n=968)	CVD risk factors: cholesterol, smoking, BMI	Stanford Five-City Project I: mass media, education programmes, capacity building C: no contact	Up to 11 years post baseline	At 11 years, I: 30% increase in knowledge of risk factors for CVD, 5% decrease in systolic BP (p<.05), C: 33% increase in knowledge (p<.05), no change in systolic BP. 8% decrease in cholesterol in both groups (p>.05). Minimal increase in BMI in both groups.
Luepker et al. (1994)	n/a	CIT, Cohort and Cross sectional	Random sample of adults in intervention and comparison community in US (n=38,246: C/S) (n=7,097: Cohort)	PA: yes/no BP, cholesterol, BMI	Minnesota Heart Health Program I: Multi level intervention, environmental change, partnerships, education, screening, counselling, mass media. C: no contact	Up to 6 years post baseline	At 6 years, C/S – I: 9% increase in % active, C: 6% increase in % active (p<.05). Cohort – I: 15% increase in PA, C: 10% increase in PA (p<.05, greatest in I community). No intervention effect for cholesterol, BP, BMI
Wen et al. (2002)	Social-ecological model, social marketing	CIT	Women aged 20-50 living in intervention area in Australia (n = 1801)	PA: self report	Concord-A Great Place to be Active I: mass media campaign, group walks, environmental change, capacity building No comparison community	2 years	At 2 years, 7% decrease in proportion deemed sedentary (p<.05). No change in MVPA

Cochrane & Davey (2008)	Social-ecological	CIT	Two urban communities in UK (n=1,532)	PA: self report	I: database of local facilities and resources, mass media, walking routes and groups, exercise referral C: no contact	I year	At 1 year, I: 31% increase in PA, C: 18% increase in PA (p<.05, higher in I group).
Jenum et al. (2009)	Social-ecological model	CIT	Two low income districts in Norway (n=1,776)	PA: self report, MR, cholesterol, BMI, mediators	I: capacity building, counselling, PA groups C: no contact	3 years	At 3 years, I: 9.5% increase in proportion doing strenuous activity, C: 8.1% increase (p<.05) Decrease in BMI in both groups, 6.9% net favourable stage progression in I group
Wendel-Vos et al. (2009)	n/a	CIT	Men and women aged 20-59 in the Netherlands (n = 3,114)	PA, diet and smoking: self report	I: Multi level interventions targeting diet, PA and smoking., mass media, print materials C: no contact	5 years	At 5 years, 13% increase in LTPA in women (p<.05, highest in I group). Favourable dietary changes in I group only
Kelishadi et al. (2009)	Precede-Proceed Social learning theory, Ottawa Charter, Diffusions of Innovations	CIT	Random samples of adults and adolescents in intervention and control community in Iran (n-12,514)	PA, diet: self report	I: multi-sectorial, education, mass media, intersectoral collaboration, policy change, professional development, community mobilisation C: no contact	Annual	At 2 years, I+C: 32% increase in LTPA in women, 15% increase in men (p<.05). Decline in smoking and fat consumption in intervention community only.

CIT = community intervention trial, PA = physical activity, I = intervention, C = control/comparison group, MVPA = moderate and vigorous intensity activity, LTPA = leisure time physical activiy

Table 2

Summary of Community Based Interventions Targeted to Women

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Segar et al. (2002)	SCT, Empowerment Objectification Self-in-Relation theory	Pre-post design	Women from a community setting in US (n = 80)	PA: Godin Leisure Time Exercise Quest Self care behaviour	Fitting in Fitness for Life I: small group workshops, group discussions, weekly evaluation, overcoming barriers, consciousness raising	6 weeks & 9 months	At 9 months, 68% increase in total PA per week. Focus groups indicated increased awareness about PA, decreased guilt about not being active.
Wilcox et al. (2006)	TTM and SCT	Pre-post design	Sedentary adults aged >50 in community settings in US (n = 838)	PA: CHAMP Stress, body satisfaction, QoL	Active for Life I 1: individual meetings, telephone counselling I2: group based programme using similar strategies	I1: 6 months I2: 20 weeks	I1 and I2: 100% increase in MVPA hours/wk Moderate improvement in body satisfaction, quality of life and depressive symptoms
Perry et al. (2007)	TTM and SCT	RCT	Healthy sedentary women from a rural community in US (n = 46)	Fitness (walk test), SE, SS, stage of change, BMI	Heart to Heart I: group meetings, group walks, motivational interviewing C: brief telephone contact	12 weeks	At 12 weeks, I: 8% increase in fitness, C: .04% decrease (p>.05). 80% attendance at 6+ group walks I: 56% increase in SS (p<.05), no change in SE
Speck et al. (2007)	Health Promotion Model	Pre-post design	Healthy women in US (n = 104)	PA: pedometers, 7-day PAR SS, SE barriers, benefits	I: provision of opportunities to be active, group walks, childcare, telephone prompts C: no contact	4, 23 & 26 weeks	No change in self report or pedometer PA. I: Increase in positive perception of PA and friend support.
Keyserling et al. (2008)	Social-ecological model	RCT	Healthy women in US (n = 236)	PA: self report and acti-graph. Dietary intake, BP, lipids, weight	WISEWOMAN I1: individual and group counselling, phone contact, community resource information I2/SI: leaflets	6 & 12 months	At 12 months, I1: 14% increase in moderate minutes per day, I2: 20% decrease (p<.05, actigraph). Similar trends in self report data for moderate, vigorous and total PA. I1: greater improvement in dietary intake (p<.05).

Stadler et al. (2009)	Cognitive behavioural model	RCT	Females aged 30-50 in Germany (n = 256)	PA: Bouchard 3-day PA record (PA diaries)	I1: information only I2: information plus self regulation, diaries	1, 2 & 4 months	At 4 months, I1: 30% increase in PA minutes per week, I2: 111% increase in PA.

SCT = social cognitive theory, TTM = transtheoretical model, RCT = randomised controlled trial, PA = physical activity, BP = blood pressure, QoL = quality of life, SS = social support, SE = self efficacy, I = intervention, C = control/comparison group, LTPA = leisure time physical activity, MVPA = moderate-vigorous physical activity

Table 3

Pedometer Based Interventions to Promote Physical Activity

Authors and Year	Theoretical Framework	Design	Sample and Setting	Measures	Intervention	Follow Up	Results
Hultquist et al. (2005)	n/a	RCT	Sedentary women in US (n = 58)	PA: pedometer data	I1: pedometer, walk 10,000 steps per day I2: pedometer, walk 30 minutes per day	4 weeks	At 4 weeks, I1: 86% increase in steps per day, I2: 40% increase in steps per day (p<.05)
Dinger et al. (2005)	TTM	Pre-post design	University setting in US (n=43)	PA, SE, SS	I: tailored leaflets, pedometers	6 weeks	I: 350% increase in total walking time per week (p<.05)
Clarke et al. (2007)	Self efficacy theory	Pre-post design	Overweight and obese low income mothers in US (n = 124)	PA: pedometers, SE, height, weight, waist circumference	10,000 Steps Ghent I: weekly education lessons, group discussions and exercise. Focus on addressing barriers, building social support. Diet component included.	8 weeks	At 8 weeks, I: 65% increase in pedometer steps per day (p<.05) and increase in SE. Reductions in weight (p<.05)
Merom et al. (2007)	SCT	RCT	Inactive adults aged 30-65 from community setting in Australia (n = 369)	PA: AA, College Alumni Quest., steps	Step by Step I1: booklet plus diaries I2: pedometer plus booklet, diaries C: control	3 months	At 3 months, I1& I2: 15% and 23% increase in proportion deemed sufficiently active
De Cocker et al. (2008)	Social-ecological model	CIT	Random sample of adults in intervention and comparison community in Belgium (n=866)	PA: IPAQ, pedometer log	I: mass media, pedometers, workplace projects, programmes for older adults, walking routes C: no contact	12 months	At 12 months, I: 9% increase in steps per day, 5% decrease in sitting time per day (p<.05), C: 14% decrease in steps per day, 5% increase it sitting time per day

Finkelstein et al. (2008)	n/a	RCT	Sedentary adults aged >50 in US (n = 51)	PA: pedometer data	I: pedometer, step logs, weekly mailings, financial incentive for increased steps C: financial incentive only	4 weeks	At 4 weeks, no change in aerobic minutes per week in either group.
Warren et al. (2010)	Social-ecological model	Pre-post design	Women from rural setting in the US (n=188)	PA: pedometer data	Small Steps Are Easier Together I: pedometers, emails, walking groups/routes	10 weeks	At 10 weeks, 38% increase in steps, 31% increase in proportion of participants meeting daily step goal

SCT = social cognitive theory, TTM = transtheoretical model, RCT = randomised controlled trial, CIT = community intervention trial, PA = physical activity, BP = blood pressure, QoL = quality of life, SS = social support, SE = self efficacy, I = intervention, C = control/comparison group

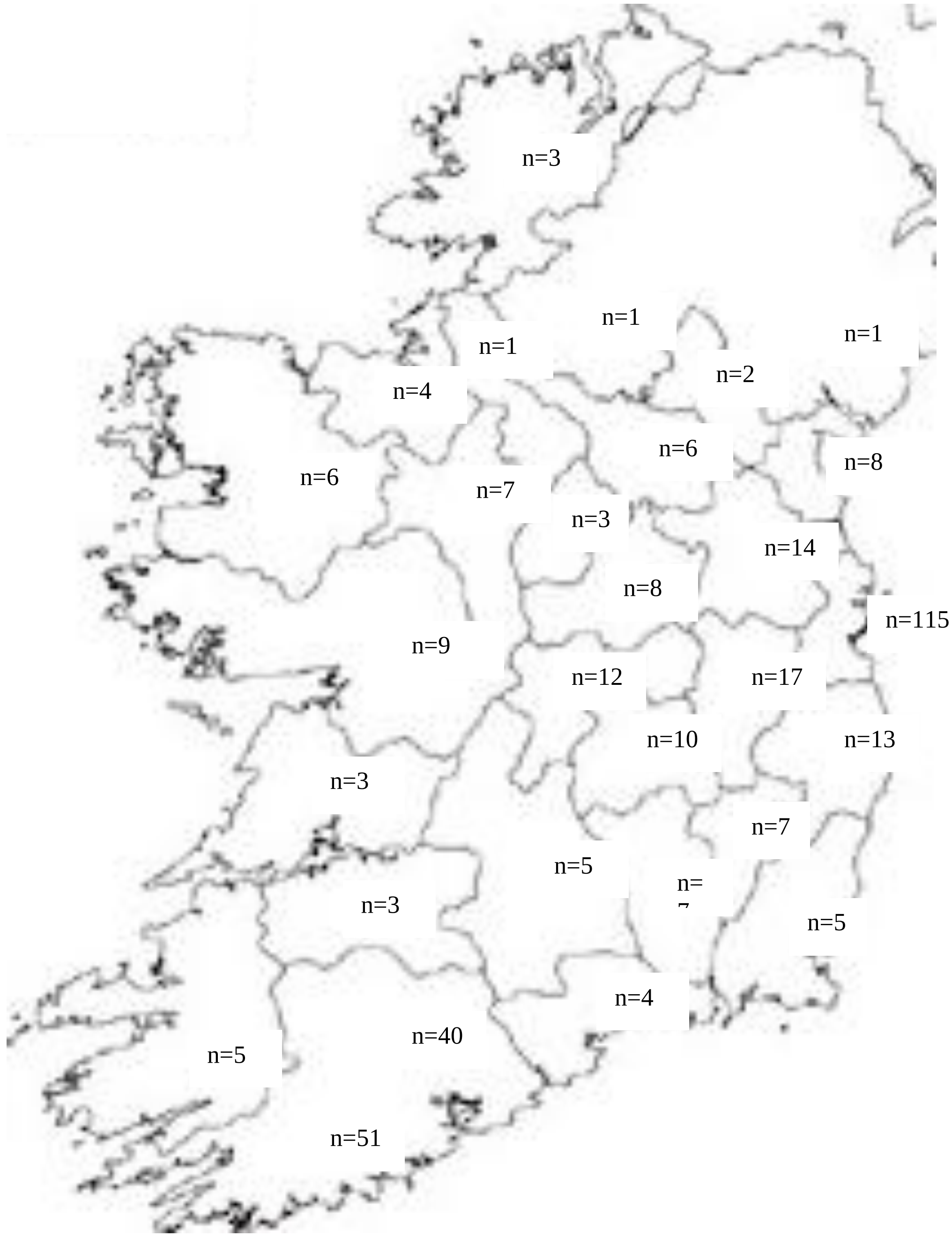


Figure 1
Geographic disparity of clusters in cluster RCT

Local Sports Partnership Audit

At the recent LSP meeting in Tyrrellstown we briefly outlined the physical activity intervention which we hope to run in partnership with the LSPs with inactive mini marathon participants, starting at the start of November. The women will be randomly allocated to either intervention or control groups, so only some LSPs will be asked to target the participants. We will prepare the initial packs and send them to you in advance for any comments or additions. To help us provide information tailored around what each LSP offers, we need to understand the workings and future plans of each individual LSP. We would very much appreciate if you could answer the following questions and include any further information that you may feel is relevant to this project. Our contact numbers and e-mails are below if you need to contact us for any reason, or if pdf versions of documents, maps etc are easier to send.

Please Note: In your answers can you consider the target group that we will be referring to your services (inactive Irish women, aged 20-60)

1. Can you please detail all physical activity related programmes that you may have scheduled for November and December 2008?

____

____

____

2. Can you please detail all physical activity events that you may have scheduled for November and December 2008?

____

____

____

3. Can you please detail any community/club groups that are affiliated to you?

____

____

____

4. Can you please detail any links you may have with public leisure centres? (please provide contact details, if possible)

____

____

____

5. Can you please identify all other local facilities that can be accessed by individuals/groups in your region?

____

____

____

6. Can you please submit detail of any promotional materials/strategies you use in your partnership (newsletters, leaflets, website, local papers/radio)

____

____

____

7. Can you please fill in the following contact details:

Name(s): ____________________________

Address:

____

____

Email address: _____________________________

Phone number (office and mobile): ______________________________________

Fax number: ___________________________

WIT Contact Details:

Aoife Lane	Dr. Niamh Murphy
Dept of Health, Sport and Exercise Science	nmurphy@wit.ie
Waterford Institute of Technology	051 302400
Cork Rd	
Waterford	
alane@wit.ie 0863166928/051302158	

Complex Design File

1. The total number of clusters (LSPs/counties) in Ireland (North and South) and the number recruited for the trials (both Dublin and Cork) were identified. This information was used to calculate inclusion probability for stage 1 (number of clusters recruited/total number of clusters).
2. The total number of adult women (age 15+ from Irish and NI Census) in each county in Ireland were identified. This information was used to calculate inclusion probability for stage 2 (number of women from each cluster in Cluster RCT/total number of women in each cluster/county).
3. Both of these variables were used to calculate the final sample weight (1/(inclusion probability stage 1*inclusion probability stage 2).
4. Finally, a complex analysis plan was created. The cluster group variable from the SPSS file and final sample weight variables were used as well as the inclusion probabilities generated above for the first and second stage of sampling.

Research Question 2 – Receipt and Use of Intervention Materials

Table 4

Correlates of Pedometer Use

		Yes n=73 (%)	No n=36 (%)
Age	Aged < 40	67.1	56.2
	Aged > 40	32.9	43.8*
Children	No children	45.9	35.9
	Children	54.1	64.1*
Education	No Tertiary	42	42.4
	Tertiary	58	57.6
Marital Status	Married	66.1	76.9
	Single	33.9	23.1*
BMI	Underweight/Normal	68.1	66.7
	Overweight/Obese	31.9	33.3

* = x^2 (bivariate) is significant ($p < 0.05$)

Research Question 6 – Cost Assessment of Cluster RCT

Below is a more detailed outline of the costs associated with the cluster RCT. To note is that all hourly rates for idea development etc. were costed at €70 per hour. Standard copies for questionnaires were charged at 4c per copy, while intervention pack contents were copied in colour, thus cost 10c per page. Physical activity booklets (from RCT – chapter 6), pedometer booklets and postcards cost €3.40, 80c and 45c each respectively. Standard postage costs were 55c per envelope, this increased to 95c for the information packs and €2.20 for pedometers while labels were costed at 8c per sheet.

Table 5

Detailed Cost of Intervention

	Time (mins)	Copies, Printing, Postage (numbers)	Cost (€)
Research Planning Costs			
Idea Development	270		
Meeting Preparation	150		
Meeting with all LSP's	60		
Meeting with Dublin LSP's	120		
Identification of Study Sample	300		
Total	**900**		**1050**
Administration Costs Pre Intervention			
Draft of Pre and Post Questionnaires	180		
Copies of Pre Questionnaires (Phase 2)		402x.04	16.08
Compilation of Pre Questionnaires (SNAP)	120 (Phase 2)		827.78 (Phase 1)
Postage of Pre Questionnaires		1979x.55	1088.45
Compilation of Online Survey and Email to Pre Questionnaires	60		

Consent to Participate	270	280x.55	154
Compilation of Consenting Participants (Cluster Analysis)	210		
Readiness to Change Analysis (Brochures)	60		
Meeting Costs (180 minsx3)	540		
Total	**1440**		**3766.31**
Intervention Compilation			
LSP Audit	90		
Email to all LSP's	15		
Phone Calls to LSP's	120		
Draft Information Sheet	1350	193x.1	19.3
Email Draft Information Sheet	15		
Brochures	120	193x3.40	656.2
Training Plan Design	100	193x.1	19.3
Free Entry to 5K Form	60	51x.1	5.1
Local Event Detail	120	51x.1	5.1
Cover Letters	85	193x.1	19.3
Compilation of Packs	180		
Pedometers		193x10	1930
Pedometer Booklet	120	193x.80	186.83
Booklets Professional Design			206.55
Postcard Design	60	193x.45	105.09
Total	**2495**		**6064.77**
Other Administration Costs During Intervention			
Photocopying	340		
Postage of Intervention Packs		193x.95	183.35
Postage of Control Leaflets		209x.55	114.95
Postage of Pedometer Packs		193x2.20	424.60
Labels	180	20x.08	1.6

Meeting Overheads			94.5
Post Intervention Administration Costs			
Copies of Post Questionnaires		402x.04	16.08
Packing and Postage of Post Questionnaires	120	402x.55	221.1
Reminder Emails	90		
Reminder Letters	110	60x.55	33
Total	**840**		**2069.58**
Net Total			**12950.30**

Table 6

Costs of Improvements in Physical Activity in Intervention Group in the Cluster RCT (n=193)

	Cost (€)
Total Cost of Intervention	11,207.75
Cost per person over 9 weeks	58.07
Cost per person per week	6.45
Cost per week per minute of improvement in physical activity in overall intervention group (divide by 35 minutes)	0.18
Cost per week per minute improvement in vigorous intensity physical activity (divide by 10 minutes)	0.65
Cost per week per minute decrease in sitting time per day (divide by 27 minutes)	0.23
Cost per week per minute of improvement in physical activity among rural participants (divide by 46 minutes)	0.14
Cost per week per minute of improvement in physical activity among non tertiary educated participants (divide by 64 minutes)	0.10

Appendix E

Women's Physical Activity Survey

We are conducting a survey to give us a picture of the normal physical activity levels of mini-marathon participants. You do not have to be active to complete the survey! The survey will take 6-8 minutes to complete. By completing the survey, you will be entered into a draw for a €300 'One 4 All' voucher

Section 1: You and the Mini Marathon

1. **Have you taken part in the mini marathon in previous years?**

No, this is my first time	Yes, once before	Yes, 2-5 times times	Yes, 6-9 times	Yes, 10 or more or more
⬭	⬭	⬭	⬭	⬭

2. **How do you expect to complete this year's mini marathon?**

I expect to walk or mostly walk	I expect to walk and run/jog	I expect to run/jog or or mostly run/jog	I expect to run
⬭	⬭	⬭	⬭

3. **Why are you participating in this year's mini marathon? (Tick all that apply)**

To raise money money for charity	Because a friend asked you to	As a personal challenge	It motivates you to be active	For a day out
⬭	⬭	⬭	⬭	⬭

4. **How would you describe your training/preparation for this year's mini marathon?**

I train continuously most of the time	I have been training for several months before the event	I have started training in the last month before the event	I am not training for the event
⬭	⬭	⬭	⬭

We are interested in finding out about the kinds of **physical activities** that people do as part of their everyday lives. These questions ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the **vigorous** activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

5. **During the last 7 days, did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?**

Yes	No
⬭	⬭

6. **On how many days did you do vigorous activities in the past 7 days?**

   No. of Days ___________________

7. How much time did you usually spend doing vigorous physical activities on one of those days?

Hours ___________ Minutes _____________

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

8. During the last 7 days, did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

Yes ◯ No ◯

9. On how many days did you do moderate activities in the past 7 days?

No. of Days ___________________

10. How much time did you usually spend doing moderate physical activities on one of those days?

Hours ___________ Minutes _____________

11. During the last 7 days, did you walk for at least 10 minutes at a time?

Yes ◯ No ◯

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

12. On how many days did you walk for at least 10 minutes in the past 7 days?

No. of Days ___________________

13. How much time did you usually spend walking on one of those days?

Hours ___________ Minutes _____________

14. How much time do you usually spend sitting on a typical day?

Hours ___________ Minutes _____________

15. How much time do you usually spend watching television on a typical day?

Hours ___________ Minutes _____________

16. **Which statement best describes your current physical activity, and your intentions to be active? (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)**

I am not regularly physically active and do not intend to be so in the next six months ◯

I am not regularly physically active but am thinking about starting to do so in the next six months ◯

I do some physical activity but not enough to meet the description of regular physical activity ◯

I am regularly physically active but only began in the last six months ◯

I am regularly physically active and have been so for longer than six months ◯

17. **Compared to 3 months ago do you think you are now…**

Much more active ◯	About the same ◯	Less active ◯	
More active ◯		Much less active ◯	

18. **The brief statements below are about how YOU feel about doing more sport and physical exercise than you do at present. Consider each statement from YOUR point of view and tick the answer that applies.**

	Strongly Agree	Agree	Disagree	Strongly Disagree
"I am confident I can be regularly physically active even when I am stressed"				
"I am confident I can be regularly physically active even when the weather is bad"				
"I am confident I can be regularly physically active even when I am tired"				
"I am confident I can be regularly physically active even when my family demands a lot of my time"				

Section 2: About You

19. **What age category are you in?**

<20 years	21-29 years old	30-39 years old	4049 years old	50-59 years old	60-69years old	>70 years
◯	◯	◯	◯	◯	◯	◯

20. **What is your average weight?**

______________ Stones _________________ Pounds (Or ________________ Kilos)

21. **What is your average height?**

______________ Foot _________________ Inches (Or ________________ Meters)

22. What is your marital status?

Married/partner without children	Married/partner with children	Single without children	Single with children
◯	◯	◯	◯

23. Are you covered by a medical card?

Yes – full medical card	Yes – GP medical card	No
◯	◯	◯

24. Which of the following best describes where you live? (Tick ONE only)

In a city	◯	Isolated location	◯
In a town	◯	In a village	◯

25. Which county do you live in? ________________________

26. What level of education have you received?

No schooling or primary education	Some secondary education	Complete secondary education	Some or complete third level education	Still in school
◯	◯	◯	◯	◯

Thank you most sincerely for taking part in this survey. We would like to follow up mini marathon participants 2 and 6 months after the event to see whether or not people remain active post-event. This information will help us to plan a series of strategies to help women to remain active in future. If you would be willing to help us with this follow up, please enter a contact name and address below Or, if you would prefer to be contacted by email, please enter your email address (Please Print Details). Also, can you please detail your mother's maiden surname and day of your birthday as an identifier for future surveys.

Name: ________________________ Email ____________________

Address1: ______________________________ Mother's Maiden Surname:

Address 2: _____________________________ Day of Birthday: ___________

Address3: ______________________________

Mini Marathon Three Month Follow Up Survey

It is now three months since the Mini Marathon. Thank you most sincerely for completing our baseline survey and agreeing to this follow up phase. We would like to ask you about your physical activity and lifestyle at this stage. The survey takes about 6 minutes to complete.

Please input your name, e-mail address and/or postal address

____

Please repeat your name, e-mail address and/or postal address

____

What is your mother's maiden surname? ____________________

What is the day of your birthday? (egs: May 19th, Answer = 19) ________________

(These are additional identifiers to help us match your survey to your earlier survey)

27.Did the Mini Marathon help you to become more active?

My physical activity levels did not increase as a result of the Mini Marathon

My physical activity levels increased prior to the Mini Marathon but has since decreased

My physical activity levels increased prior to the Mini Marathon and have been maintained

My physical activity levels were already sufficient and did not change prior to or since the Mini Marathon

28. Compared to 3 and 6 months ago, how active are you now….

	3 months ago	6 months ago
Much less active		
Less active		
About the same		
More active		
Much more active		

29. Which statement best describes your current physical activity, and your intentions to be active? (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)

I am not regularly physically active and do not intend to be so in the next six months

I am not regularly physically active but am thinking about starting to do so in the next six months

I do some physical activity but not enough to meet the description of regular physical activity

I am regularly physically active but only began in the last six months

I am regularly physically active and have been so for longer than six months

The following questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the **vigorous** activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

4. **During the last 7 days, did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?**

Yes ◯ No ◯

5. On how many days did you do vigorous activities in the past 7 days?

No. of Days ___________________

6. How much time did you usually spend doing vigorous physical activities on one of those days?

Hours ___________ Minutes _____________

Think about all the **moderate** activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

8. **During the last 7 days, did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.**

Yes ◯ No ◯

8. On how many days did you do moderate activities in the past 7 days?

No. of Days ___________________

9. How much time did you usually spend doing moderate physical activities on one of those days?

Hours ___________ Minutes _____________

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

9. **During the last 7 days, did you walk for at least 10 minutes at a time?**

Yes ◯ No ◯

11. On how many days did you walk for at least 10 minutes in the past 7 days?

No. of Days ___________________

12. How much time did you usually spend walking on one of those days?

Hours ___________ Minutes _____________

13. **How much time do you usually spend sitting on a typical day?**
    Hours ___________ Minutes _____________

14. **How much time do you usually spend watching television on a typical day?**
    Hours ___________ Minutes _____________

15. The brief statements below are about how your social and physical environment assist you in doing more sport and physical exercise than you do at present. You are asked whether you strongly agree, agree, have no opinion either way, disagree, or strongly disagree. Consider each statement from YOUR point of view and tick the answer that applies.

	Strongly Agree	**Agree**	**No Opinion**	**Disagree**	**Strongly Disagree**
I have someone (family, friends, pets) that I can be active with					
My family and friends encourage me to be active					
My family and friends look after my children so I can be active					
I can be active in the streets/roads around where I live					
There is a green area in my locality where I can be active					

Thank you for participating in this survey

Physical Activity Survey February 2008 – RCT

Thank you for completing our baseline survey and the follow up phases of our Mini Marathon study. We would like to ask you about your physical activity and lifestyle at this stage, prior to your participation in a 6-week print based intervention. The survey takes about 6 minutes to complete.

Please input the following details:
Name ___________________________
Address Line1 _______________________
Address Line 2 _______________________
Address Line 3 _______________________

What is your mother's maiden surname? ____________________
(This is an additional identifier to help us match this survey to a post intervention survey)

The following questions are about any physical activities you have done in the past week.

1. **In the past week, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get from place to place?**

   ____________ No. of times

2. **What do you estimate was the total time that you spent walking in this way in the last week?**

   In hours and minutes
   _________________ hours ___________________ minutes

3. **In the last week, how many times did you do any vigorous gardening or heavy work around the yard, which made you breathe harder or puff or pant?**

   ____________ No. of times

4. **What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard in the last week?**

   In hours and minutes
   _________________ hours ___________________ minutes

   The next question excludes housework and gardening:

5. **In the last week, how many times did you do any vigorous physical activity, which made you breathe harder or puff or pant? (e.g. jogging, cycling, aerobics)**
   ____________ No. of times

6. **What do you estimate was the total time that you spent doing vigorous physical activity in the last week?**

   In hours and minutes
   _________________ hours ___________________ minutes

7. **In the last week, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)**

   ____________ No. of times

8. **What do you estimate was the total time that you spent doing these activities in the last week?**

   In hours and minutes
   _________________ hours ___________________ minutes

9. How much time do you usually spend sitting on a typical day?

__________ hours ______________ minutes

10. **Which statement best describes your current physical activity, and your intentions to be active?**
    (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)

I am not regularly physically active and do not intend to be so in the next six months

I am not regularly physically active but am thinking about starting to do so in the next six months

I do some physical activity but not enough to meet the description of regular physical activity

I am regularly physically active but only began in the last six months

I am regularly physically active and have been so for longer than six months

11. **On a scale of 1-5, where 1 is 'not at all ready' and 5 is 'very ready' how would you rate your readiness to start being more physically active in the next month? (Circle the answer that applies)**

Not at all ready				Very ready
1	2	3	4	5

12. Compared to twelve months ago, do you think you are now…

Much more active than you were then	⬭	Less active than you were then	⬭
More active than you were then	⬭	Much less active than you were	⬭
About the same	⬭	I don't know	⬭

13. The brief statements below are about how YOU feel about doing more sport and physical exercise than you do at present. You are asked whether you strongly agree, agree, have no opinion either way, disagree, or strongly disagree. Consider each statement from YOUR point of view and tick the answer that applies.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
"I am confident I can be regularly physically active even when I am stressed"					
"I am confident I can be regularly physically active even when the weather is bad"					
"I am confident I can be regularly physically active even when I am tired"					
"I am confident I can be regularly physically active even when my family demands a lot of my time"					

14. In the past three months, how often did your family members or friends provide you with any of the following assistance? For each please indicate if it was often, sometimes or never.
(Please tick the box that applies)

	Often	Sometimes	Never
Exercised with you			
Gave you encouragement to keep exercising			
Looked after the children so you could exercise (if appropriate)			
Assisted you with household or other jobs so you could exercise			

15. If I participate in regular physical activity or sports, then:
(Please tick the box that applies)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I will feel less depressed/bored					
I will meet new people					
I will lose weight					
I will feel less tension and stress					
I will improve my health and/or reduce my risk of disease					
I will do better at my job					
I will feel more attractive					
I will increase my energy levels					

16. How often do the following prevent you from getting physical activity?

	Often	**Sometimes**	**Never**
Self conscious about how I look when I do activities			
Lack of interest in physical activity			
Lack of time			
I do not have anyone to do physical activities with me			
The weather is too bad			
I do not enjoy physical activity			
Lack of knowledge on how to do physical activities			
Fear of injury			
Lack of a convenient place to do physical activity			

17. On a scale of 1-5, where 1 is 'very easy' and 5 is 'very difficult' how easy is it for you to walk or be active in your local area? (Circle the answer that applies)

Very easy				**Very difficult**
1	2	3	4	5

Thank you for participating in this survey

Physical Activity Survey May 2008 – RCT

Thank you for completing our baseline survey and the follow up phases of our Mini Marathon study. We would like to ask you about your physical activity and lifestyle at this stage, after your participation in a 6-week print based intervention. The survey takes about 6 minutes to complete.

Please input the following details:
Name ___________________________
Address Line1 ________________________
Address Line 2 ________________________
Address Line 3 ________________________

Please print your mobile number and/or landline number ___________________________________

What is your mother's maiden surname? _____________________
(This is an additional identifier to help us match this survey to a post intervention survey)

---

1. **Did you receive a health related print booklet in the post approximately six weeks ago?**
   Yes ◯ No ◯
2. **Did you read this booklet?**
   I read all of it ◯ I read some of it ◯ I didn't read it ◯
3. **How often have you used/referred to this booklet in the past six weeks?**
   Never ◯ Once ◯ 2-3 times ◯ 4-5 times ◯

The following questions are about any physical activities you have done in the past week.

4. **In the past week, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get from place to place?**
   _____________ No. of times
5. **What do you estimate was the total time that you spent walking in this way in the last week?**

   In hours and minutes
   __________________ hours ____________________ minutes
6. **In the last week, how many times did you do any vigorous gardening or heavy work around the yard, which made you breathe harder or puff or pant?**
   _____________ No. of times

7. **What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard in the last week?**

In hours and minutes

__________________ hours ____________________ minutes

The next question excludes housework and gardening:

8. **In the last week, how many times did you do any vigorous physical activity, which made you breathe harder or puff or pant? (e.g. jogging, cycling, aerobics)**

 _____________ No. of times

9. **What do you estimate was the total time that you spent doing vigorous physical activity in the last week?**

 In hours and minutes

 __________________ hours ____________________ minutes

10. **In the last week, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)**

 _____________ No. of times

11. **What do you estimate was the total time that you spent doing these activities in the last week?**

 In hours and minutes

 __________________ hours ____________________ minutes

12. **How much time do you usually spend sitting on a typical day?**

 ___________ hours _______________ minutes

13. **Which statement best describes your current physical activity, and your intentions to be active?**
 (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)

I am not regularly physically active and do not intend to be so in the next six months

I am not regularly physically active but am thinking about starting to do so in the next six months

I do some physical activity but not enough to meet the description of regular physical activity

I am regularly physically active but only began in the last six months

I am regularly physically active and have been so for longer than six months

14. **On a scale of 1-5, where 1 is 'not at all ready' and 5 is 'very ready' how would you rate your readiness to start being more physically active in the next month? (Circle the answer that applies)**

Not at all ready				**Very ready**
1	2	3	4	5

15. **Compared to two months ago, do you think you are now…**

Much more active than you were then	⬭	Less active than you were then	⬭
More active than you were then	⬭	Much less active than you were	⬭
About the same	⬭	I don't know	⬭

16. **The brief statements below are about how YOU feel about doing more sport and physical exercise than you do at present. You are asked whether you strongly agree, agree, have no opinion either way, disagree, or strongly disagree. Consider each statement from YOUR point of view and tick the answer that applies.**

	Strongly Agree	**Agree**	**No Opinion**	**Disagree**	**Strongly Disagree**
"I am confident I can be regularly physically active even when I am stressed"					
"I am confident I can be regularly physically active even when the weather is bad"					
"I am confident I can be regularly physically active even when I am tired"					
"I am confident I can be regularly physically active even when my family demands a lot of my time"					

17. **In the past three months, how often did your family members or friends provide you with any of the following assistance? For each please indicate if it was often, sometimes or never.**

	Often	**Sometimes**	**Never**
Exercised with you			
Gave you encouragement to keep exercising			
Looked after the children so you could exercise (if appropriate)			
Assisted you with household or other jobs so you could exercise			

18. **(Please tick the box that applies)**

18. If I participate in regular physical activity or sports, then:
(Please tick the box that applies)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I will feel less depressed/bored					
I will meet new people					
I will lose weight					
I will feel less tension and stress					
I will improve my health and/or reduce my risk of disease					
I will do better at my job					
I will feel more attractive					
I will increase my energy levels					

19. How often do the following prevent you from getting physical activity?

	Often	Sometimes	Never
Self conscious about how I look when I do activities			
Lack of interest in physical activity			
Lack of time			
I do not have anyone to do physical activities with me			
The weather is too bad			
I do not enjoy physical activity			
Lack of knowledge on how to do physical activities			
Fear of injury			
Lack of a convenient place to do physical activity			

20. On a scale of 1-5, where 1 is 'very easy' and 5 is 'very difficult' how easy is it for you to walk or be active in your local area? (Circle the answer that applies)

Very easy				Very difficult
1	2	3	4	5

Thank you for participating in this survey

Physical Activity Survey 2009 – Cluster RCT

Thank you for completing our baseline survey and the follow up phases of our Mini Marathon study. We would like to ask you about your physical activity and lifestyle at this stage, after your participation in a 9-week print based programme. The survey takes about 6 minutes to complete.

Please input the following details:
Name __________________________
Address Line1 _______________________
Address Line 2 _______________________
Address Line 3 _______________________

What is your mother's maiden surname? ____________________
What is the day of your birthday? (egs: May 19th, Answer = 19) _______________
(These are additional identifiers to help us match this survey to your earlier answers)

---

1. **Please complete the following table, which asks about the items distributed to you as part of this programme.**

	Booklet on physical activity	Information sheet of local programmes and events	Training Plan	Local Events Information	Pedometer and Booklet
Did you receive each of the items identified above?					
Yes					
No					
Not sure					
Did you read these items?					
I read all of it					
I read some of it					
I didn't read it					

2. **Were you aware of your Local Sports Partnership before this programme?**
   Yes ⬭ No ⬭ Not sure ⬭

3. **Did this programme increase your awareness of local programmes, facilities etc that may help you become more active?**
   No, it didn't help ⬭
   Yes, it helped a little ⬭
   Yes, it helped alot ⬭

4. **Please complete the following table, which asks about your use of and attendance at programmes etc. that were communicated to you.**

Did you contact any of the following to obtain more information about getting more active?

	Local Sports Partnership	Local Leisure Centre	Walking/Cycling/ Athletic Clubs	Meet and Train Groups	Waterford Institute of Technology
Yes					
No					

Did you attend/use any of the following to increase your activity levels?

	Training Plan	Exercise Classes	Meet and Train Groups	Walking Routes	Pedometer
Yes					
No					

Other, please state:

5. **Did this programme help you to become more active?**

My physical activity levels did not increase as a result of this programme ⬭
My physical activity levels increased just after receiving this material but have since decreased ⬭
My physical activity levels increased just after receiving this material and have been maintained ⬭
My physical activity levels were already sufficient and did not change prior to or since receiving this programme ⬭

6. **In your opinion, what could have improved this programme to help you become more active?**
   ____
   ____
   ____

7. **Compared to nine weeks ago, how active are you now….**
   Much more active ⬭
   More active ⬭
   About the same ⬭
   Less active ⬭
   Much less active ⬭

8. **Which statement best describes your current physical activity, and your intentions to be active? (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)**

I am not regularly physically active and do not intend to be so in the next six months

I am not regularly physically active but am thinking about starting to do so in the next six months

I do some physical activity but not enough to meet the description of regular physical activity

I am regularly physically active but only began in the last six months

I am regularly physically active and have been so for longer than six months

The following questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the **vigorous** activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

9. **During the last 7 days, did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?**

Yes ◯ No ◯

10. **On how many days did you do vigorous activities in the past 7 days?**

No. of Days ___________________

11. **How much time did you usually spend doing vigorous physical activities on one of those days?**

Hours __________ Minutes _____________

Think about all the **moderate** activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

12. **During the last 7 days, did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.**

Yes ◯ No ◯

13. **On how many days did you do moderate activities in the past 7 days?**

No. of Days ___________________

14. **How much time did you usually spend doing moderate physical activities on one of those days?**

Hours __________ Minutes _____________

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

15. **During the last 7 days, did you walk for at least 10 minutes at a time?**

Yes ◯ No ◯

16. **On how many days did you walk for at least 10 minutes in the past 7 days?**

No. of Days ___________________

17. **How much time did you usually spend walking on one of those days?**

Hours ___________ Minutes _____________

18. **How much time do you usually spend sitting on a typical day?**

Hours ___________ Minutes _____________

19. **How much time do you usually spend watching television on a typical day?**

Hours ___________ Minutes _____________

20. **The brief statements below are about how YOU feel about doing more sport and physical exercise than you do at present. You are asked whether you strongly agree, agree, have no opinion either way, disagree, or strongly disagree. Consider each statement from YOUR point of view and tick the answer that applies.**

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
"I am confident I can be regularly physically active even when I am stressed”					
"I am confident I can be regularly physically active even when the weather is bad"					
"I am confident I can be regularly physically active even when I am tired”					
“I am confident I can be regularly physically active even when my family demands a lot of my time"					

21. **In the past nine weeks, how often did your family members or friends provide you with any of the following assistance? For each please indicate if it was often, sometimes or never.**
(Please tick the box that applies)

	Often	Sometimes	Never
Exercised with you			
Gave you encouragement to keep exercising			
Looked after the children so you could exercise (if appropriate)			
Assisted you with household or other jobs so you could exercise			

22. How often do the following prevent you from getting physical activity?

	Often	Sometimes	Never
Self conscious about how I look when I do activities			
Lack of interest in physical activity			
Lack of time			
I do not have anyone to do physical activities with me			
The weather is too bad			
I do not enjoy physical activity			
Lack of knowledge on how to do physical activities			
Fear of injury			
Lack of a convenient place to do physical activity			

23. On a scale of 1-5, where 1 is 'very easy' and 5 is 'very difficult' how easy is it for you now to walk or be active in your local area? (Circle the answer that applies)

Very easy				**Very difficult**
1	2	3	4	5

Thank you for participating in this survey

Physical Activity Survey 2009 – Cluster RCT Control Group

Thank you for completing our baseline survey and the follow up phases of our Mini Marathon study. We would like to ask you about your physical activity and lifestyle at this stage. The survey takes about 6 minutes to complete.

Please input the following details:
Name ___________________________
Address Line1 ________________________
Address Line 2 ________________________
Address Line 3 ________________________

What is your mother's maiden surname? _____________________
What is the day of your birthday? (egs: May 19th, Answer = 19) ________________
(These are additional identifiers to help us match this survey to your earlier answers)

---

13. **Did you receive a booklet in the post approximately nine weeks ago?**

    Yes   No

14. **Did you read this booklet?**

    I read all of it   I read some of it   I didn't read it

15. **Compared to nine weeks ago, how active are you now….**
    - Much more active
    - More active
    - About the same
    - Less active
    - Much less active

16. **Which statement best describes your current physical activity, and your intentions to be active? (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)**

I am not regularly physically active and do not intend to be so in the next six months

I am not regularly physically active but am thinking about starting to do so in the next six months

I do some physical activity but not enough to meet the description of regular physical activity

I am regularly physically active but only began in the last six months

I am regularly physically active and have been so for longer than six months

The following questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the **vigorous** activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

5. **During the last 7 days, did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?**

   Yes ◯ No ◯

6. On how many days did you do vigorous activities in the past 7 days?

No. of Days ___________________

7. How much time did you usually spend doing vigorous physical activities on one of those days?

Hours ___________ Minutes _____________

Think about all the **moderate** activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

9. **During the last 7 days, did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.**

   Yes ◯ No ◯

9. On how many days did you do moderate activities in the past 7 days?

No. of Days ___________________

10. How much time did you usually spend doing moderate physical activities on one of those days?

Hours ___________ Minutes _____________

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

10. **During the last 7 days, did you walk for at least 10 minutes at a time?**

    Yes ◯ No ◯

12. On how many days did you walk for at least 10 minutes in the past 7 days?

No. of Days ___________________

13. How much time did you usually spend walking on one of those days?

Hours ___________ Minutes _____________

14. **How much time do you usually spend sitting on a typical day?**

    Hours ___________ Minutes _____________

15. How much time do you usually spend watching television on a typical day?
Hours __________ Minutes ____________

16. The brief statements below are about how YOU feel about doing more sport and physical exercise than you do at present. You are asked whether you strongly agree, agree, have no opinion either way, disagree, or strongly disagree. Consider each statement from YOUR point of view and tick the answer that applies.

	Strongly Agree	**Agree**	**No Opinion**	**Disagree**	**Strongly Disagree**
"I am confident I can be regularly physically active even when I am stressed"					
"I am confident I can be regularly physically active even when the weather is bad"					
"I am confident I can be regularly physically active even when I am tired"					
"I am confident I can be regularly physically active even when my family demands a lot of my time"					

17. In the past nine weeks, how often did your family members or friends provide you with any of the following assistance? For each please indicate if it was often, sometimes or never.
(Please tick the box that applies)

	Often	**Sometimes**	**Never**
Exercised with you			
Gave you encouragement to keep exercising			
Looked after the children so you could exercise (if appropriate)			
Assisted you with household or other jobs so you could exercise			

18. How often do the following prevent you from getting physical activity?

	Often	**Sometimes**	**Never**
Self conscious about how I look when I do activities			
Lack of interest in physical activity			
Lack of time			
I do not have anyone to do physical activities with me			
The weather is too bad			
I do not enjoy physical activity			
Lack of knowledge on how to do physical activities			
Fear of injury			
Lack of a convenient place to do physical activity			

19. On a scale of 1-5, where 1 is 'very easy' and 5 is 'very difficult' how easy is it for you to walk or be active in your local area? (Circle the answer that applies)

Very easy				**Very difficult**
1	2	3	4	5

Thank you for participating in this survey

Appendix F

Factsheet 1: Five tips on how policy makers could assist event organisers and charities in engaging with the health sector to help promote the physical activity message.

- When participants register and receive their entry pack, consider including some physical activity material or links to good physical activity resources. A link to the National Physical Activity Guidelines website provides information about safe and effective exercise for all, and provides further links to other useful resources (http://www.getirelandactive.ie). Another good website is http://www.greatactivity.org, which encourages people to get involved in an event and provides training programmes and practical advice. Information about Fit4Life and Meet and Train groups is also available on www.athleticsireland.ie.
- Ensure that charities and event organisers are using the same physical activity message and brand/logos. It may be possible to include this logo on promotional materials.
- Link with the Local Sports Partnership in your area. They may have lists of groups to whom you could target your event, and could provide you with advice on how to make your event attractive to the greatest number of people possible. Contact details are available online at http://www.irishsportscouncil.ie/Participation/Local_Sports_Partnerships/LSP_Contacts/
- Providing a series of lead-in events can help people use the event as a goal, but gives them small steps to reach that goal. Having follow-on opportunities for people to stay motivated and active is also a good idea, and can help increase your participant numbers in subsequent years. These may not be timed events, but could be just a group walk or run in a local park. Adding a social element, such as a cup of tea afterwards will increase attractiveness.
- Engage the local media in the event with regular prompts to action for people. For example, follow the training progress of a local participant, undertake challenges with free race entry as a prize, or profile local 'Meet and Train' groups.

Factsheet 2: Gathering information on your target audience

- It is easiest to gather this information at registration. You could add questions to your application form (see examples of questions below), or if using on-line entry, add a link to an on-line survey instrument, like Surveymonkey (www.surveymonkey.com). It is quite easy to build a survey and it is free with a survey which has less than 100 responses. A yearly subscription costs 200 US dollars and allows unlimited responses and unlimited surveys. There is no data entry work and simple descriptive data is automatically generated. If you are using hard copy entry forms there is a bit of work in entering and analysing data.
- Think about the questions you want to ask. Consider seeking help on this from a local third level research group. It is useful to understand who your clients are so you can target events to best meet their needs. You might ask their age, whether they are regular event participants and what their motive is for taking part. A scale of answer choices is best. Keep the questions to a minimum, with short answers. It may be useful to contact your local research/education institution for assistance at this stage.
- Event and demographic questions could include:
  See Appendix E.
- There are several options for asking people about their physical activity levels. With large populations, the International Physical Activity Questionnaire (**IPAQ**) is useful and you can compare your participants with the overall Irish population. If you are following a group over time, an instrument like the Active Australia questionnaire is better. Both are shown here. A link to a web page containing these instruments will shortly be available on the Irish Sports Council webpage.

IPAQ

See Appendix E.

Active Australia

See Appendix E.

- You may wish to follow up participants post-event, perhaps to check on satisfaction levels with the event. You need to ask people's permission in order to do this, and should include a piece such as that below. If you want to match up people's original response with this follow up response you will need to also include an identifier, such as mother's maiden name:

We would like to follow up participants to help us improve this event in future. If you would be willing to help us with this follow up, please enter a contact name and address below Or, if you would prefer to be contacted by email, please enter your email address (Please Print Details). Also, can you please detail your mother's maiden surname and day of your birthday as an identifier for future surveys.

- It is also possible to include questions on many other factors, for example on what kinds of events or initiatives people would like in order to get them more active, on whether they would like to join and club and what the barriers are to doing this, or on sports injuries. Always try to use short, tick box questions with a scale of possible answers.

Factsheet 3: Promoting Meet and Train groups

- When people walk or run as part of a group, they are more likely to stay active, and they are more likely to progress towards higher levels of physical activity. The Athletics Association of Ireland (AAI) helps support Meet and Train groups countrywide through the Fit4Life programme. The programme is suitable for beginners through to regular runners, and the emphasis is on meeting with people of a similar ability on a regular basis to walk or run. The AAI have started to train Fit4Life leaders to organise local groups. Details of the Fit4Life groups, supporting training programmes, and how to set up a group can be found on http://www.athleticsireland.ie/content/?page_id=3156.
- There are opportunities to take part in leagues and events wherever you live. A blogspot which provides a good link between groups countrywide is http://womensmeetandtrain.blogspot.com/
- You could form a group at work and walk or jog at lunchtime, or form an informal group amongst neighbours or friends. The web links listed in *Factsheet 1* can help you find the resources you might find useful to progress your training. Also, you can find new routes to run and walk on www.walkjogrun.net
- If you are trying to recruit people to join your group, be innovative! As well as notice boards in leisure centres etc, you could put a notice in the parish newsletter or the church or in children's lunchboxes through schools, and in post offices and libraries. Or organise a dog walking group and put a notice in your local vets' surgery.
- Having a goal makes training more fun and focused. This can be an event, or a fundraising activity, or a treat of a night away! Sometimes it can be motivational to get feedback about how active you are, and pedometers are a low cost, easy way to do this. For examples of how to use pedometers for your group, and where to buy one, go to www.ebay.ie or http://www.youthsportdirect.org/

Factsheet 4: Tips for sports/physical activity promoting agencies including LSPs

1. ***Communication:*** Three quarters of this sample were not aware of LSPs prior to the study but simple communication led to a similar proportion becoming cognisant of this local entity at follow up, high recall rates and favourable changes in high intensity activity and sedentary behaviour. LSPs engage in hugely beneficial practices, including the development of newsletters and websites, and the provision of events and programmes designed to directly increase physical activity. It is essential that these efforts are communicated to individuals in their locality to instigate similar beneficial changes.
2. ***Dissemination of information:*** Generating databases of individuals' names and contact details as well as their activity status and preferences for activity can assist in the overall communication of the workings of the LSP. At any opportunity, gather these contact details and ask simple questions like the one underneath to assist the provision of more tailored information to the target group of interest. This undertaking will simultaneously assist the targeting of high priority groups; a core function of LSPs

   Which statement best describes your current physical activity, and your intentions to be active? (Regular physical activity means undertaking a half an hour of at least moderate physical activity on most days of the week)

   I am not regularly physically active and do not intend to be so in the next six months ○

   I am not regularly physically active but am thinking about starting to do so in the next six months ○

   I do some physical activity but not enough to meet the description of regular physical activity ○

   I am regularly physically active but only began in the last six months ○

   I am regularly physically active and have been so for longer than six months ○
3. ***Evaluation:*** Although some evaluation is undertaken by LSPs, a more concerted effort is required. Asking some basic questions before and after events (detail attached) can provide some assessment of a particular initiative and merits for/against its replication. Evidence of success can assist funding applications and wider dissemination of the programme in question while evidence otherwise can inform better future allocation of funds. Evaluation can also contribute to the aforementioned database.

4. ***Motives for participation:*** LSPs are charged with promoting physical activity among hard to reach, at risk groups and thus must consider the specific needs of these cohorts. Strategies identified earlier will assist this but it is also important to remember that motives for participating in activity may be quite different among these sub groups than the general population and already active individuals. For example, there is a link between participation and the benevolent nature of Irish communities that may merit further exploitation. Also, physical activity, may benefit from the adoption of a 'trojan horse' approach where physical activity is packaged as something more than a health requirement and a difficult, unpleasant experience but rather an enjoyable, worthy venture

5. ***Additional suggestions for physical activity promotion:***

- Provision of (more) information about opportunities to be active is warranted. Such information can be acquired from the Irish Heart Foundation, Irish Sports Council and Coillte websites, as well as local tourism sites, heritage sites, commercial 'What's On' guides and from Athletic Association of Ireland walking and training groups. LSP's should avail of information that is already available and use their individual vehicles of communication to inform where and how to avail of this detail.
- The provision of pedometers is another useful endeavour. These can be purchased cheaper in bulk and are a simple motivational tool to prompt activity. Providing additional information about how and when to use the pedometer is also worthwhile.
- More physical activity events at a regional level should be promoted and supported. It is unlikely that LSP's have time to organise these initiatives but instead could advocate their development by local running/walking groups and clubs, charity organisations or community groups.
- Greater or more cohesive partnerships could be fostered between all relevant health and sport promoting agencies in and between particular regions. Suggestions offered here could be disseminated to and adopted by all groups to facilitate a more collaborative, sustained effort to promote one common physical activity message. The development of Irish guidelines for physical activity (www.getirelandactive.ie) should assist this process.

Factsheet 5: Basic Cost Assessment

- Firstly, to facilitate a cost assessment of a particular endeavour to promote physical activity, its impact on physical activity must be quantified. This can be achieved by asking some simple questions prior to and following the initiative in question. Examples of and information about these is provided underneath and is also available from the following source:

The UK Health Promotion and Health Economics Forum. Moving from evaluation into economic evaluation: a health economics guide for health improvement programmes. Welsh Assembly Government, 2007.

- Secondly, a detailed inventory of all costs associated with the strategy in question must be recorded. These include person hours as well as administration, postage and programme costs. Person hours can contain time spent doing the following; developing the idea, in meetings about the idea, generating databases, data entry and analysis, photocopying, phone calls, emailing, devising programme content and packing envelopes. Administration costs can include costs of phone calls, paper, labels, envelopes, subscription to online data collection and photocopies. Postage refers to all costs associated with mail shots, questionnaire dissemination, reminder letters etc. Finally, programme costs includes purchase or hire of any specific equipment such as pedometers, hiring facilities or community centres, specialists to deliver the programme, provision of tea/coffee and transport expenses. These lists are not exhaustive but should suggest how important it is to record all costs, however minor they may appear, to conduct an accurate cost assessment.
- The collection of information on the impact and cost of the programme will facilitate the following:
- Calculate the net change in physical activity in minutes,
- Calculate the total cost of the programme,
- Divide the total cost by the number of participants in the programme (just those who completed pre and post questionnaires?)

- Divide the cost per participant by the number of months/weeks the programme ran for to generate cost per participant per month/week
- Divide the cost per participant per month/week by the number of minutes of change in physical activity. This will present the cost of every one minute increase in physical activity per participant per month/week and a satisfactory estimate of the cost effectiveness of the programme.
- This information can be used to make a stronger case for investment in physical activity promotion; we need to demonstrate that it is good value for money. Some comparable costs of programmes and what they entailed are presented in the table underneath:

Author/Programme	Programme Content	Programme Cost
Lane et al; Mini marathon participants	Print information about promoting activity, opportunities to be active in locality, pedometers, training plans	18 cent per minute improvement of physical activity per participant per week
Sevick et al (2007); Project Stride	Low contact, print information, provision of tailored feedback	57 cent per minute improvement of physical activity per participant per month