The ECAHB Take PART study: An Investigation of the relationship between physical activity, the transtheoretical model of behaviour change and social support for physical activity among Irish Adolescents.

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This thesis is submitted in fulfilment of the requirements for a M.Sc. Degree by Research at the Centre for Sport Science and Health in Dublin City University

I declare that the work submitted is my own work, that any data presented is accurate, were collected and analysed by myself and that appropriate credit has been given where reference has been made to the work of others.

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Dedication

This thesis is dedicated to the memory of Jacinta O'Brien, who gave me the encouragement and inspiration to continue with my studies. Ar dheis Dé go raibh a Anam dílis.

"Those who bring sunshine to the lives of others cannot keep it from themselves." (James Barrie)

Abstract

Physical inactivity has been identified as a risk factor for coronary heart disease (CHD) and Obesity (Pate, R. R. et al., 2002), with adolescents particularly at risk. The 'Take PART' study examines the relationship between physical activity, the transtheoretical model (TTM) of behaviour change and social support for physical activity, while also providing physical activity and health behaviour data.

A self-report questionnaire was used to quantify physical activity level, the TTM variables and social support. Regular physical activity was defined as ≥ 60 minutes of moderate-vigorous physical activity (MVPA) on four or more days per week. Physical measures included body mass index and aerobic fitness (20-MST). Structural Equation Modeling was used to test a hypothesised relationship between the TTM and social support.

A total of 939 students (age 16.04 yrs ± *0.66*; mean ± *s*), 60% female, participated in this cross sectional study. Sixty five per cent of participants were not regularly active (NRA), with more NRA females (70% vs. 58%, p <0.001). The NRA group exhibited lower aerobic fitness (46.5 ± 24.3 runs Vs 62.7 ± 29.9 runs, p <0.001) and participated in less leisure time physical activity (260 Vs. 483 minutes per week, p<0.001). Five percent of the adolescents were classified as obese, with 17% overweight. The stage distribution of the overall sample was Precontemplation (3.1%); Contemplation (11.8%); Preparation (34%); Action (9.1%); Maintenance (41.9%). A hypothesised TTM model, with the new model replacing pros and cons with social support, explained 70% of the variance in physical activity (χ^2(15, N=675)=18.71, p =0.23, GFI=0.99, AGFI=0.98, RMSEA=0.02).

Regular physical activity was associated with higher aerobic fitness, leisure time physical activity, self-efficacy and social support. Interventions need to focus on increasing levels of physical activity as a weight management strategy for youth, whilst incorporating the determinants of self-efficacy and social support

Publication 1

Submitted and accepted for presentation at Annual BASES (British Association of Sport and Exercise Science) conference, Liverpool, 2004

The '*Take PART*' study of activity levels of Irish adolescents

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Physical inactivity has been identified as a risk factor for coronary heart disease (CHD), obesity and type II diabetes mellitus (Booth *et al.*, 2000: *Journal of Applied Physiology*, **88**, 774-787).(Pate, R. R. et al., 2002) Adolescence is a target group for physical activity promotion because of recent concern that many diseases have their origins in the young (Gutin and Barbeau, 2000: In *Physical Activity and Obesity*, edited by C. Bouchard, Champaign, I.L.: Human Kinetics). The 'Take PART' study (**P**hysical **A**ctivity **R**esearch for **T**eenagers) examines Irish adolescent physical activity behaviours. Its purpose was to investigate physical activity levels in Irish adolescents, and to explore the influence of Body Mass Index (BMI), self-efficacy and social support on this behaviour. Self-Efficacy is the confidence one has in one's ability to perform a desired behaviour, for example physical activity. Social Support is a key element of the social environment and has been found to influence participation in physical activity (Steptoe *et al.*, 1997: *Preventive Medicine*, 26, 845-854).

A one-stage cluster sampling method was used to select schools from a health board region, with clusters based on school type, classification and geographic location. A total of 939 students (age 16.04 yrs ± 0.66; mean ± *s*), 60% female, participated in this cross sectional study. A self-report questionnaire was used to quantify physical activity level, sedentary behaviours, exercise self-efficacy and social support. Regular physical activity is defined as participating in ≥ 60 minutes of moderate-vigorous physical activity (MVPA) on most or all (≥ 4) days of the week (Pate *et al.*, 1998: In *Young and Active? Young people and health-enhancing physical activity – evidence and implications,* edited by Biddle *et al.*, London: Health Education Authority). High Sedentary leisure habit (HSLH; in the form of television watching) was defined as > 2 hours per day. Both family and peer social support was measured

independently. Physical measures included height (m) and body mass (kg), these were used to determine BMI. Aerobic fitness was measured via the 20-metre shuttle run test (20MST) with results presented as the total number of runs completed. Sixty Five per cent of participants were not regularly active (NRA), with more females than males in this category (70% vs. 58%, $P<0.001$). The NRA group exhibited lower aerobic fitness (46.5 ± 24.3 runs Vs 62.7 ± 29.9 runs, $P<0.001$), and were more likely to watch > 2 hours of television per day (59% vs. 46%, $P<0.05$) than their regularly active (RA) counterparts. Based on the BMI classifications provided by Cole and colleagues (2000: *British Medical Journal*, **320**, 1240-1245), 17% and 5% of the adolescents were classified as overweight and obese respectively, with 9% of the sample fitting the underweight criteria. A higher proportion of obese individuals had a HSLH (61.5% vs. 38.5%, $P<0.05$) and lower aerobic fitness (32.6 ± 18.9 runs vs. 55.6 ± 27.3 runs, $P<0.001$) than normal weight participants. In relation to exercise self-efficacy, the RA group had a higher mean score than the NRA's (6.15 ± 1.63 vs. 4.86 ± 1.67, $P<0.01$), and males scored higher than females (5.85 ± 1.75 vs. 4.95 ± 1.68, $P<0.01$). The RA group reported a higher average social support score than their NRA counterparts (31.15 ± 6.36 vs. 26.8 ± 6.15, $P<0.001$). Of the NRA group, males scored higher on the peer (15.45 ± 3.31 vs. 14.39 ±3.16, $P<0.05$) and the family (12.59 ± 3.83 vs. 11.72 ± 4.03, $P<0.001$) social support scale than females. Similarly, the RA males scored higher than females on both the peer (17.32 ± 3.32 vs. 15.82 ± 3.01, $P<0.001$) and family (15.14 ± 4.08 vs. 14.11 ± 4.43, $P<0.05$) scales.

A large proportion of the sample was not regularly active and a high number were overweight or obese. Higher levels of self-efficacy and social support were associated with higher levels of activity. Interventions need to focus on increasing levels of physical activity as a weight management strategy for youth, whilst self-efficacy and social support appear to be determinants that facilitate physical activity adherence. Further research is needed to identify the barriers to activity in Ireland for this population.

Publication 2

Presented (oral presentation) at conference 'Research on the TTM: Where are we now, where are we going?' University of Marburg, Germany, August 24th, 2004.

"The 'Take PART' study: An investigation of Irish adolescent physical activity behaviour"

E Foley, C Woods, DO Gorman, J Kearney, N Moyna (IRL)

Regular physical activity is essential during adolescence to maintain normal development and to establish lifestyle physical activity patterns. Adolescence is a target group for physical activity promotion because of recent concern that many diseases have their origins in the young [1]. The 'Take PART' study (Physical Activity Research for Teenagers) examined Irish adolescent physical activity behaviour; it is guided by the Transtheoretical Model (TTM).

Schools, selected via one-stage cluster sampling procedure, were targeted and cross-sectional data on 939 students (age 16.04 yrs ± 0.66; mean ± s), 60% female was collected. Physical activity was measured via an adolescent screening measure [2] and an ordered-categorical stage of change instrument [3]. Regular physical activity was defined as participating in at least 60 minutes of moderate-vigorous physical activity (MVPA) on most or all (>/=4) days of the week [4]. A 30-item instrument measured the processes of change [5]. Aerobic fitness was measured via the 20-metre shuttle run test (20MST).

Sixty Five per cent of participants were not regularly active (NRA), with more females than males in this category (70% vs. 58%, P<0.001). The NRA group exhibited lower aerobic fitness than the regularly active (RA) group (46.5 ± 24.3 runs Vs 62.7 ± 29.9 runs, P<0.001). The stage distribution of the sample was Precontemplation (3.1%), Contemplation (11.8%), Preparation (34%), Action (9.1%) and Maintenance (41.9%). A logistic regression analysis was performed, with physical activity as the dependent variable (divided into RA versus NRA) and the ten processes of change as the independent variables. The regression model was reliable (c2 = 138.38, df = 10, p <0.001), with a prediction success of 71%. The significant

predictors of regular activity were counter-conditioning (OR, 1.20; 95% CI, 1.12-1.29) and self-liberation (OR, 1.14; 95% CI, 1.05-1.24). Therefore a one unit increase in counter conditioning was associated with a 20% increase in the odds of being RA and a one unit increase in self-liberation was associated with a 14% increase in the odds of being RA.

In conclusion, a large proportion of the adolescents in this study were not regularly active. There is a need for stage matched physical activity interventions in Ireland. These should emphasise counter conditioning, or substituting a healthy for previously unhealthy behaviour; and self-liberation where an individual's belief and commitment in their ability to adopt and maintain a healthy behaviour is strengthened.

Publication 3

Some of the material presented in this section has previously featured in a report written for the East Coast Area Health Board (Woods, C. B., Foley, E., O' Gorman, D., Kearney, J., & Moyna, N., 2004) who part-funded this project.

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LIST OF ABBREVIATIONS & ACRONYMS

A	Action
BMI	Body Mass Index
BP	Blood Pressure
C	Contemplation
CC	Counterconditioning
CHD	Coronary Heart Disease
CR	Consciousness Raising
CVD	Cardio-Vascular Disease
DR	Dramatic Relief
ECAHB	East Coast Area Health Board
ER	Environmental Reevaluation
HBSC	Health Behaviours of School Children
HR	Helping Relationships
LTPA	Leisure Time Physical Activity
M	Maintenance
MVPA	Moderate to Vigorous Physical Activity
NHANES	National Health and Nutrition Examination Survey
NIDDM	Non Insulin Dependent Diabetes Mellitus
NRA	Not Regularly Active
P	Preparation
PC	Precontemplation
PE	Physical Education
POC	Process of Change
RA	Regularly Active
RM	Reinforcement Management
SC	Stimulus Control
SD	Standard Deviation
SEM	Structural Equation Modeling
SES	Socio Economic Status
SL	Self-Liberation
SLÁN	Irish Adult Health Behaviours Study
SO	Social Liberation
SOC	Stage of Change
SR	Self Reevaluation
Take PART	Study name: Physical Activity Research for Teenagers
TTM	Transtheoretical Model
20MST	20 Metre Shuttle-run Test

Chapter 1: Introduction

Rationale

The growing epidemic of obesity is now a major health concern in many western societies. There is considerable media attention on the wider health risks of our sedentary lifestyles in the industrialised 21st century (Department of Health, 2004). Evidence shows that the health impacts of inactivity in terms of coronary heart disease (CHD) is comparable to that of smoking and are almost as great as high cholesterol levels (McPherson, Britton, & Causer, 2002). Physical inactivity has been identified as a risk factor for CHD and with an increased risk of developing chronic diseases such as obesity, Type II diabetes mellitus, hypertension, osteoporosis and colon cancer (Pate et al., 2002). Table 1.1 provides an overview of the level and strength of evidence for the relationship between physical activity and a range of Conditions. This Table, which provides a simplified summary of the nature and volume of evidence available, was compiled for the chief medical officers report in the UK. It is divided into preventive and therapeutic effects of physical activity for a range of chronic conditions. Following an electronic literature search of the Cochrane library, Medline and Embase in February 2002, expert reviewers synthesised and interpreted the existing and new evidence on their subject. A review panel, consisting of academic professionals from Exercise and Health departments, then assessed and summarised the findings before final appraisal of the evidence by advisory groups and peer reviewers. The column entitled 'level of evidence' refers to the volume and quality of the available evidence, whereas 'strength of effect' indicates how positive, or otherwise, the findings are. The expert reviewers decided upon three broad descriptors for both headings. Level of evidence was categorised as low, medium or high, whereas strength of effect was categorised as weak, moderate or strong.

Although many of these diseases rarely manifest before middle adulthood, it is important for children and youth to lead an active lifestyle and thereby improve their risk factor status. According to the European Heart Health Initiative (2001) many of the serious diseases have their origins in younger age. Childhood and adolescence form the early phases of accumulated exposure to risk factors throughout the lifecycle

Table 1.1. Level and strength of evidence for a relationship between physical activity and contemporary chronic conditions

	Preventive effects			Therapeutic effects	
Condition	**Level of evidence**	**Strength of effect**	**Evidence of dose response relationship**	**Level of evidence**	**Strength of effect**
Cardiovascular disease					
Coronary heart disease	High	Strong	Yes	Medium	Moderate
Stroke - occlusive	High	Moderate	-	Low	Weak
- haemorrhagic	Medium	Weak	-	Low	Weak
Peripheral vascular disease	No data/ insufficient data	-	-	Medium	Moderate
Obesity and overweight	Medium	Moderate	-	Medium	Moderate
Type 2 diabetes	High	Strong	Yes	Medium	Weak
Musculoskeletal disorders					
Osteoporosis	High	Strong	-	Medium	Weak
Osteoarthritis	No data/ insufficient data	-	-	Medium	Moderate
Low back pain	Medium	Weak	-	High	Moderate
Psychological well-being and mental illness					
Clinical depression	Low	Weak	-	Medium	Moderate
Other mental illness	No data/ insufficient data	-	-	Low	Weak
Mental well-being	-		-	Medium	Moderate
Mental function	Low	Moderate	-	Low	Weak
Social well-being	No data/ insufficient data	-	-	Low	Weak
Cancer					
Overall	Medium	Moderate	Yes		
Colon	High	Strong	Yes		
Rectal	Medium	No effect	-	No data/ Insufficient data	-
Breast	High	Moderate	Yes		
Lung	Low	Moderate	-		
Prostate	Medium	Equivocal	-		
Endometrial	Low	Weak	Yes		
Others	Low	Equivocal	-		

Taken from Department of Health, P. A. H. I. a. P. (2004). *At least five a week* London: Department of Health

and high levels of a range of risk factors, for instance obesity or low bone mineral density can act as markers of morbidity and mortality.

Regular physical activity is essential during childhood and adolescence in order to maintain normal growth and development and also to establish lifestyle physical activity patterns that will reduce risk factors for health problems in later life. Current physical activity guidelines recommend that youth should participate in physical activity, of at least moderate intensity, for an average of one hour per day (Pate, Corbin, & Pangrazi, 1998), however recent population surveys highlight that young people may not be meeting these guidelines (Sallis, Prochaska, & Taylor, 2000); (Centres for Disease Control and Prevention, 2000). The most recent Health Behaviours of School-Aged Children (HBSC) study (Kelleher et al., 2003) reports that participation in vigorous physical activity on four or more days per week by Irish children decreases from 59% of 10-11 year olds and 53% of 12-14 year olds to 35% of 15-17 year olds. This result mirrors a similar pattern observed in 1999, with the proportions decreasing from 63% to 58% to 40% respectively.

Adolescence provides an opportunity to influence attitudes towards activity, as the majority of adolescents are still in the schooling system and under their parent's control. It is during the adolescent stage that identities are shaped and hence the belief that this is the time when behaviours are established. It is believed that adolescence is an important period for learning health-related behaviour patterns that will carry over into adulthood (Andersen & Wold, 1992). Blair suggests that adolescent physical activity improves adult health in three ways (Blair, Clark, Cureton, & Powell, 1989). Firstly, the direct effect of activity will improve adolescent health and in turn be beneficial to adult health. Secondly, an active lifestyle will have direct health benefits in later years by reducing risk factors. Lastly, an active adolescent is more likely to be an active adult thus lowering risk of disease.

Many studies have tracked exercise behaviours from adolescence to adulthood (Kelder, Perry, Knut-Inge, & Lytle, 1994; Malina, 2001). The results, though inconclusive, indicate that an individual's physical activity/ inactivity behaviour is more likely to remain stable, rather than change, over time (Barnekow-Bergkvist, Hedberg, Janlert, & Jansson, 1996; Malina, 2001). This suggests that adolescence is an important time for setting physical activity patterns that will continue through into adulthood and physical activity promotion should thus be intensified among this age group. However, before interventions can be designed there is a need for more

comprehensive baseline data on the physical activity levels and determinants of Irish adolescents.

Transtheoretical Model

The Transtheoretical Model (TTM) is an integrative model of behaviour change, which offers a framework for understanding and intervening with human intentional behaviour change (DiClemente & Prochaska, 1999). This model describes how people acquire a positive behaviour or modify problem behaviour. It has been applied to a wide variety of problem behaviours, in particular health risk and health protective behaviours such as smoking cessation, exercise, low fat diet, alcohol abuse and drug addiction (DiClemente et al., 1999). The TTM is the most widely validated stage model and has been applied to adolescents in the last few years in an attempt to understand this at-risk population. The TTM recognises that people differ in their readiness to adopt new behaviours and this readiness to change can be understood in terms of four key constructs. Central to the model is the stages of change, which provides a temporal dimension to the model. The model also includes a series of independent variables known as the processes of change, and a series of outcome measures including decisional balance and self-efficacy.

The TTM has been used as a behavioural surveillance tool (Nigg, Maddock, Barnett, & Marshall, 2004) to identify the proportions of the population who are at risk of not achieving the health benefits associated with physical activity. This surveillance assists in understanding population readiness for behaviour change and thereby assists in targeting health promotion efforts and resource allocation. This provides health professionals with the guidance to target messages with maximum impact.

Social Support

The social environment plays a huge role in an individual's lifestyle choices. Social relationships and social support are key elements of the social environment and exert an influence over health behaviours and health status (Stahl et al., 2001). The main sources of support are from family and/or peer and can be direct or indirect. Direct support includes transport provision, paying fees or participating in the activity with the child. On the other hand, indirect support is not tangible, for example positive reinforcement, encouragement, or acting as a role model. While parents and

family members continue to influence their child's health behaviours, peer influence actually increases with age (Eccles, 1999). Social support is only a minor feature of the TTM, incorporated as helping relationships in the processes of change. Based on the findings of positive association with physical activity (Sallis et al., 2000), it may be that social support is a major determinant of physical activity and should be incorporated on a larger scale in the TTM. There is a need for research to examine the impact of the addition of a social support variable to the ability of the TTM to adequately explain exercise behaviour in youth.

Justification for the Study

At present, there are few studies examining the exercise behaviours of Irish adolescents. The HBSC offers limited data on the physical activity levels of Irish youth as it only includes screening physical activity questions. As the HBSC focuses on a range of health behaviours, it is important to examine physical activity in more detail. One of the strategic aims of the National Health Promotion Strategy 2000-2005 is to increase participation in regular, moderate physical activity, with a specific objective of identifying models of good practice, which encourage young people (especially young girls) to participate in regular, moderate physical activity (Department of Health and Children, 2000). While the HBSC results were useful in identifying the problem, more detailed research is now needed to guide intervention. To develop effective physical activity interventions for this population, influences on and determinants of, activity levels need to be understood. While many of the influences and determinants of physical activity may be applicable to all adolescents, research needs to be country and culture specific to identify factors that may be the key to physical activity promotion. This will thus allow the researcher to design a more tailored intervention.

Cross-sectional studies of association will help identify the potential mediators of physical activity, which can then be targeted for change in interventions. The TTM offers a suitable framework for examining exercise behaviour, with its multi-stage model approach. Until now, the TTM has not been applied to the Irish adolescent population and there is a need for baseline data on our nation's physical activity behaviours. The study will also investigate whether social support is an important

determinant of physical activity for this population and whether a social support construct should be included in the TTM.

The Take PART study is also the first Irish study to combine self-report data and physical data in an effort to understand exercise behaviour. This allows the researcher to compare results and determine which results best describe and/or predict exercise behaviour.

Aim

The aim of this study is to investigate the relationship between physical activity, the transtheoretical model of behaviour change and social support for physical activity. The specific objectives of this study are:

1. To establish data on an Irish adolescent population in relation to physical activity behaviour, aerobic fitness level and physical health status.
2. To examine the effect of gender, age, area of residence and socio-economic status on physical activity behaviour, aerobic fitness level and physical health status.
3. To investigate the relationship between self-report physical activity and aerobic capacity.
4. To investigate the impact of sedentary behaviours, namely T.V. watching and inactive commuting to school, on physical activity.
5. To examine if level of social support is associated with level of physical activity involvement in youth; and if this association is modified by type of social support provided (i.e. parents or peer support).
6. To assess the efficacy of the core and independent variables within the TTM for predicting physical activity in a sample of Irish youth.
7. To develop the TTM by adding social support as an independent variable; assessing its ability to improve the likelihood of the TTM to explain physical activity avoidance or adherence amongst youth.

Limitations

- Only school going 15-17 year olds were included in this study as school was the most feasible site for accessing large numbers of this age group. However,

this excludes adolescents who do not attend school (early school leavers or irregular attendees).

- Due to the self-report nature of the questionnaire, the answers given may not have been entirely accurate. In order to limit social desirability bias, participants were ensured that all information was confidential and they were encouraged to be as honest and accurate as possible. Names and personal identifiers were removed from the questionnaire before completion and the research team stressed the importance of accurate data. More objective physical measures were also assessed for comparative purposes.
- Both schools and students were given the choice to participate so over-sampling was required to allow for refusals.
- Schools without facilities for the aerobic fitness test, either indoor or outdoor, were not included.
- An automated blood pressure cuff was used for measuring blood pressure, as it was not practical to use manual blood pressure cuff. Firstly it would have taken too much time to measure blood pressure manually and secondly it would have been difficult to hear the change in pressure due to the noise level in the testing sites. Automated blood pressure cuffs are not as accurate as manual measurements and this may affect results.

Chapter 2: Literature Review

The following section is a review of the literature on physical activity, adolescents and the associated theories and models. Literature published between 1980 and 2004 will be examined. The databases used in the collection of literature were ScienceDirect (www.sciencedirect.com), PubMed (http://www.ncbi.nlm.nih.gov) and Swetswise (http://www.swetswise.com). The following keywords were entered into each database: physical activity, exercise, adolescence, youth, health, obesity, transtheoretical model and social support.

Adolescence

Introduction

Adolescence has been described as a state or process of growing up and also as the period of physical and psychological development from the onset of puberty to maturity. It is one of the most important periods of development in the life cycle as it is during this time, that one's personal identity begins to be constructed. According to Dacey and Kenny (1997), personal identity is the "the set of beliefs about the self concerning how one changes over time yet remains the same individual, how one is different from others, and how one is able to act independently"(p.165). Therefore the construction of personal identity during adolescence may have repercussions on adulthood and the type of health behaviours the individual will be involved in.

Theories of Development

During the 1920s, a biologist named Jean Piaget (1896-1980) proposed a theory of cognitive development of children and caused a new revolution about how thinking develops. He hypothesised that children are born with reflexes that are used to adapt to the environment. These reflexes are quickly replaced with constructed schemes. As these schemes become increasingly more complex, that is, responsible for more complex behaviours, they are termed structures. As one's structures become more complex, they are organised in a hierarchy, from general to specific (Huitt & Hummel, 2003).

Piaget identified four stages in cognitive development. The final stage relates to the adolescent period, and is termed the Formal Operational Stage. During this stage intelligence is demonstrated through the logical use of symbols related to

abstract concepts. As adolescence progresses, one's facility with abstract thinking skills allows one to formulate complex and logical theories of social, political and moral philosophy- views of what could be, or should be (Dusek, 1996). This is considered as the ultimate stage of development and it is thought that not every child reaches this stage.

Erik Erikson, a leading psychosocial theorist from the mid 20th century, viewed human development as an interaction between one's genes and the environment (Dacey & Kenny, 1997). His theory of psychosocial development is made up of eight stages, through which human life progresses. Each stage relates to a certain time period, however these stages are not set in stone. Rather, the sequence of when the stages occur is fixed. Within each stage, there is a crisis that needs to be resolved before the individual can move on. Stage five relates to the adolescent period (12 to 18 years) and the psychosocial crisis that occurs at this time is termed "identity and repudiation versus identity confusion". Erikson believed that during this time, the main task of the adolescent is to achieve a state of identity. He also suggested that identity confusion is far more likely in a democratic society because there are so many choices (Dacey et al., 1997). Dusek (1996) believes that the qualities of Formal Operational thinking also apply to the resolution of Erikson's identity crisis, that is in order to have an identity crisis, one must realise that they are different and this requires abstract and logical thinking.

Adolescence has also been termed as "the stage in which the individual is required to adapt and adjust childhood behaviours to culturally acceptable adult forms" (Dusek, 1996; p.4). It is understandable why this time period has often been referred to as "turbulent" as for many teenagers; this is a time for bridging the gap from childhood to adulthood, developing critical thinking while striving for a state of identity. Furthermore, it is believed that adolescence is an important period for learning health-related behaviour patterns that will carry over into adulthood (Andersen et al., 1992), for example healthy eating patterns and physical activity. However, unhealthy behaviours such as smoking, sedentary lifestyle and overeating may also be traced back to adolescence (Kelder et al., 1994). The type of lifestyle that one leads during childhood and adolescence is particularly important as "risk-related behaviours can be viewed as social behaviours that are learned, developed, and become prevalent in childhood and adolescence"(Perry et al., 1990; p.409). It is for these reasons, that the behaviours of this age group have been the target of extensive

research (Kelder et al., 1994). However, there is a lack of studies examining the health behaviours of Irish adolescents, thus making health promotion for this age group difficult. This study will investigate the behaviour of physical activity amongst this target group in Ireland, with the aim of providing baseline data that will guide future research and health promotion.

Physical Activity

Physical activity has been generally defined as "any bodily movement that is produced by skeletal muscles that results in energy expenditure" greater than that at rest (Caspersen, Powell, & Christenson, 1985; p.126). Physical activity is an umbrella term used to describe exercise, sport, leisure time activities and activities of daily living. Caspersen and colleagues (1985) describe exercise as a subset of physical activity, which is planned, structured and repetitive with the aim to improve or maintain physical fitness. Physical fitness, which is brought about through physical activity or exercise, is the set of attributes that allow individuals to carry out daily tasks without undue fatigue (Caspersen et al., 1985). These attributes include cardiovascular endurance, muscular strength, flexibility, body composition and aerobic capacity. Sport is defined as an activity that is governed by rules, structured and competitive and involves gross motor movement characterised by physical strategy, prowess and chance (Rejeski and Brawley, 1988 cited in (Biddle & Mutrie, 2001). Leisure time activities are activities outside of work or school and daily living activities refer to activities that are required to carry out daily routines such as housework, gardening, shopping etc.

Physical Activity & Adolescents

Physical activity is essential throughout the life cycle, however it is particularly fundamental during childhood and adolescence in order to maintain normal growth and development and also to establish lifestyle patterns that will reduce risk factors for health problems in later life (Berger, Pargman, & Weinberg, 2002).

Physical Activity Guidelines for Youth

Current physical activity guidelines recommend that all children and youth should participate in physical activity that is of at least moderate intensity for an

average of one hour per day on most or all days of the week. It is also recommended that although young people should be physically active nearly every day, the amount of physical activity can appropriately vary from day to day in type, intensity, duration and amount (Pate et al., 1998). The recommendation for youth includes the idea of adding up activity over the course of the day, thus allowing the accumulation of short bouts of activity, which is particularly important for young people who do not tend to take part in sustained activity of vigorous intensity (Cavill, 2001). The National Heart Alliance in Ireland also supports this recommendation in their most recent position statement (National Heart Alliance, 2001).

The definition of regular physical activity for youth is somewhat vague, as it recommends physical activity on MOST or all days of the week. This leaves the guideline open to interpretation, as there is no consensus on how many days MOST refers to. For the purposes of this research, regular physical activity will be defined as 60 minutes of moderate-vigorous physical activity (MVPA) on four or more days of the week. The HBSC study uses a criterion of vigorous physical activity on 4 or more times per week to categorise regular physical activity. Prochaska and colleagues used five or more days as the identifier for regular physical activity (Prochaska, Sallis, & Long, 2001), when designing a screening measure for use with adolescents. However, it was felt that a cut off of five days per week was too stringent, whereas four days is a more conservative estimate.

Current Levels of Physical Activity among Youth

In recent years, population surveys show that many young people are not meeting physical activity guidelines (Centres for Disease Control and Prevention, 2000; Sallis et al., 2000). It has been reported that physical activity among adults declines with increasing age (Nigg & Courneya, 1998) and this trend has a biological basis (Rowland, 1999). The decline in physical activity with age is largely intrinsic, the result of a fall in central drive as well as a decreasing skeletal muscle mass in older years (Rowland, 1999). Unfortunately, it seems that this decline may be occurring prior to adulthood, which would indicate the influence of external modifiable factors. The evidence suggests that the decline is accentuated during teenage years and it is feared that if a sedentary lifestyle is established at a young age, then it may be incorporated into the adult lifestyle (Reynolds et al., 1990)

The most recent health behaviours of school-aged children (HBSC) study (Kelleher et al., 2003) reported that participation in vigorous physical activity (≥4 days a week) by Irish children decreased from 59% of 10-11 year olds and 53% of 12-14 year olds to 35% of 15-17 year olds. This trend was also evident from the 1999 HBSC survey, which found that similar participation decreased from 63% of 10-11 year olds, to 58% of 12-14 year olds, to 40% of 15-17 year olds (Friel, Nic Gabhainn, & Kelleher, 1999). The similar trends observed in both studies suggest that there is a trend towards inactivity, as children grow older; however longitudinal research that tracks individuals over time is required. Other European countries have reported similar reductions, for example, in Denmark, participation in organised sports activity drops from 90% at age 12 to 46% at age 17 (Cavill, 2001).

The HBSC (2003) included a physical activity screening measure that asked participants on how many days of the previous week and typical week they participated in physical activity for at least 60 minutes. The answers ranged from 0 days to 7 days and an average of the two questions was then calculated. Based on our criteria of regular physical activity (≥ 4 days/wk), 53% of the 15-17 year olds (n=2191) were classified as regularly active. A gender analyses revealed that 64% of males and 43% of females met this criteria. When the results were analysed by region, 47% of the East Coast Area Health Board region (ECAHB) were classified as regularly active, with 58% of females and 36% of males fitting this category. The ECAHB participants were less active than the national sample of 15-17 year olds, however, this sample was small (n=253) and had a substantially higher number of female than male participants (202 vs. 51 respectively) (Corrigan, personal communication, September 22, 2003). A limitation of this study is the absence of objective data to support the findings. Also teachers in the school setting administered this survey, thus the absence of qualified physical activity researchers may have affected the quality of supervision.

The Benefits of Physical Activity

The beneficial effects to health of regular physical activity are numerous. These benefits include both physical and psychological effects. The following section will examine the risks associated with leading an inactive lifestyle and provide rationale for the measures chosen in this study. Due to the increasing prevalence of

child and adolescent obesity, a section will also be included outlining the relationship between obesity and physical activity.

Physical Benefits

There is an abundance of evidence available highlighting the physical benefits of physical activity and these benefits have been summarise in Table 1. The physical benefits include a reduction in morbidity and mortality from diseases of several body systems (Bouchard, Shephard, & Stephens, 1994). Physical inactivity has been cited as a risk factor for cardiovascular disease. It has also been linked with an increased risk of developing chronic diseases such as obesity, Type 2 diabetes mellitus, hypertension, osteoporosis and colon cancer (Pate et al., 2002). However, many of these diseases have their origins in childhood and adolescence, due to high levels of risk factors over years (Andersen, Wedderkopp, Hansen, Cooper, & Froberg, 2003).

Cardiovascular Disease and Physical Activity

Cardiovascular disease (CVD) is any disease of the circulatory system. Most of the deaths from CVD relate to coronary heart disease (CHD or heart attack), stroke (cerebrovascular disease) and other diseases of the circulation including heart failure and diseases of the arteries. In 1999, 12996 Irish men and women died from vascular diseases that is, 40% of all deaths were due to heart attack, stroke and other diseases of the circulation (Codd, 2001). Thirty seven per cent of premature deaths (<65 yrs) were accounted by vascular diseases. In 2004, the Irish Heart Foundation reported that Ireland's premature death rate from CHD, mainly heart disease, in those under 65 years is above the European Union average. Specifically, this figure was 61.83 deaths per 100,000 in Ireland compared to the EU average of 55.63 deaths per 100,000 (Irish Heart Foundation, 2004).

A longitudinal study of young people from Finland (N=961) tracked physical activity and its influence on selected coronary heart disease risk factors (Raitakari et al., 1994). Participants were tracked every 3 years over a 6-year period and were aged 12, 15 and 18 at baseline. Physical activity was measured by self-report questionnaire, with an index figure (range 1-225) calculated from the product of intensity, duration and monthly frequency. If a participant scored 85 or higher in all three surveys, they were considered constantly active, whereas if they scored 15 or less, they were considered constantly sedentary. Measurements also included blood

samples, height, weight and skinfold thickness. Participants who had remained active or inactive in all three examinations were compared for a number of CHD risk factors such as lipoprotein density, cholesterol and adiposity. Results showed that the participants who were constantly inactive expressed a poorer coronary risk profile (higher serum insulin and triglyceride concentrations) compared to those who were constantly active.

In Denmark, a cross-sectional study of 1020 boys and girls aged 9 and 15 years was carried out as part of the European Youth Heart Study. Risk factors for CVD were assessed, including total cholesterol, HDL-cholesterol, triglyceride, serum insulin, systolic blood pressure and body fat. Physical fitness was also assessed via a maximal cycle test and body mass index via height and weight. Results showed that fifty of the subjects had four or five risk factors and their physical fitness was 1.2 standard deviation (SD) lower and body mass index 1.6 SD higher than the mean values for the population. This indicates that physical activity and diet may influence the development of unhealthy risk profiles (Andersen et al., 2003).

Hypertension or high blood pressure is an important risk factor for CHD. A cross-sectional study of 13,557 boys and girls aged between 15 and 20 (mean age=17.2) examined fitness via a shuttle run test, BP and BMI. The mean VO_{2max} scores for aerobic fitness were 51.1 ml/min/kg for males and 40.1 ml/min/kg for females. Results showed that boys had a higher systolic BP than girls (Nielsen & Andersen, 2003). Low physical fitness and high BMI were independently associated with a high BP and risk of having hypertension. Age adjusted odds ratios (OR) for fitness revealed that boys in the lowest quintile of fitness were 1.3 times as likely to be hypertensive, with the same figure for girls equalling 1.5. This is compared to an OR of 1 for those in the highest fitness category.

A study of the relationship between physical activity and risk factors for CHD amongst Northern Irish 15 year old adolescents (n=252 boys; 254 girls), measured cardiorespiratory fitness via the 20-metre shuttle run test (Boreham, Twisk, Savage, Cran, & Strain, 1997). Mean fitness scores for boys was 79 ± 21 laps, and for girls the mean score was 45 ± 14 laps.

Obesity and physical activity

Obesity is defined as an excessively high amount of body fat or adipose tissue in relation to lean body mass. It is the end result of a mismatch between energy intake

(EI) and energy expenditure (EE). That is, EI exceeds EE and results in net accrual of energy stores in the body (Goran, 2001). It remains to be seen whether obesity is due to an increase in EI or a decrease in EE or a combination of both. As EE is made up of resting EE, Thermic Effect of Feeding and Activity EE, it is obvious that physical activity is the only modifiable factor of EE. Energy Intake, on the other hand is open to change, with the individual in control of the amount they intake.

Measuring Obesity

Body Mass Index (BMI) is a measure of obesity and is obtained from the following equation:

$$\frac{\text{weight (kg)}}{\text{height}^2 \text{ (m)}}$$

The adult criteria for BMI is that individuals with a body mass index (BMI) of 30 or more are considered obese (Stunkard A.J., 1993; p.14) and a BMI greater than 25 considered overweight. However, BMI in childhood changes substantially with age, indicating a need for age and sex specific cut off points. Cole and colleagues developed a standard definition for child overweight and obesity, based on six large international surveys. They produced centile curves for each survey, which incorporated the widely used adult cut-off points, and calculated averages for age and sex specific cut-off points from 2-18 years. In the United States, the 85th and 95th percentiles of BMI have been recommended as cut off points for identifying overweight and obese children and youth. These percentiles are questionable, as they are conveniently rounded figures and can be criticised as arbitrary (Cole, Bellizzi, Flegal, & Dietz, 2000). In Britain, the 91st and 98th centile were used as cut-off points for defining overweight and obesity respectively. In a study of 11-16 year olds (N=3784), the authors used the 91st and 98th percentiles as they were standard on the British charts and also similar to the cut-off points identified in the international survey by Cole and colleagues (McCarthy, Ellis, & Cole, 2003). The international definition for overweight and obesity has been chosen for this study because of its standardisation, which will make it easier to compare with future international studies that use this definition.

The prevalence of obesity is increasing rapidly worldwide. Results from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) indicate

that an estimated 64% of U.S. adults (aged 20-74) are either overweight or obese. This prevalence has doubled between NHANES II (1976-80) and NHANES III (1999-2000), from 15% to an estimated 31%. A recent study in Ireland, the SLAN survey (2003), found that Irish adult levels of obesity have increased over the last 4 years by 3%, from 11 to 14% in males and from 9 to 12% in females (Kelleher et al., 2003). However this study was both self-report and cross sectional, thus making it difficult to draw conclusions relating to this data. The Pan EU Survey (1999) measured consumer attitudes to various aspects of health among 15 member states and the Irish statistics showed that 31% were in the overweight category and 8% in the obese category (Trinity College Dublin, 1999). However, these results were also self-report. The North/South Ireland Food Consumption Survey (2001) carried out a study among 1379 Irish adults aged 18-65, which included objective anthropometric measurements. The researchers found that 18% were obese and 39% were overweight (Kiely, 2001). This figure is substantially higher than that found by the Pan EU survey and the SLAN survey, highlighting the difference between self-report data and objectively measured data. There is a need for objectively measured BMI among the Irish population, so that we can gauge the seriousness of the situation.

Lissau and colleagues (2004) reported on the BMI and overweight levels of adolescents in thirteen European countries, Israel and the United States (Lissau et al., 2004). Ireland was included in this study, which examined the data from the 1997-98 health behaviours of school children (HBSC) study. Participants were asked to report how tall they were and how much they weighed without clothes. BMI was categorised as "at risk of overweight" if greater than the 85th percentile or "overweight" if greater than the 95th percentile. The average BMI for Irish 15 year olds was 21.2 for boys and 20.6 for girls. Nineteen per cent of 15-year-old Irish boys were "at risk of overweight" whereas 3% were overweight. The corresponding figures for 15-year-old Irish girls were 14% and 5%. A weakness of this study was that 39% of the Irish data was missing due to unclear, confusing or unfamiliar terminology used. That is, measurement units were requested in kilograms for weight and centimetres for height. Some of the participants were only familiar with feet/inches and stones/pounds. The U.S. ranked highest for prevalence of overweight BMI, and Lithuania ranked the lowest. The highest prevalence for overweight among the European countries was found in Ireland, Greece and Portugal (Lissau et al., 2004).

The results of the HBSC study in Canada (N=5890) revealed that 15% of 11-16 year olds were overweight, with a further 4.6% obese (Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004). The study used the BMI cut-off points developed by the Childhood Obesity Working Group (Cole et al., 2000) and found a significant positive relationship between BMI and TV watching, and a negative relationship between BMI and physical activity. However, it must be noted that all the information in this study was of self-report nature and this is cited as a major limitation of the study.

According to Gutin and Barbeau (2000) many of the health problems associated with obesity (Table 2.1) manifest themselves in the form of morbidity and mortality during adult years, however the origins of these problems can be traced to childhood (Gutin & Barbeau, 2000). Therefore it is important for children and youth to lead an active lifestyle and thereby improve their risk factor status. Similar to physical activity patterns, obesity can also be tracked from adolescence to adulthood. The odds of being obese as an adult are 1.3 if obese at ages 1-2 years, however this increases to 17.5 if obese at ages 15-17 years (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997).

Table 2.1 Medical conditions associated with obesity

- Hypertension	- Mood disorders
- Stroke	- Sleep disorders
- Heart Disease	- Eating disorders
- Hyperlipidemia	- Gout
- Type 2 Diabetes	- Gallbladder disease
- Osteoarthritis	- Some cancers

Note. Taken from Bray, G.A., Overweight, Mortality, and Morbidity, N. (2000). In C. Bouchard (Eds.), Physical Activity and Obesity (1st ed., pp. 31-54). Champaign, IL: Human Kinetics.

Obesity is a co morbidity of type 2 diabetes (Must et al., 1999). Type 2 diabetes, which was previously called non-insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes, means that the body is not producing enough insulin or the cells are ignoring the insulin. A study by Pinhas-Hamiel et al. (1996) found an increase in the incidence of type 2 diabetes among children and adolescents (N=1027) from the greater Cincinatti area, Ohio. Prior to 1982, only 4% of diabetes cases were classified as type 2, however by 1994, this figure increased to 16%. Among patients aged 10-19

years, 33% of diabetes cases were classified as type 2 (Pinhas-Hamiel et al., 1996). Body weight and body weight change have been reported to be important predictors of the likelihood of developing type 2 diabetes with odds ratios rising to over 40-fold in men and over 90-fold in women who are obese (Prentice, 1997).

The psychosocial consequences of childhood obesity are also of great concern. Overweight and obese children and adolescents are often targets of discrimination, thus creating a negative self-image that may persist into adulthood. Grilo and colleagues found that obese adults who had been obese since childhood had substantially higher levels of body dissatisfaction than those who became overweight as adults. The findings suggest that being teased about weight/size while growing up may represent a risk factor for the development of negative body image (Grilo, Wilfley, Brownell, & Rodin, 1994). And even if weight loss is accomplished, there is not necessarily a parallel improvement in body image, suggesting that this issue is much more complex (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 2002).

Psychosocial Benefits

The WHO constitution of 1948 defines health as "a state of complete physical, social and mental well-being and not merely the absence of diseases or infirmity" (Vuori, 1998; p.S95). This definition highlights that health is not just physical and that it encompasses all aspects of well-being. Mental health is extremely important to one's quality of life and in recent years health professionals have advocated that exercise promotes sound mental health. Physical activity can be considered both for its preventative and therapeutic effects on mental illness and also for its impact on mental health in the general population (Department of Health, 2004).

The psychological health benefits associated with physical activity are well documented for all age groups. Mutrie (2000) reports that epidemiological evidence has demonstrated the relationship between physical activity and a reduced risk of developing clinically defined depression. She also notes that exercise has an anti-depressant effect similar to that found from psychotherapeutic techniques (Mutrie, 2000). A meta-analysis by Gruber (as cited in (Mutrie & Parfitt, 1998)) of 27 studies supports the view that physical activity has a positive effect on self-esteem for children and youth. An overall effect size of 0.41 was found for physical activity on self-esteem, meaning that children in studies experiencing a physical activity intervention, displayed an increase in self-esteem scores of nearly one-half of a

standard deviation (0.41). He also compared self-esteem scores among pre-adolescent children and handicapped children and the results provided "convincing evidence of a moderately strong positive effect of activity on self-esteem for normal children and a larger effect for those classified as 'handicapped'" (Mutrie et al., 1998). Other benefits of physical activity to mental health include reduced levels of stress and anxiety, with positive effects found on emotion and mood (Biddle, Fox, Boutcher, & Faulkner, 2000).

Brown and Siegel (1988) examined the effect of physical activity and life stress on the health of adolescents. A prospective study of 200 American girls (ages 11-15) indicated that illness was associated with life stress, but was significantly mediated by physical activity patterns. Girls reporting greater incidents of illness had significantly lower physical activity levels (Brown & Siegel, 1988).
Physical activity also offers "a diverse range of social interaction possibilities" (Carless & Faulkner, 2003: pg 68) thus providing the opportunity for positive social interaction and support. Physical activity, particularly organised sport, physical education and neighbourhood games provide children and adolescents opportunities to interact with peers (Smith, 2003).

A purpose of this study is to examine the physical activity levels of Irish adolescents and to determine whether they are doing enough activity to accrue the multiple benefits identified with leading a regularly active lifestyle.

Tracking of physical activity from adolescence to adulthood

Tracking has been defined as the tendency of individuals to maintain their rank or position within a group over time. In relation to physical activity, tracking studies measure the stability of remaining active/inactive over time. It is widely believed that physically active adolescents become physically active adults. Existing studies provide conflicting results, with some supporting the tracking of physical activity, however prospective studies of this relationship are sparse and limited by small sample sizes or different assessments of physical activity, making comparison difficult. It has been suggested that perhaps "physical inactivity tracks better into adulthood (meaning that sedentary young people have an increased risk of becoming sedentary adults)" (Cavill, 2001:p7).

Malina (1996, 2001) suggests that the limited data spanning adolescence into adulthood indicates that physical fitness tracks better than physical activity (Malina,

1996; Malina, 2001). This may be due to the measuring techniques used, as physical fitness can be objectively measured by various means, whereas physical activity is largely measured by self-report.

The study of Young Finns by Raitakari and colleagues (1994), which tracked the physical activity status of adolescents for a 6-year period found that significant tracking of physical activity occurred over the fist 3 years, with correlations of the physical activity index ranging from 0.35 to 0.54 (r values) in boys and from 0.33 to 0.39 (r values) in girls. The higher correlations were recorded for the older participants (18 year olds) suggesting that physical activity behaviours are set at this age and not as vulnerable to change as the younger age groups. It might also be the case that self report measurement of physical activity amongst younger age groups is limited in terms of question comprehension. According to the baseline index value of physical activity, an active and sedentary group of adolescents were formed. Approximately 57% of those classified as inactive remained inactive after a 6-year follow-up, with 44% of active participants remaining active. The authors concluded that physical inactivity shows better tracking than does physical activity (Raitakari et al., 1994).

In the Amsterdam Longitudinal Growth and Health Study, the habitual physical activity levels of 181 (98 female) participants were measured at 6 different time periods, from age 13 years to 27 years (Van Mechelen, Twisk, Post, Snel, & Kemper, 2000). Habitual physical activity concerning the 3 months previous was measured by means of a semi-structured interview at ages 13, 14, 15, 16, 21 and 27. All activities including work, school, leisure, organised and nonorganised sports and active transportation were questioned. Results showed a significant decrease in habitual physical activity time for males over the 15-year period by 31% (10.6 $h.wk^{-1}$ to 7.3 $h.wk^{-1}$, $p<0.05$). Females also showed a decrease in habitual physical activity time, however this decrease was not significant (9.1 $h.wk^{-1}$ to 8.4 $h.wk^{-1}$, $p>0.05$). The total average weekly energy expenditure also decreased significantly by 42% for males and 17% for females ($p>0.05$).

The Muscatine study, a 5-year population study, tracked physical fitness and physical activity from childhood to adolescence (Janz, Dawson, & Mahoney, 2000). The authors proposed that a high degree of tracking would suggest early measurement and intervention as a strategy to assure healthy levels of physical fitness and physical activity in later years. Participants (n=126, 61 boys, mean age 10.8 yrs (boys), 10.3

yrs (girls)) were measured every 3 months for 5 years for a range of variables including body composition, sexual maturation, aerobic physical fitness, muscular fitness and physical activity. Physical activity was assessed via a brief interview every 3 months. The interview assessed TV viewing and video game usage and also assessed vigorous physical activity using the 3-day Sweat Recall. Results indicated a moderate to high tracking of most variables, which suggests some predictability of early measurements for later values. The 3-day Sweat Recall demonstrated a moderate degree of tracking (0.32-0.52 for boys and 0.43-0.65 for girls). As expected, the objective measure of peak VO_2 showed high levels of tracking (0.48-0.86 for boys and 0.43-0.74 for girls). This highlights the need for better self report measures of physical activity that have high validity with objective measures such as VO_2.

A longitudinal study by Barnekow-Bergkvist and colleagues (1996) investigated the gender-related differences in physical activity patterns at ages 16 and 34 (Barnekow-Bergkvist et al., 1996). In 1974, 425 randomly selected students (mean age=16.1 yrs, ±0.33; 52% male) completed a questionnaire on participation in leisure time physical activity, membership of sports clubs and attitudes towards different activities. Twelve years later this cohort were reinvestigated (mean age 33.7, ±0.74) with 88% of the original sample participating. A new questionnaire was administered at this time, where information regarding type of activity, frequency and duration were collected for sports activities and travel to and from work. A retrospective section was also included questioning leisure time physical activity at ages 16-20 yrs, 21-25 yrs, 26-30 yrs and 31-36 yrs. Physical activity beliefs and attitudes and environmental and motivational variables were also assessed. Evidence for the belief that physical activity/ inactivity patterns are established during adolescence is presented in Figure 2.1. Sixty two percent of both males and females who were active at age 16 remained active at age 34, while 63% of males and 57% of females who were inactive at 16 remained inactive at 34. A higher percentage of females than males (43% vs. 37%) changed their physical activity pattern from inactive at age 16 to active at age 34.

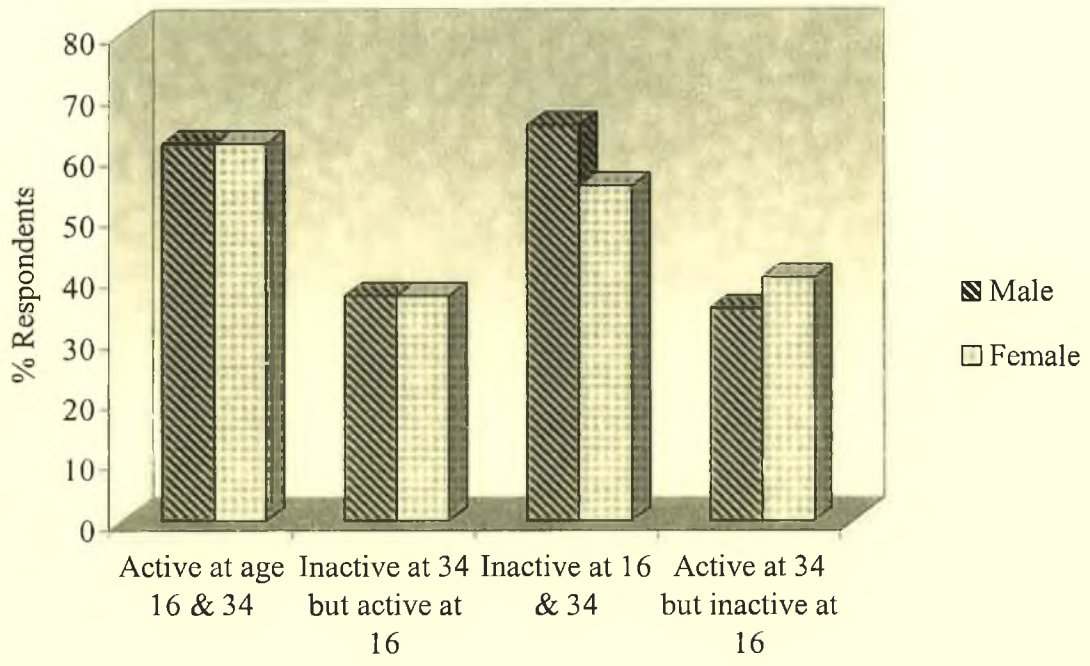


Figure 2.1. Changes in percentage of participants in status of physical activeness/inactiveness from the age of 16 to 34 among men (n=194) and women (n=179).
Note. Taken from Barnekow-Bergkvist, M., Hedberg, G., Janlert, U., & Jansson, E. (1996). Physical activity patterns in men and women at the ages of 16 and 34 and development of physical activity from adolescence to adulthood. *Scand.J.Med.Sci.Sports, 6,* 359-370.

Critique of Tracking Studies

Although these studies provide some evidence for the tracking of physical activity/ inactivity, it is important to note the variety of methodology employed. Physical activity has been measured in many different ways, with measures ranging from self-report questionnaires to semi-structured interviews. Retrospective questionnaires may not provide very accurate data as it requires the individual to recall behaviour from their youth and this may lead to under or overestimation of the amount of physical activity they actually participated in.

While many studies report a moderate degree of tracking, the evidence is not yet conclusive. Although, it is evident that good habits in youth are likely to continue into adulthood, studies showing a higher degree of tracking are needed. Future tracking studies should concentrate on employing suitable methodology. Objective data should be included to support subjective data, as this would provide a more accurate picture of physical activity. Confounding factors, such as socio-economic

status, environment and health, should also be taken into account during the phase of study, as it may be that an individual's situation changes.

Sedentary behaviours

Sedentary behaviours are classified as those, which involve sitting down and do not involve participation in physical activity (Varo et al., 2003). They include TV and video watching, playing computer games, using the Internet, talking on the phone, sitting and talking with friends and listening to music (Marshall, Biddle, Sallis, McKenzie, & Conway, 2002). As mentioned previously, physical inactivity tracks better than physical activity from adolescence to adulthood (Malina, 1996), therefore it is important for young people to reduce the time spent being inactive. The opportunity for young people to be sedentary is ever increasing, mainly due to advancing technology such as digital TV and computer games. TV watching has received considerable attention in recent years. Other than sleep, TV watching represents the single greatest source of physical inactivity among American children (Lowry, Galuska, Fulton, Wechsler, & Kann, 2002). A report titled 'Healthy People 2010' recommends that young people should not watch more than 2 hours per day of TV (U.S.Department of Health and Human Services, 2000). More than 2 hours per day of TV watching has also been identified as the threshold for high sedentary behaviour (Marshall et al., 2002).

It has been suggested that TV watching may promote obesity both by displacing physical activity that would expend more energy and by increasing dietary energy intake, either during viewing or as a result of food advertising (Dietz, Jr. & Gortmaker, 1985). There is concern that if the activity patterns of young people decline, then the long-term health problems associated with a sedentary lifestyle may be amplified (Health Education Authority, 1997; Sallis & Patrick, 1994). It has also been suggested that the health-protective effects of physical activity may be negated by prolonged periods of sedentary behaviour (Salmon, Bauman, Crawford, Timperio, & Owen, 2000).

Commuting

Along with the increase in technology, there has also been an increase in inactive commuting to school, that is, commuting by automated transport. For example, the proportion of young people in the U.K. travelling to school by car

increased from 16% in 1985/1986 to 30% in 1997/1998 (Department of the Environment UK, 2000). In 2002, only 31% of Irish school going youth aged 13-18 years actively commuted to school (27% by foot, 4% by bicycle) with the remaining 70% travelling via automated modes (39% bus, 30% car, 1% train) (CSO, 2004). Commuting to school is a potential opportunity for young people to increase their physical activity levels, however there is little evidence available regarding the magnitude of this contribution to overall physical activity. A study by Cooper and colleagues (2003) recorded the physical activity of 114 children (59 boys; aged 10.4 ± 0.8 years) for 7 days via an accelerometer and questionnaire (Cooper, Page, Foster, & Qahwaji, 2003). Children were compared by mode of transport to school. Results indicated that those who walked to school were significantly more active than those who travelled by car ($p<0.05$). Results also revealed that boys who walked to school had higher physical activity levels after school and during the evening.

It is important to examine sedentary behaviours in this study, as it provides a more holistic understanding of an adolescent's activity patterns. If an adolescent is not regularly active, then analysis of sedentary behaviours such TV watching and inactive commuting may identify potential areas for intervention.

Determinants of Physical Activity

In order to develop effective physical activity interventions for youth, it is imperative that the determinants of physical activity are understood. Determinants have been defined as "causal factors, and variations in these factors are followed systematically by variations in physical activity" (Bauman, Sallis, Dzewaltowski, & Owen, 2002: pg 6). However, Buckworth and Dishman took a different view of determinants and described them as "established reproducible associations or predictive relationships" as opposed to a cause-and-effect connection (Buckworth & Dishman, 2002: pg. 191). For the purpose of this study, the latter definition will be adopted as it is felt that there will always be unexplained variance in behaviours such as physical activity, and it is almost impossible to fully account for all determinants involved. The term "correlate" is often used interchangeably with the term "determinants", however correlates refer more specifically to statistical associations or correlations between measured variables and physical activity (Bauman et al., 2002).

The Social Cognitive Theory (Bandura, 1986) provides a practical framework for organising determinants of physical activity. They can be considered in the context of personal, environmental and behavioural factors, which form a triad of interacting variables (Buckworth et al., 2002). This model has been described as reciprocal as all variables are interacting with each other on the same level (Fig. 2.2).

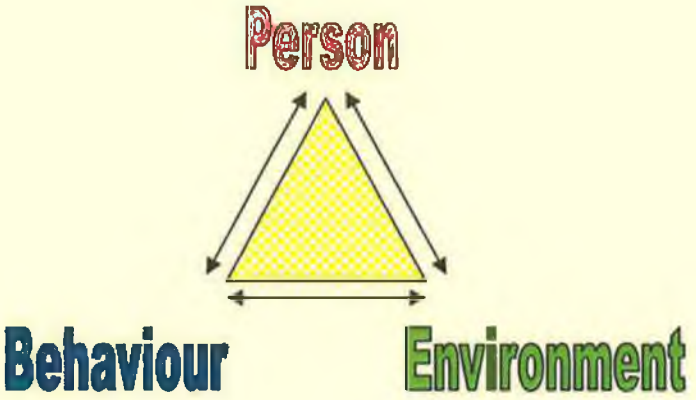


Figure 2.2. Model of Reciprocal Determinism
Note. Taken from Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

There is no one determinant that best explains or predicts physical activity behaviour; rather it is the combination and interaction of determinants that influence behaviour. This interaction is complex and is constantly changing over time, mainly due to the ever-changing nature of the environment and lifestyle. Identifying factors that are associated with physical active lifestyles are particularly important as these can help to design programmes and interventions aimed at high-risk groups, such as those with high sedentary behaviours and low levels of physical activity.

In 2000, Sallis and colleagues published a review of 54 studies, published between 1970 and 1998, which examined the potential correlates of physical activity among adolescents aged 13-18 years (Sallis et al., 2000). The studies varied greatly in sample size, study design, gender, ethnicity and physical activity measure, highlighting the lack of consistency across studies. A summary of the findings can be seen in Table 2.2. The review supported the association between gender and physical activity, which is males are more likely to be active than girls, with 27 out of 28 studies reporting this finding. Seventy percent of the studies reported a negative association between age and physical activity. Adolescent body-weight and adiposity were found to be indeterminate due to conflicting results.

The psychological variables found to be positively associated with physical activity were achievement orientation, perceived competence and intention to be active, with depression reported as negatively correlated with physical activity. A review of behavioural attributes found positive associations for sensation seeking, previous physical activity and participation in community sports. Of the social variables, parental support, direct help from parents, support from significant others and sibling physical activity was consistently related to adolescent physical activity. Finally opportunities to exercise were the only physical environment variable that exhibited consistent positive association.

In particular, non-modifiable demographic factors such as gender, age and ethnicity highlight certain subgroups that need to be targeted for physical activity interventions. It is well known that girls, older adolescents and minority ethnic groups are most at risk for being inactive (Sallis et al., 2000) and greater efforts to promote activity amongst these individuals are warranted. If the specific determinants that influence each sub category of the population can be established, then interventions and programmes can be more suitably designed. Although many of the determinants of physical activity are universal, some may be culture specific. For example, the climate in Australia is very different from the climate in Ireland. Likewise the attitudes of American adolescents may be very different to the attitudes of Irish adolescents. For intervention design, it is important that we do not solely rely on international research, but instead examine the target group in question and in this case, Irish adolescents are the group of interest.

Table 2.2. Determinants associated with adolescent physical activity

	Determinant Category	**Variable**	**Relationship (-/+)**
Personal	Demographic and Biological Factors	Age	-'ve
		Gender (female)	-'ve
		Ethnicity/Race	+'ve
		Socioeconomic status	+'ve
		Body Mass Index	-'ve
Behaviour	Psychological Factors	Self-Esteem	+'ve
		Perceived Competence	+'ve
		Enjoyment of Physical Activity	+'ve
		Self-Efficacy	+'ve
		Dislikes PE	-'ve
	Behavioural Attributes and Skills	Physical Activity History	+'ve
		Healthy diet	+'ve
		Cigarette Use	-'ve
		Sedentary Habits	-'ve
Enviroment	Social and Cultural Factors	Social Support from Parents/Peers/Teachers	+'ve
		Class Size	-'ve
		Subjective Norms	+'ve
		Parent Modelling	+'ve
	Physical Environment Factors	Access to Facilities	+'ve
		Access to Programmes	+'ve
		Opportunities to exercise	+'ve

Note. Adapted from Sallis, J. F., Prochaska, J. O., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32,* 963-975.

Theories of Exercise Behaviour

Theories help us to develop an understanding of behaviour change in physical activity. They enable us to understand how and why people might be motivated or amotivated to adopt/and or continue exercise, while also allowing the researcher to devise and test hypotheses (Mutrie & Woods, 2003). Exercise psychology has borrowed and modified theories of behaviour change from social-cognitive, behavioural and health psychology in an effort to comprehend why individuals become active or inactive (Mutrie et al., 2003).

Models are constructed in order to help the researcher to conceptualise the process of behaviour change. They draw on a number of theories for help in understanding a specific behaviour. Earp and Ennet (1991) define conceptual models as "a diagram of proposed causal linkages among a set of concepts believed to be related to a particular public health problem" (Earp & Ennet, 1991). Conceptual models are useful as organising tools as they can convey complex information and also help the reader to visualise relationships. When constructing a model of health behaviour, an endpoint must be fixed as the main outcome of interest e.g. physical activity, smoking cessation. From there, we move backwards including the selected determinants of the behaviour. The complex inter-relationships among the various factors must also be adhered to (Earp et al., 1991). In the case of this study, physical activity was considered as the endpoint, with the many determinants of physical activity feeding into the outcome. Rather than depicting the entire causal process, it is proposed that researchers limit their scope to a small part of the causal chain, while at the same time being aware of the larger causal web surrounding research questions (Earp et al., 1991). It may often prove difficult to refine the model to a narrow set of concepts and choose a realistic outcome and many attempts may have to be made in order to successfully construct a model that has clarity and is also visually appealing (Earp et al., 1991).

The Transtheoretical Model (TTM) is a model which has received a great deal of attention in health and exercise research and practice (Biddle & Nigg, 2000) in recent years. It has been successfully applied to exercise behaviour change and it provides practitioners with tangible strategies on how to design interventions to suit different groups of people. However, the majority of research is based on adult samples, with very few concentrating on adolescents. A detailed overview of the

TTM will be presented, including its applicability to exercise and adolescents and also the strengths and weaknesses associated with the model. A search for studies published between 1984 and 2004 was carried out using three main databases (Pubmed, ScienceDirect and Swetswise), yielding a total of 83 studies published examining the TTM in the exercise domain. Of these, 16 studies used an adolescent sample.

The Transtheoretical Model

The Transtheoretical Model (TTM) is an integrative model of intentional behaviour change (DiClemente et al., 1999). The TTM was developed through observations of how people quit smoking on their own (Prochaska, DiClemente, Velicer, & Rossi, 1993) and has proven useful in the design of tailored interventions for smoking cessation. Following extensive research on smokers attempting to change their behaviour without professional intervention (self-changers), it was found that these individuals progress through specific stages as they attempt to reduce or remove high-risk behaviours (Prochaska & Marcus, 1994a). Although the model was developed to describe changes in addictive behaviours, it has been applied to a wide variety of problem behaviours, in particular health risk and health protective behaviours such as smoking cessation, exercise, low fat diet, alcohol abuse and drug addiction (DiClemente et al., 1999).

The TTM recognises that people differ in their readiness to adopt new behaviours and this readiness to change can be understood in terms of four key constructs. The central construct of the model is the stages of change (Plotnikoff, Hotz, Birkett, & Courneya, 2001). The model also includes a series of independent variables known as the processes of change, and a series of outcome measures including decisional balance and self-efficacy.

Stages of Change

During their research with smokers, Prochaska and DiClemente (1982) reported that when people were asked how frequently they used psychotherapy processes, the participants replied that it depended on what point in the course of change they were at. The idea of stages began to unfold, providing a temporal dimension that had not been identified previously in any of the major systems of psychotherapy (Prochaska & Norcross, 1999). A series of five stages have been

proposed that differ according to an individual's intention and behaviour: Precontemplation, Contemplation, Preparation, Action and Maintenance. Each stage reflects both a period of time and a set of tasks required for movement to the next stage. The time an individual spends in each stage varies, however the tasks to be accomplished are assumed to be invariant (Prochaska et al., 1999).

The following is a general description of each stage, with an exercise specific description also included:

1. **Precontemplation** is the stage where there is no intention to change behaviour in the foreseeable future. This time frame is usually measured as the next 6 months. Many of the individuals in this stage are oblivious to the fact that they have a problem and individuals may also be uninformed or under-informed about the consequences of their behaviour.
   - Individuals are inactive and have no intention to begin exercising
2. **Contemplation** is the stage, which involves serious thinking about changing their behaviour, but has not yet made a commitment to take action. During this stage, people are constantly weighing up the pros and cons of changing and this ambivalence can keep people stuck in this stage for long periods of time (Velicer, Prochaska, Fava, Norman, & Redding, 1998).
   - Individuals are inactive but they intend to start regular exercise in the next 6 months
3. **Preparation** is the stage where people are intending to take action in the immediate future (usually measured as 30 days) and requires significant dedication. Individuals in this stage typically have a plan of action.
   - Individuals are active below the criterion level, but intend on being regularly physically active in the near future
4. **Action** is the stage in which people have made specific overt modifications to their lifestyles within the past 6 months (Prochaska, Johnson, & Lee, 1998). In order to overcome their problems, individuals modify their behaviour, experiences and environment (Prochaska et al., 1999). Thus, the action stage requires a considerable commitment of time and energy.
   - Individuals have engaged in regular exercise for less than 6 months
5. The **Maintenance** stage is the final stage of the TTM and during this stage, individuals strive "to prevent relapse and consolidate the gains attained during

action" (Prochaska et al., 1999). This stage may last indefinitely as people are less tempted to relapse and are increasingly more confident that they can continue to change.

- Individuals have been exercising regularly for more than 6 months

Most people tend to recycle to previous stages several times before successful behaviour change is attained. This spiral pattern as illustrated in Prochaska and Norcross (1999) demonstrates how some relapsers return to the precontemplation stage and remain there for some time. The sense of failure often demoralises individuals and prevents them from continuing the behaviour change. On the other hand, the majority of individuals recycle to the contemplation or preparation stage before actually entering the action phase (Prochaska et al., 1999). Often they have learned from the first attempt and are willing to try again with a new plan of action in mind.

A sixth stage termed "termination" has been included in some behaviour models. This stage refers to the exit from the spiralling cycle of change, that is, the individual is free from the problem. It has been suggested that termination is impossible and that the most anyone can hope for is a lifetime of maintenance (Prochaska, Norcross, & DiClemente, 1994b). Physical Activity in particular is a behaviour that requires persistence and one cannot possibly anticipate future events that might change an individual's situation.

Processes of Change

Processes of change are the covert or overt activities/ strategies that people engage in to modify affect, thinking, behaviour, or relationships related to particular problems or patterns of living (Prochaska et al., 1999). Following an extensive comparative analysis of the leading psychotherapies, ten processes of change were identified. They provide a "middle level of abstraction between global theories (such as psychoanalysis, behaviourism, systems) and specific techniques (such as dream analysis, progressive muscle relaxation and family sculpting)" (Prochaska et al., 1999:11). These processes provide important guidelines for designing intervention programmes, as in order to move from stage to stage, one must apply these processes (Prochaska et al., 1998).

The ten processes represent two higher order constructs: experiential (where information is gathered through experiences) and behavioural (where information is

collected through the environment and actions) (Biddle & Nigg, 2000). Table 2.3 provides a definition of each process accompanied by an item example.

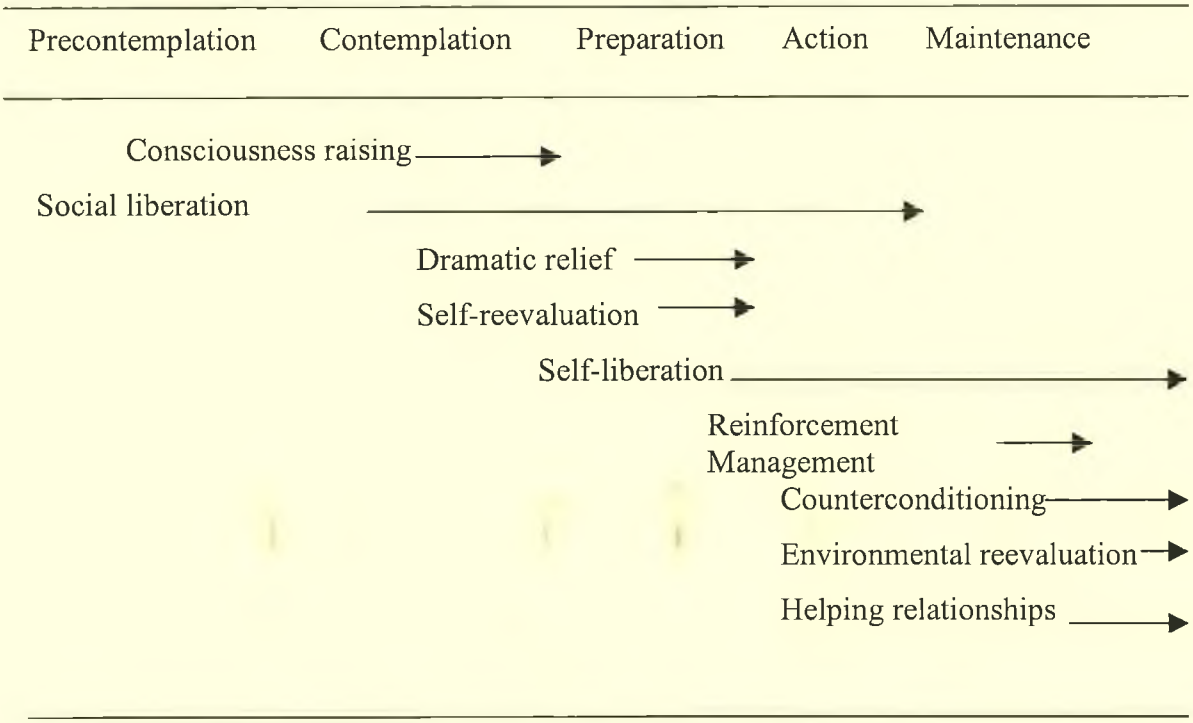
Table 2.3 Definitions and examples of the ten processes of change

The Experiential Processes are:	Item example:
Consciousness Raising (CR): involves increased awareness about the problem behaviour or the new positive behaviour	I read articles to learn more about exercise
Dramatic Relief (DR): Emotional experiences which are associated with the problem behaviour	I get upset when I see people who would benefit from exercise but choose not to exercise
Self re-evaluation (SE): Affective and Cognitive appraisal of one's image and values with or without the behaviour in question	I feel more confident when I exercise regularly
Environmental re-evaluation (ER): Combination of affective and cognitive appraisal of how the behaviour affects ones physical and social environment	I realize that if I don't exercise regularly, I may get ill and be a burden to others
Social Liberation (SO): Awareness and acceptance of opportunities and alternatives in society	I have noticed that many people know that exercise is good for them
The Behavioural Processes are:	**Question Example:**
Counter-conditioning (CC): the learning of healthier behaviours that can substitute for problem behaviours	Instead of relaxing by watching TV or eating, I take a walk or exercise
Helping Relationships (HR): involves trusting, accepting and utilizing the support of others during the attempt to change the problem behaviour	My friends encourage me to exercise
Stimulus Control (SC): Control of situations and other causes, which trigger the problem behaviour and also adding stimuli that encourage alternative behaviours	I use my calendar to schedule my exercise time
Self-Liberation (SL): Choice and commitment to change the problem behaviour, belief in oneself that they have the ability to change	I tell myself that I can keep exercising if I try hard enough
Reinforcement Management (RM): involves changing or altering the contingencies that control or maintain the problem behaviour	If I engage in regular exercise, I find that I get the benefit of having more energy

Note. Definitions taken from Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport, 63,* 60-66. Examples taken from questionnaire items Nigg, C. R., Norman, G. J., Rossi, J. S., & Benisovich, S. V. Processes of Exercise Behaviour Change:Redeveloping the Scale. Annals of Behavioral Medicine 21, S79. 1999.

Table 2.4 displays the integration occurring among the processes most often used by successful self-changers at different stages. However, this pattern relates to overcoming bad habits, such as smoking and not to the acquisition of healthy behaviours. Giving up a bad habit is very different from taking on a healthy habit and it may be that the pattern of processes for adopting and maintaining physical activity occurs differently.

Table 2.4. Processes used most often by successful self-changers across the stages



Note. Adapted from "Changing for good: A revolutionary six-stage programme for overcoming bad habits and moving your life positively forward" by Prochaska, J.O., Norcross, J.C. and DiClemente, C.C., 1994a, Avon Books, New York: p.54

Self-Efficacy

Self-Efficacy is a component of the TTM and has been defined as the belief that one has the capabilities to perform a behaviour that will result in an expected outcome (Biddle and Nigg, 2000). The Self-Efficacy theory proposes that the confidence that one has in his or her ability to perform a behaviour is highly related to actual ability (Marcus, Eaton, Rossi, & Harlow, 1994). It is believed that the degree of self-efficacy determines whether the individual will approach or avoid the achievement situation. Marcus and Owen (1992) also report that self-efficacy beliefs are superior to past performance in predicting future behaviour (Marcus & Owen, 1992a).

Self-Efficacy is developed from four major sources of information: performance accomplishments, vicarious experiences, verbal persuasion and physiological states (Bandura, 1977).

Performance Accomplishments develop from past performances. Successful past performances raise mastery expectations and repeated failures lower mastery expectations. Therefore strong efficacy expectations can be developed through repeated success (Bandura, 1977).

Vicarious Experiences are another source of information that affects self-efficacy. They are gained by seeing others perform an activity or behaviour, either positive or negative, which thus may generate expectations in observers that they too might be able to improve their behaviour. Modelling, however, largely depends on social comparison, so therefore is a "less dependable source of information about one's capabilities than is direct evidence of personal accomplishments" (Bandura, 1977).

Verbal Persuasion is a type of reinforcement (Mutrie et al., 2003) by which people are led through suggestion. The person is persuaded that they can deal successfully with what has overwhelmed them in the past (Bandura, 1977).

Emotional Arousal also influences expectations, as people tend to partly rely on their physiological arousal to judge their stress and anxiety levels. Individuals may be more likely to expect success when they are calm and relaxed as opposed to tense and apprehensive (Bandura, 1977).

Decisional Balance

The final outcome measure included in the TTM is decisional balance. Decision making was first conceptualised by Janis and Mann (1977) as a decisional balance sheet that assessed the importance that an individual places on the potential advantages, or pros, and disadvantages, or cons, of a behaviour. In making decisions, it is argued that individuals consider the benefits and costs that will result from enacting potential courses of action (Janis & Mann, 1977). Originally, there were four categories of pros (instrumental gains for self and others and approval for self and others) and four categories of cons (instrumental costs for self and others and disapproval from self and others) (Velicer et al, 1998). An empirical test of the model, however, revealed a much simpler structure with only two factors, pros and cons. The balance between the pros and cons varies depending on which stage of

change the individual is in. When the cons of exercise are of greater importance than the pros of exercise, motivation to change the behaviour is low (Marcus et al., 1992a). Thus, the cons are assumed to outweigh the pros in the precontemplation and contemplation stages. For the advanced stages of action and maintenance, pros are of great importance and the cons are decreased, indicating that the maintenance of regular exercise requires a continual series of decisions. It has been suggested that this decision making process relates to present and future probability to participate in behavioural change (Velicer, DiClemente, Prochaska, & Brandenberg, 1985).

A study investigating the relationship between decisional balance and stage of change across twelve problem behaviours e.g. smoking cessation, exercise acquisition, weight control, quitting cocaine etc. found a consistent trend across all twelve behaviours, that is the cons for changing problematic behaviour were higher than pros in the precontemplation stage, with the pros being higher for individuals in the action stage (Prochaska et al., 1994c).

Physical activity and TTM

The TTM was originally studied in the context of smoking cessation, but has since been applied to a number of health behaviours, including physical activity. In the early 1990's, the TTM was studied in the context of exercise related behaviour change, with the main focus being measurement development and validation. More recently, the emphasis has been on intervention studies.

In 2001, Marshall and Biddle published a meta-analysis of the application of the TTM to physical activity and exercise. The analysis included 91 independent samples from 71 published reports, published between 1983 and 2000. Studies were selected if they applied to at least one core construct of the TTM. The aggregate number of individuals in each stage of change was computed for the primary studies, so that population estimates could indicate the amount of individuals at risk of a sedentary lifestyle and its associated negative outcomes. Of the 91 samples, 54 were cross-sectional, 6 longitudinal, 10 quasi-experimental and 1 was a random sample.

Only 3 studies included all key constructs of stage of change, processes of change, self-efficacy and decisional balance. The total sample (N=68,580) was distributed as follows: 14% precontemplation; 16% contemplation; 23% preparation; 11% action and 36% maintenance. The younger samples (<25 years) had fewer

individuals in precontemplation (3%), but more individuals in preparation (31%) and action (18%).

Studies with no frequency, intensity or duration criteria had the most individuals in the precontemplation stage (25%) and the least in action stage (8%), whereas studies that employed the most stringent criteria for regular physical activity (4-7 days X 30 min MVPA /week) had the highest proportion in the maintenance stage (54%). It is possible that studies with no definitions of physical activity, forces individuals to rely on their own opinion of what regular physical activity is. They may overestimate the amount of physical activity required to be regularly active and thus categorise themselves in a lower stage.

The majority of studies have found that exercise self-efficacy scores increases linearly across stages (Prochaska et al., 1994a) and this also holds true for adolescent samples (Nigg et al., 1998). However, Marshall's review found the pattern of increase in self-efficacy to be non-linear, with effects regarded as moderate (PC to C), small to moderate (C to P), moderate (P to A) and moderate to large (A to M).

The pros of physical activity were significant and positive (except from C to P), suggesting that the perceived benefits of change increase for every forward stage transition. The largest effect size was evident at the PC to C stages, indicating that the change in intention may be due to an increase in perceived benefits or else the change produces this increase. The analysis reported a small to moderate and significant decrease in the cons of physical activity across stages, supporting the model prediction (Velicer et al., 1985). Similar to the pros, the steepest decline was evident from PC to C.

The stage transition from PC to C also produced the largest effect for the processes of change, with the P to A transition following. The largest single effect size was for self-liberation from PC to C, indicating that the change in intention is mainly caused by a re-appraisal of one's image and values. This is consistent with the study by Marcus and colleagues (1992), which also found self-liberation to increase significantly from PC to C ($p<.05$). Large effect sizes were also reported for self-liberation in a study of American adolescents (Nigg et al., 1998).

In general, this analysis supported the view that core constructs differ across stages; however, it did not confirm whether behaviour change occurred in a series of stages or whether behaviour change occurs along a continuum. The authors also reported that it was difficult to compare results, as there was huge variance among the

measures used. For this reason, it is imperative that measures are standardised and reliabilities improved.

In 1994, Marcus and colleagues applied some of the components of the TTM to exercise behaviour. This study examined the relationship between stage of change, self-efficacy, decisional balance and also included a self report measure of physical activity in an attempt to build a model that could be used in predicting level of physical activity (Marcus et al., 1994). The sample included 698 male and female (mean age=40.7 ± 10.8; 48.6% female) employees of four Rhode Island worksite samples. Physical activity was measured via a self-administered seven-day physical activity recall questionnaire. A three-step model approach was employed to examine the theoretical model of physical activity. Exploratory principal components analyses firstly examined the component structure of the three independent constructs, conducted on half of the sample (n=349). This was followed by a confirmatory structural equation modelling procedure carried out on the second half of the sample. This analysis examined the hypothesised model of the three independent constructs (self-efficacy, pros of exercise and cons of exercise), the stage of change and a dependent construct (amount of physical activity). This model showed the predicted relationships between the constructs and is illustrated in Figure 2.3. This analysis revealed that the hypothesised model was an excellent fit with the data, accounting for 81% of the variance and that the individual's level of physical activity could indeed be predicted by knowing their stage of readiness for exercise, decisional balance and self-efficacy. Specifically, exercise pros accounted for 16% of an increase in stage of change and exercise cons accounted for a 16% decrease in stage of change. Self-Efficacy was the strongest predictor accounting for 50% of the variation in stage of change, with an indirect effect of 21.5% (0.50*0.43) on physical activity.

Take PART

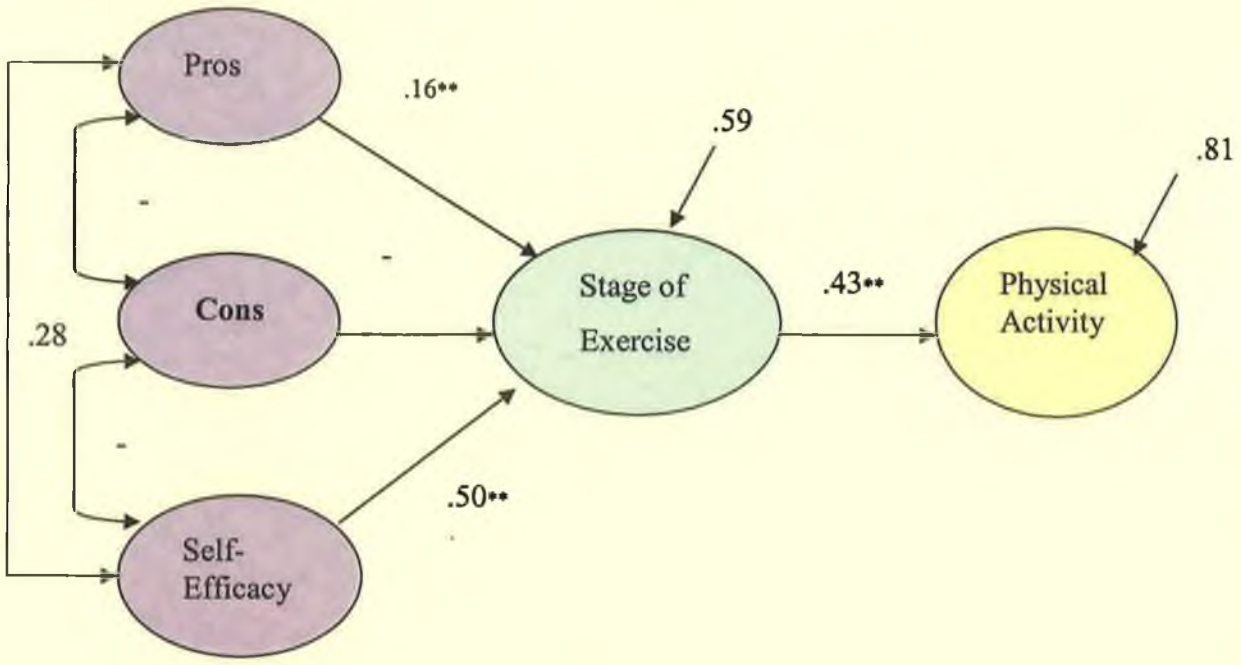


Figure 2.3. Hypothesised theoretical model of physical activity.
Note. (*p<.05, **p<.01, ***p<.001) Taken from (Marcus et al., 1994)

The third and final step was to test the hypothesised model with longitudinal data collected 6-months later (n=433, 62% of original sample). The three independent constructs and stage of change from the first assessment were used to predict physical activity at the second assessment (Fig. 2.4). This model shows that the TTM constructs were able to account for 72% of the variance in physical activity 6 months later. Self-Efficacy was again the strongest variable accounting for 48% of the variance in stage and producing an indirect effect of 25.4%. In this model, cons produced a negative effect of 24% on stage, compared to the 11% influence by pros.

Take PART

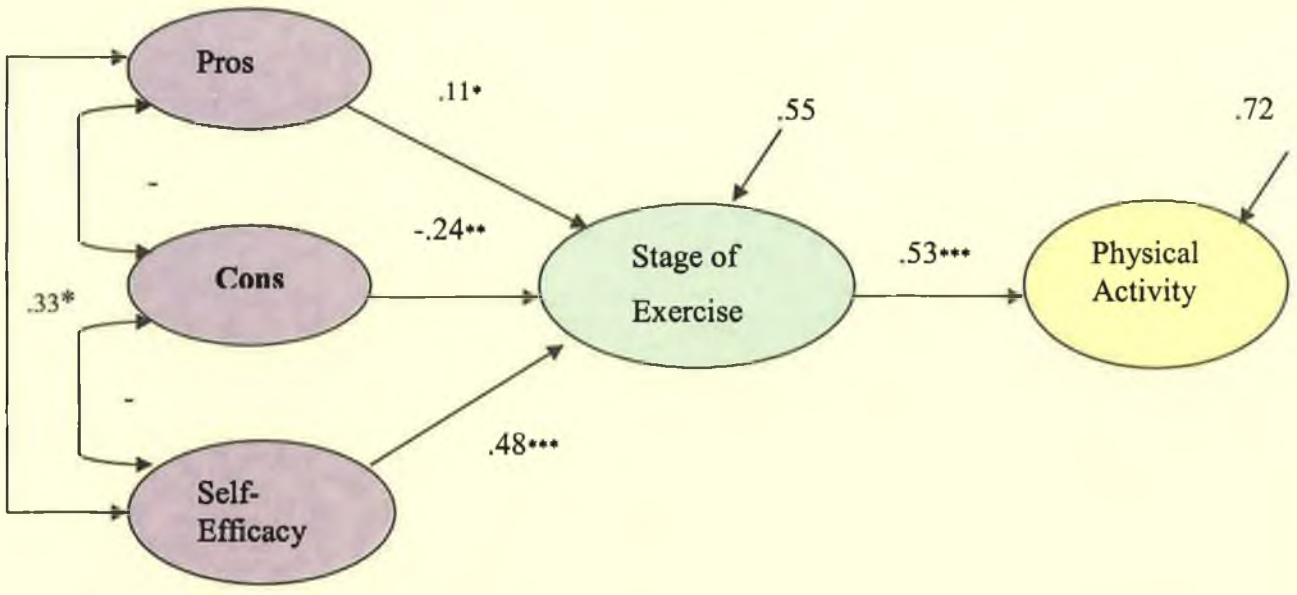


Figure 2.4. Standardised maximum likelihood parameter estimates for the structural portion of the longitudinal theoretical model of physical activity
Note. (*p<.05, **p<.01, ***p<.001). Taken from (Marcus et al., 1994).

The results of this study were consistent with Bandura's theory of self-efficacy (Bandura, 1977), as the participants who expressed high levels of self-efficacy were more likely to approach exercise than those with low levels. Also, the decisional balance results supported Janis and Mann's model for decisional balance, with the individuals who perceived exercise as beneficial possessing a greater readiness for exercise (Marcus et al., 1994). The study also found that direct pathways between the independent constructs and physical activity were non-significant, indicating the strong mediational role of the stages of change.

Critique of Stage of Change

Stage of Exercise Behaviour is central to the TTM and there has been an abundance of research in the last decade on the construct reliability and validity of the Stage of Change model in the exercise domain (Leslie, Johnson-Kozlow, Sallis, Owen, & Bauman, 2003; Schumann, Estabrooks, Nigg, & Hill, 2003; Cardinal, 1997; Cardinal, 1995; Wyse, Mercer, Ashford, Buxton, & Gleeson, 1995).

One of the most recent studies of the reliability of the Stage of change measure was carried out on American (n=105; mean age = 20.6 ± 2.5) and Australian (n=123; mean age = 22.3 ± 5.3) college students (Leslie et al., 2003). Study one, which

included the American students, required participants to complete a survey on two occasions separated by 1-week. Moderate physical activity was defined as 30 minutes a day for 5 or more days doing physical activities such as walking briskly, vacuuming, digging in the garden and general housework. Vigorous activity was defined as at least 20 minutes, 3 times a week of physical activity such as power walking, swimming, rowing, aerobics or tennis. Participants were asked a series of 5 Yes-No questions for both staging measures to indicate their exercise status for moderate and vigorous intensity activity. The answers were given a score and from this the participants were assigned to a stage.

Reliability scores (Cohen's kappa coefficient) for the moderate intensity were 0.50 [95% CI: 0.34-0.66], while the reliability for the vigorous intensity was 0.76 [95% CI: 0.67-0.86]. In study two, participants completed a mail survey on two occasions, the second survey being sent out 2 days after the first was returned. The second survey had to be returned within 2 weeks of receiving the first survey. The definition of moderate and vigorous activity in this study were phrased differently than that in study one, however the information conveyed was basically the same. A short-form five-response option item was used for both moderate and vigorous activity. Reliabilities were slightly lower for study 2, with a kappa value of 0.45 [95%CI: 0.33-0.57] for moderate intensity and 0.72 [95%CI:0.63-0.81] for vigorous intensity. The low values reported for moderate intensity activity is indicative of the measurement problems associated with this type of activity, as moderate intensity is associated with more frequent participation and lower salience, making it difficult for people to accurately recall these activities (Tourangeau, 1984).

Wyse and colleagues examined the concurrent validity of the Stages of Exercise Behaviour Change scale (SEBC) in young British adults (N=244, age = 16-21, 58.6% female) (Wyse et al., 1995). This cross-sectional study found significant differences between the exercise change categories ($p<0.01$) in self-report levels of exercise behaviour. Lower intensity exercise (measured via the Godin-Shepard leisure time physical activity questionnaire) did not significantly differentiate stages, whereas significant differences were found for the "higher intensity" exercise. This supports suggestions that higher intensity exercise (moderate-vigorous) are more likely to be encoded into memory and highlighted during recall (Baranowski, 1988). A cross-validation study of a random 40% of the sample confirmed the predictive validity of the classifications, with 70.7% of males and 67.8% of females assigned to

the correct category. A limitation of this study, however, was the collapsing of the five stages into three stages, that is, Precontemplation/Contemplation, Preparation and Action/Maintenance. Although, this study provides evidence for the construct validity of the Stage of Change model, it is still uncertain whether the five stages can be significantly differentiated.

With the ever-growing interest in adolescent exercise behaviour, a validity study with adolescents was carried out in Canada and USA (Lee, Nigg, DiClemente, & Courneya, 2001). The research comprised of two studies, the first of which took place in Canada (N=858, mean age = 14.99 yrs ± 1.2; 51.28% male). Both strenuous and moderate exercise varied significantly by stage ($p<0.0125$). The second study utilised data from older adolescent college students in the U.S. (N=184, mean age = 18.6, ±0.5; 54.89% female). Strenuous and moderate exercise also varied significantly as a function of stage classification ($p<0.01$). In the first study, the Stage of Change measure did not include intention for the preparation stage, whereas the second study did. The findings indicated that the sensitivity of the staging algorithm was better when immediate intention was included (95.06% vs. 80.39%).

TTM and Adolescents

Nigg and Courneya (1998) applied the TTM in its entirety to an adolescent population. This study tested the applicability of the TTM for the adolescent population in order to understand exercise behaviour. Participants (N=819, 51.3% male) ranged from 13 years to 19 years (mean age 15 yrs ± 1.22). Stages of change distributed as follows: 2.1% Precontemplation, 4.2% Contemplation, 28.7% Preparation, 15.7% Action, and 49.3% Maintenance, reflecting a substantially more active group than previous studies of adult populations (Marcus, Banspach, & Lefebvre, 1992; Marcus et al., 1994).

All components from the core constructs significantly differentiated at least one stage of change and also supported the hypothesis that different constructs are more or less important at different stages. As predicted self-efficacy increased with stage of change, pros increased from precontemplation to maintenance and cons decreased significantly from contemplation and preparation to maintenance. The intersection of pros and cons occurred at the action stage. Marcus and Owen (1992) found the intersection point for pros and cons occurring at preparation stage for the American sample and at contemplation stage for the Australian sample (Marcus et al.,

1994). It would seem that perhaps the decisional balance intersection point might be population specific. However, it must be noted that this study used the full 16-item decisional balance questionnaire whereas Marcus and Owen used a shortened 6-item decisional balance questionnaire. To overcome this limitation, both studies report t-score values for the decisional balance data. T-scores provide a standardised metric value to facilitate comparison and are based on a mean value of 50 with a standard deviation of 10. For this reason, the study will report t-scores to allow comparison with other adolescent studies.

The results of the processes of change questionnaire largely support previous research by Marcus et al. (1992) with the experiential processes used more frequently by those in the early stages and the behavioural processes increasingly more important towards the more advanced stages. Dramatic relief however did provide some unpredicted results with, with the adolescents in the active stage using dramatic relief more than precontemplators. It may be that adolescents have fewer emotional experiences related to exercise than adults (Nigg et al., 1998). The study provides support for the use of the TTM with adolescent populations, however due to the cross sectional nature of the research, it does not clarify whether there is a predictive link to behaviour or whether the results are a reflection of increased experience with exercise. Although the study incorporated all the elements of the TTM, there was no independent measure of physical activity included. For the purpose of the TTM constructs, exercise was defined as leisure time physical activity (out of school activity) in order to control for those who participated in physical education classes. Some of the participants were required to do P.E. on a mandatory basis whereas others took it as school subject. This may have biased the results, as those who participated in P.E. may have had more exercise experiences to rely on have a better understanding of the benefits of exercise.

A recent study by Hausenblas and colleagues (2002) examined both subjective and objective parameters of exercise behaviour/ fitness level across stage of change. The sample (N=387, mean age = 12.61 yrs ± 1.00, range 11-15; 52% girls) completed a questionnaire including physical activity measures, stage of change, self-efficacy and decisional balance measures. They also participated in a fitnessgram test, which included a 1-mile run/walk, BMI, curl-up and sit-up test and trunk lift flexibility test. The Godin Leisure Time Exercise Questionnaire (GLTEQ) was used to assess

physical activity and regular physical activity was defined as 3-5 times per week, for a minimum of 20 minutes per session. The sample were distributed across the stages of change as follows: 1.3% Precontemplation, 3.4% Contemplation, 6.4% Preparation, 27.8% Action, and 60.9% Maintenance. An ANOVA analyses revealed that push-up, curl-up, 1-mile run/walk and self-efficacy differed significantly across the stages. BMI decreased across the stages, however this result was not significant. Leisure time physical activity did not differentiate across the stages, and one would have to question the validity of this measure for this age-group. The pros and cons were also insignificant suggesting that the pros and cons important to adults may not be the same for children.

A study of Irish adolescent physical activity behaviour would be extremely beneficial to future programme and policy design. Although we have seen that the TTM can be applied to an American adolescent population, it remains to be seen whether the outcome would hold true for an Irish population. The TTM has never been applied to this population in the exercise context and would provide preliminary results that could guide future research design. Although longitudinal studies have been recommended for future research in this area, a cross sectional examination would educate practitioners as to the health and physical activity status of the current adolescent population in Ireland. This baseline data would be beneficial for a number of reasons. Firstly, it would provide data on an Irish adolescent population in relation to physical activity behaviour, aerobic fitness and health status. Secondly, it would determine whether the TTM is applicable to this population. Finally, it would provide information regarding the demographics of the 'at-risk' individuals, which are those in the pre-action stages.

Critique of TTM

The TTM has been extensively applied to the domain of physical activity behaviour. The strength of the TTM lies in its stage-based nature, which offers the researcher the opportunity to identify sedentary individuals, while at the same time determining their intentions towards physical activity. The TTM makes no assumption about how ready individuals are to change and recognises that appropriate interventions must be designed to suit different stages. This recruitment strategy results in higher participation rates (Prochaska et al., 1994a). Another major problem that faces health professionals is adherence to exercise programmes with most

programmes reporting a 50% dropout rate after 6 months (Dishman, 1994). Since the TTM allows the researcher to design stage-matched interventions, interventions are individualised to peoples needs. Thus, there are higher retention rates because of the appropriate demand characteristics.

Interventions should be assessed based on their outcome, which is the recruitment rate times the efficacy (Velicer, et al. 1998). For example, a physical activity intervention could have a very high efficacy rate but very low recruitment rate, which would have very little impact on physical activity levels in the population. However, interventions based on the TTM have the potential to have both a high efficacy and a high recruitment rate, thus creating a much bigger impact.

On the other hand, critics of the TTM argue that human behaviour cannot be simplified into discrete stages or categories, due to its complexity. It has been suggested that the stages are artificial divisions of a natural continuum and that individuals are permanently evolving (Bandura, 1997). Bandura (1997) believes that a shift in intention or behaviour does not make the stage process a dynamic process model. Rather it is a descriptive device, providing no explanation for why individuals consider making changes. Lippke (2004) describes the stages as pseudostages, which are just arbitrary divisions of an underlying continuum. To counter this argument, it has been suggested that most people follow a 'spiral' pattern rather than a linear progression as originally hypothesised (Lippke, Nigg, & Maddock, 2004). The spiral pattern recognises that people may regress or relapse back to an earlier stage before progressing.

Another limitation of the TTM is that it assumes that the individual has full responsibility over the behaviour change and does not account for other factors, which may be outside of the individual's control. Therefore the TTM only accounts for intentional change and not for societal, developmental or imposed change. For example, if an individual's child was ill and this prevented them from participating in regular physical activity, then it would be outside of their control. It may be that the TTM needs a measure of perceived behavioural control similar to the theory of planned behaviour.

The environment also plays a huge role in determining whether an individual can change their behaviour (Bandura, 1986). Albert Bandura 's social cognitive theory integrates social psychology, cognitive psychology and behaviourism. Environment is a major determinant of this framework and represents both the social

and physical environment, however the reciprocal relationship between the environment, the person and the behaviour will ultimately determine whether the individual is active or not. Even if physical activity is promoted and provided, the environment may not allow for the individual to progress through the stages, that is the environment may be enhancing or inhibiting. For example, road safety fears due to high levels of traffic or speeding in a neighbourhood, may discourage young people from participating in playing, cycling and walking activities (Mullan, 2003). So although, the TTM posits that behaviour change is completely under the individual's control, realistically there are many factors outside of the persons control that need to be taken into account.

Social Support

Social support, has been referred to as any process through which social relationships might promote health and well-being (Cohen S, Underwood LG, & Gottlieb BH, 2000). Social factors influence people's decisions to be active or not, however the magnitude of this influence is unknown. According to Stahl et al. (2001), social relationships and social support are key elements of the social environment and exert an influence over health behaviours and health status. This influence may be positive or negative, for example peers encouraging friends to smoke (negative) or parents giving negative feedback about alcohol (positive). "Social support is thought to affect mental and physical health through its influence on emotions, cognitions and behaviours" (Cohen et al., 2000: pg.10).

A strong positive association has been found between physical activity and social support, with family and peer support consistently associated with physical activity participation. The opposite also holds true, with studies reporting an association between lack of social support and lower levels of participation (Stahl et al., 2001).

The social cognitive perspective of social support is concerned primarily with the perception of support. This perceived support is influenced strongly by the individual's impression of the supporters' characteristic rather than the actual support that is being provided (Cohen et al., 2000). Therefore negative thoughts about social relations can overlap with and stimulate negative thoughts about the self, which in turn may stimulate emotional distress. It suggests that once a person develops stable

beliefs about the supportiveness of others, daily thoughts of social support are shaded to fit these pre-existing beliefs. For example, if a child perceives low support from his or her family, this may lead to lower self-esteem and result in the child discontinuing with physical activity. This model (Figure 2.5) also maintains that perceived support can lead directly to health outcomes so whether the child chooses to participate in physical activity may depend on the amount of support the child perceives to be available.

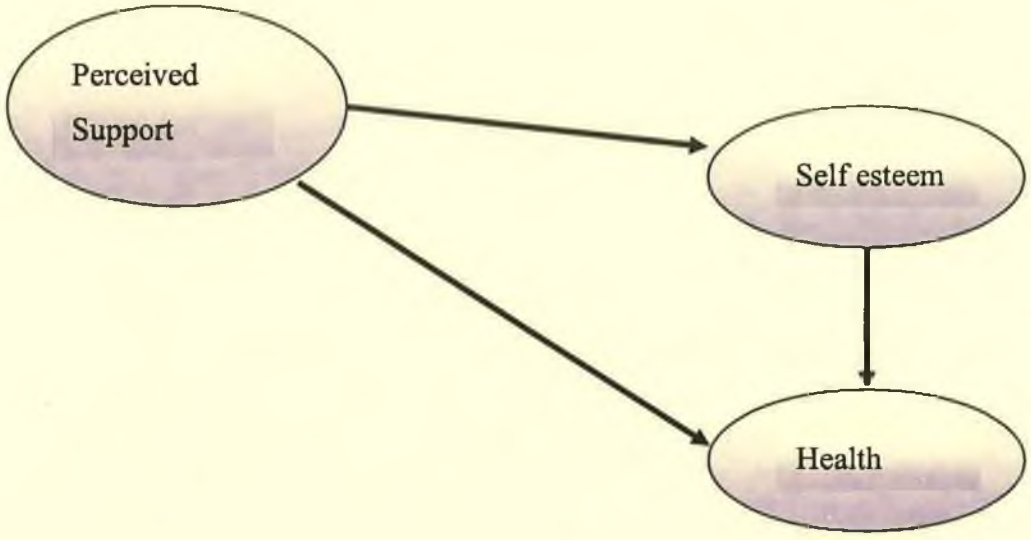


Figure 2.5. The social-cognitive perspective of social support.
Note. Taken from (Cohen S et al., 2000)

In an international cross sectional study of adults across six countries (N=3342, 56.9% female, median age=45) respondents were interviewed via telephone (Stahl et al., 2001). A simple screening question asked participants whether they did any gymnastics, physical activity or sports, and was used to classify the respondent as active or inactive. Examples of physical activity given were commuting to work, gardening and competitive sport. Perceived social support for participation in physical activity was assessed via a 10-item measure asking the respondent about perceived motivation to participate in sports and physical activity from family and friends, and also from other influences such as newspapers and TV. Social support was then categorised as low or high using the median as a cut off point. Results indicated that those who perceived low levels of social support from their personal environment were twice more likely to be physically inactive compared to those who reported high support. The physical activity measure used in this study was a

somewhat crude measure, however the authors felt that the because the purpose of the study was to look at the factors associated with physical activity as opposed to measuring physical activity, it was deemed acceptable. Also due to the diversity of nationalities involved in the study, it was felt that a simple universal measure should be used.

Parental and Family Influence

Parents and family play a vital role in the health and well-being of adolescents in many ways. They directly influence their children's physical and psychological development, they provide guidance and information on health-related matters and they often influence the adolescent's access to health care and health related information (Steinberg & Duncan, 2002). Nowadays there are so many influences outside the family, it is extremely important for parents to be included in the promotion of health to their adolescent child. According to the (Health Education Authority, 1997), parents play a vital role in this process as they can influence their children both directly and indirectly:

Helping and supporting their children

This form of support is instrumental and direct, e.g. participating in activities with the child, organising activities, transporting the child to the activity, payment of fees. A recent study of parental provision of transport measured the physical activity (7-day recall and past year leisure physical activity) of 1,678 adolescents (58% girls, m age = 13 yrs), with 72% of parents completing a survey on transportation to, and location of, their child's physical activity (Hoefer, McKenzie, Sallis, Marshall, & Conway, 2001). A mean of 2.13 times per week was found for parent transportation; with the boys being transported more (2.35 times/wk vs. 1.97 times/wk, p=0.03). Parent transportation contributed significantly to girl's total physical activity (p=0.001) and participation in sports/activities lessons (p=0.001). Parent transportation also contributed significantly to boy's participation in sports/activities lessons (p=0.001), however no significant contribution was found for total physical activity. This may be because the boys participate in unorganised sport in their local area, such as playing soccer in the streets, which does not require transportation. In general, these results indicated that the provision of transport is associated with out of school physical activity.

Serving as active role models

This form of support is observational in the form of parental modelling. Although there is conflicting evidence on parental modelling, it is thought that inactive parents can influence children. In a study of normal weight (n=142) and obese (n=129) children (mean = 9.6 yrs, n=245 mothers, n=222 fathers), it was found that parent inactivity was a strong and positive predictor of child inactivity ($p<0.001$)(Fogelholm M, Nuutinen O, Pasanen M, Myöhänen E, & Säätelä T, 1999). On the other hand, a review of the correlates of physical activity for youth by Sallis et al. (2000) reported that parent physical activity levels were the most frequently measured social variable, however no association was found amongst the 27 studies (Sallis et al., 2000). Therefore it may be that inactivity has a more influential effect on adolescents and that this form of modelling is very harmful.

Providing positive encouragement and reinforcement

This form of support is largely emotional and motivational including parental beliefs, attitudes, reward systems and positive encouragement. A study of parental correlates of physical activity in a racially/ethnically diverse adolescent sample, measured parental physical activity, sedentary behaviours, and physical activity attitudes and also adolescent physical activity, sedentary behaviours and perception about their parents physical activity levels (McGuire, Hannan, Neumark-Sztainer, Falkner-Crossow, & Story, 2002). The sample included 900 parents (90% female) and 900 adolescents (50% female). Results showed that parents reported encouragement was positively related to physical activity in white ($r=0.39$, $p<0.001$) and black boys ($r=0.26$, $p=0.007$), and girls ($r=0.15$, $p=0.001$). Unfortunately, parents can have a negative effect on their child's physical activity if they are overpowering. Many parents are ego orientated, pressurising the child to win at all costs. In this case, the type of encouragement may have a negative effect.

Many studies measure social support with a range of questions relating to different aspects of support. An example of this is a study by Leslie and colleagues (1999), which examined a sample of college students (N=2729; 57.2% female; m age = 20 yrs) in Australia. Social support from family and friends was measured via three questions asking about family and friends exercising with the student, offering to exercise with the student and encouraging the student to exercise. A five-point scale was used (0=never to 4=very often) and social support was categorised as low if the respondent scored less than or equal to 2, and high if scored higher. A logistic

regression analyses revealed that males who reported low social support from the family were 48% more likely to be insufficiently active that those who scored high on the social support scale (OR 1.48; 95% CI 1.22-1.81; $p<0.001$). Also, males who scored low on friend's social support were 45% more likely to be insufficiently active (OR 1.45; 95% CI 1.11-1.89; $p<0.01$). For females, the likelihood of being insufficiently active transpired as 55% if low family social support (OR 1.55; 95% CI 1.35-1.79; $p<0.001$) and 23% if low friends social support (OR 1.23; 95% CI 1.06-1.43; $p<0.01$) (Leslie et al., 1999).

A study of American adolescents (N=380, mean=14.0 ± 1.6 years) examined parent physical activity habits, enjoyment of physical activity, importance placed on physical activity and supportive behaviours for their child's physical activity via self-report measures (Trost et al., 2004). The adolescents completed a 7-day recall questionnaire on physical activity and also a 5-item self-efficacy measure. The authors created and tested a model using structural equation modeling (SEM), which indicated that parental support was a significant correlate of youth physical activity, acting directly or indirectly on physical activity behaviour through its influence on youth self-efficacy.

Peer Influence

It is well known that significant others in youths' lives, serve as primary socialising agents in the physical activity context (Smith, 2003), however the majority of research on social influence has concentrated on the role of adults. It is believed that while parents and family members continue to influence adolescents' health behaviours, peer influence actually increases with age (Eccles, 1999). According to Rubin and colleagues (1998) peer influence in the physical activity setting can be investigated at different levels, including an individual's social orientation and perceptions through interactions, relationships and group-level processes (Rubin, Bukowski, & Parker, 1998).

As children grow up, they develop an interest in social comparison, which is comparing themselves to their peers on a number of characteristics. In particular, athletic competence and physical appearance have been identified as key social status determinants (Chase & Dummer, 1992). Sport, is thus an important arena for achievement situations in the physical domain. Interest in social comparison intensifies as the youth moves from middle to late childhood and the youth shifts from

relying predominantly on adults for physical competence information to information from peer comparison (Horn & Weiss, 1991).

In accordance with Bandura's social learning approach (1977, 1986), peer modelling is possibly the primary mechanism of support, from which youths learn moral attitudes and behaviours (Smith, 2003). Adolescent peers do not attempt to teach or train each other in the same way in which parents must teach their children. In a study of Norwegian adolescents (N=904, mean age=13.3 years ± 0.3), Anderssen and Wold (1992) investigated the influence of parents and peers on leisure time physical activity. Leisure time physical activity was measured through a categorical question asking how often they participated in sports or exercise outside of school hours on a 5-point Likert scale ranging from never to everyday. Parents (mother, father) and peer (best-friend) leisure time physical activity was measured via the participant's perception of this frequency. Direct support was measured through questions of frequency of encouragement and direct help was measured through questions on frequency of help in organising exercise sessions. Questions regarding the importance that significant others place on physical activity were also included. Results revealed that perceived physical activity levels, helping and support for activity of both parents and best friends contributed to youth physical activity. For males, the strongest associations found were direct help from parents ($r=0.33$, $p<0.001$), physical activity level of best friend ($r=0.23$, $p<0.001$) and support from parents ($r=0.23$, $p<0.001$). The strongest associations for females were direct help from parents ($r=0.33$, $p<0.001$) and the activity level of best friend ($r=0.31$, $p<0.001$). The results of this study highlight the importance of both family and peer support and suggests that both groups should be targeted in strategies for promoting physical activity in young people.

Critique of social support

When measuring social support, caution must be taken as with all self-report measures. Many studies have asked the parents about the level of support offered to the child, however the child may perceive the amount of support as different. Similarly the child may report different levels of support than that perceived by the parents. However, the child's perception of support does provide important data about their activity level, as perceptions are often more directly linked to outcomes than actual support. The source of support should also be identified, as the individual

may receive more support from a teacher or family friend than a family member. Also the individual may be receiving support from other sources not identified in the questionnaire such as a coach, or a player they admire. Therefore, it is difficult to provide an ultimate definition of social support.

Social Support and the TTM

The TTM includes *helping relationships* as one of its 10 processes of change, thereby acknowledging the importance of social support in health behaviour change. Helping relationships has been described as a measure of social support, whereby the goal of the process is to enlist the help of someone that cares (Prochaska et al., 1994b). However, this process does not address the broader spectrum of social support, as it is limited to encouragement. Social support is not limited to receiving encouragement on changing or maintaining behaviour. Rather it is the combinations of direct and indirect help, encouragement, positive role modelling and reinforcement. Social support from family, friends and significant others has a major influence over many health related behaviours such as physical activity, smoking cessation and dieting.

Social support will be included in this study for two reasons. Firstly, the relationship between social support and the physical activity levels of Irish adolescents must be examined. This aspect of the social environment has never been examined for Irish adolescent population and based on reviews of the determinants of adolescent physical activity, social support is one of the most influential determinants. The other reason for including social support in this study is to determine whether it improves the strength of the Transtheoretical model. The TTM for physical activity was developed and tested with American and Australian populations and it might be that some of the TTM constructs are not relevant to the Irish population. On the other hand, it may be that social support is a fundamental construct missing from the TTM, or that it indirectly influences the existing variables. Perhaps the support an adolescent receives from their family increases self-efficacy and thus influences physical activity behaviour? This study will examine the impact of social support on the TTM.

Conclusion

In conclusion, this literature review has emphasised the importance of physical activity in terms of physical and psychological health benefits. It is clear that physical activity is especially important for adolescents, as this is the period when health behaviours such as physical activity habits are being set. Results from national and international studies indicate that adolescents are not doing enough physical activity to achieve these health benefits and this will have dire consequences later on in life (Kelleher et al., 2003; Friel et al., 1999; Riddoch et al., 2004). Therefore this study will provide data on the physical activity behaviours, aerobic fitness and physical health status of Irish adolescents. It will also examine the effect of personal characteristics such as gender, age, socio-economic status and residence on these parameters. The impact of sedentary behaviours, which include TV watching and commuting to school, will also be examined in the light of these parameters. The influence of social support on physical activity will be determined, with a focus on the source of support.

The TTM has provided a theoretical model that will assist in understanding how behaviour change occurs. Its temporal dimension allows for the targeting of certain groups such as sedentary precontemplators, thus improving the adherence rate of physical activity programmes. This study will examine the efficacy of the TTM for predicting physical activity amongst this sample. The TTM will be developed further through the addition of social support in an effort to improve the prediction capability of the model. Chapter three will describe the methodology employed in the study, with the results and discussion chapters following.

Chapter 3: Methodology

This study is a cross-sectional analysis of 15-17 year old students in the East Coast Area Health Board (ECAHB) region. The geographical area served by the ECAHB ranges from Ringsend in the north to Carnew in the south, and from the east coast of Wicklow to the borders of West Wicklow and Carlow. It incorporates the Dundrum, Rathfarnham and Sandyford areas of South Dublin (Figure 3.1).

Figure 3.1. Map of the East Coast Area Health Board (ECAHB)

Due to the scale of the project, a research team of five individuals was appointed to carry out testing. This meant that the ratio of researchers to students was never more than 1:10. Meetings began immediately, under the guidance of the involved departmental staff, and a framework for the project was established. The study was called the Take PART study, with PART an acronym for Physical Activity Research for Teenagers.

Participants

School Selection

A list of all post-primary schools in Ireland was obtained from the Department of Education and the schools within the East Coast area were extracted. A telephone script was prepared (See Appendix 1) and each member of the research team was trained in screening procedures. The main purpose of this call was to screen each school for pupil numbers, gender breakdowns and types of facilities available.

There were a total of 73 post-primary schools listed in the East Coast area, however this included secondary schools, vocational schools, community colleges, comprehensive schools and community schools. Twelve of the vocational schools were only for mature students and repeat leaving certificate and were immediately screened out. Also, some of the schools did not have indoor or outdoor facilities or access to a hall or court to run the 20MST, so a further ten schools were also screened out. The final database included 51 schools.

Sampling

The sampling frame of 51 schools was stratified by the following variables.

- **Type of school:** Secondary School, Community College, Comprehensive College, Vocational School
- **Geographic Location:** Urban, Rural
- **Gender of School:** Male, Female, Mixed
- **School Classification:** Free Education, Fee Paying

Following this a one-stage cluster sampling method was used to obtain a representative sample. A one-stage cluster sample is a probability sample, in which each sampling unit is actually a collection or cluster of elements, and where all member of the cluster are sampled. This sampling method allows the researcher to overcome the constraints of costs and time associated with a dispersed population. The number of clusters selected replaces the sample size and the number of clusters in the population replaces the population size. The sample size was calculated based on the HBSC study (2003) which indicated that 65% of 15-17 year olds were not regularly active. To estimate the percentage to within ± 3% (95% confidence interval) a sample size of 972 was required. Therefore twenty four schools were

selected (approximately 2,000 eligible students) thus allowing for refusals and cancellations.

Contact was made with the P.E. teacher in each selected school and the project was briefly explained. A meeting was then organised in the school to discuss feasibility and logistics. It was felt that the initial contact should be made with the P.E. teacher, as they would have a greater understanding of the concepts involved and be in a better position to talk to the principal. A letter was also sent to the Principal at this time, describing the project and informing them of the link with the P.E. teacher.

Of the twenty-four schools were selected, three had inadequate facilities for testing. A further five schools declined the invitation to participate; with another three schools unreachable following several phone calls and a letter. All eleven schools had to be removed from the study. Plans for testing were made with the remaining thirteen schools and an information pack was sent to the P.E teacher containing consent forms, information sheets and a copy of the questionnaire.

Inclusion Criteria

Approximately 1,300 students were available for the project, made up of 700 Transition year students and 600 5th year students. The following inclusion criteria were enforced prior to the study:

- Students must be in Transition Year or 5th Year.
- Students must not be in an exam class.
- Students must be between 15 and 17 years of age at the time of testing.
- Students under the age of 16 at the time of testing must have parental consent or consent from the school board.
- Informed consent must be received from all participants prior to the test.

Ethical Approval

In accordance with the University's regulations for non-clinical research involving human participants, a research proposal form was completed and submitted to the DCU Ethic's Committee. This document described the purpose, design and methodology of the research project. It also gave details of the participant's involvement in the project and outlined any ethical considerations. Due to the nature of the project, the main ethical issue to be considered was confidentiality.

An Academic colleague initially reviewed the submitted proposal, and a report was returned in early January detailing suggested changes and revisions. These revisions were predominantly clarity of terms and procedures. A revised submission was then submitted to the DCU Research Ethical Committee and approval was granted on the 7th of February (Reference no. 01/2003/CSSH/5).

Informed Consent

Informed Consent was required for all students; with students under the age of sixteen requiring either parental or school consent. The school was presented with the option of either seeking parental consent for those under the age of consent or granting consent via the school board, which is primarily made up of parents. The Principal of each school was given this decision, as every school has its own set of rules and procedures. Five of the schools opted for parental consent, with the remaining eight schools granting consent from the school board. Parental consent forms were provided two-weeks prior to the testing (Appendix 2).

When designing the Informed Consent form (Appendix 3), the researcher consulted the Federal Policy for the Protection of Human Subjects, which lists the policy requirements for research involving human subjects (OHRP, 2001). Informed consent is essential to all research studies of this nature, including the Take PART study. Of these issues, the following were applicable to the Take PART project:

- A statement that the study involves research, an explanation of the purposes of the research and the expected duration of the subject's participation, a description of the procedures to be followed, and identification of any procedures which are experimental
- A statement describing the extent, if any, to which confidentiality of records identifying the subject will be maintained
- An explanation of whom to contact for answers to pertinent questions about the research and research subjects' rights, and whom to contact in the event of a research-related injury to the subject
- A description of any reasonable foreseeable risks or discomfort to the subject
- A statement that participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled, and the subjects may discontinue participation at any time without penalty or loss of

benefits to which the subject is otherwise entitled. (Drowatzky, 1996)(OHRP, 2001)

Procedures

The procedure for testing in each school was as follows:

1. The project was explained to all students and they were then given the choice to participate by signing an informed consent form.
2. Students were divided into groups (depending on numbers) and seated in classrooms with adequate space between each student, to complete the questionnaire in privacy.
3. All participants were given an ID code number (in the form of a sticker that they put on a visible item of their clothing), which was associated with all the participant's data from that point on.
4. A member of the research team provided instructions on how to complete the questionnaire and reiterated the confidentiality of each student's questionnaire. Students were advised to take their time completing the questionnaire and to answer all questions.
5. Once the student had completed the personal information on the first page, they were to tear this page off and hand it over to the supervisor. From that point on, an ID number was the only identifier on the questionnaire.
6. Once the student had completed the questionnaire, they were to raise their hand to signal that they were finished. Their questionnaire responses were checked by the researcher and then collected. The student then left the room and began the physical measurements. The physical measurements included height, weight and blood pressure.
7. Following this, the students participated in a 20m shuttle run test, an assessment of aerobic fitness. The 20m-shuttle run test involves continuous running between two lines 20m apart in time to recorded beeps. The time between recorded beeps decrease each minute (level), thus requiring participants to speed up for each level
8. Finally, a presentation on the importance of physical activity was given to the students. The ID numbers of all participating students in each school were entered into a draw for a tracksuit.

Self-Report Measures

A questionnaire (Appendix 4) was developed for the Take PART project by combining a number of well-known self-report measures that had been used previously in the area of physical activity. Measures that had been modified for adolescents or previously validated with this age group were favoured.

Demographics

Prior to completing the questionnaire, participants were required to answer a number of demographic questions on a detachable sheet. These questions assessed gender, age, school year, and also asked them for their name and address. Also included were questions on family structure i.e. how many siblings they had and the respective ages. Finally, the participants were asked a question on the presence of physical or learning disabilities that would affect physical activity participation.

Socio-economic Status (SES)

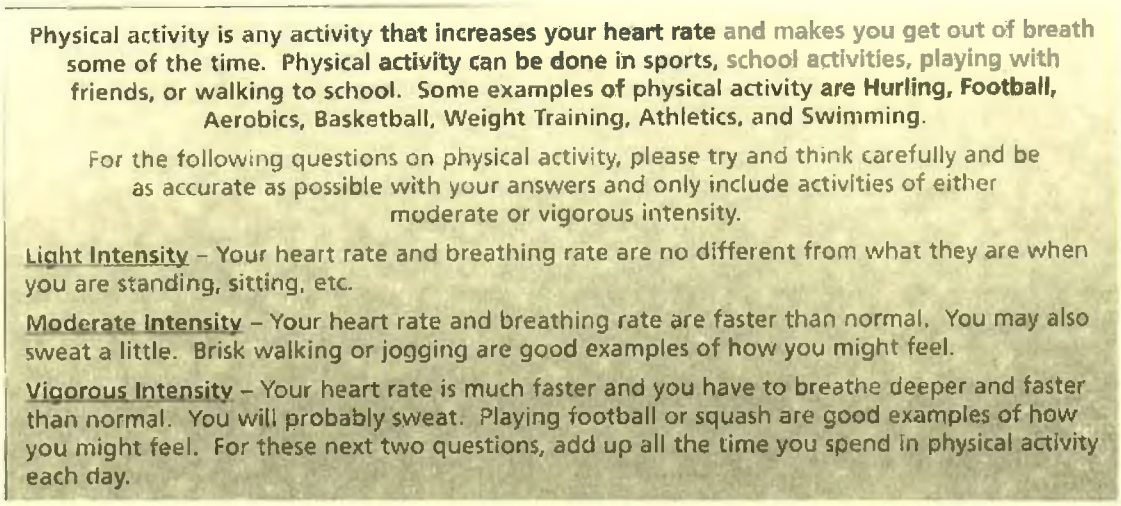
Socio-economic status was assessed via questions regarding parental occupation. An SES measure was taken from the HBSC questionnaire (Currie, Samdal, Boyce, & Smith, 2001) asking participants what profession their father and/or mother are in. These professions are then translated into social class 1-7:

1. Professional Workers
2. Managerial and technical
3. Non-Manual
4. Skilled Manual
5. Semi-Skilled
6. Unskilled
7. All others gainfully occupied and unknown

Habitual Physical Activity

Physical activity level was measured via a physical activity screening measure that was developed for use with adolescents in primary care (Prochaska et al., 2001). This measure provides categorical data ranging from 0 days to 7 days and assesses the number of days that participants had accumulated 60 minutes of moderate-vigorous physical activity (MVPA) during the past seven days and for a typical week. A composite average of the two items gives a score of days per week that the

adolescents had accumulated the 60 minutes. The definition of physical activity was read to the students ensuring that frequency, intensity and types were understood by all students. The definition used in the questionnaire is presented in Figure 3.2.


Physical activity is any activity **that increases your heart rate** and makes you get out of breath some of the time. **Physical activity can be done** in sports, school activities, playing with friends, or walking to school. **Some examples of physical activity are Hurling, Football,** Aerobics, Basketball, Weight Training, Athletics, and Swimming.

For the following questions on physical activity, please try and think carefully and be as accurate as possible with your answers and only include activities of either moderate or vigorous intensity.

Light Intensity – Your heart rate and breathing rate are no different from what they are when you are standing, sitting, etc.

Moderate Intensity – Your heart rate and breathing rate are faster than normal. You may also sweat a little. Brisk walking or jogging are good examples of how you might feel.

Vigorous Intensity – Your heart rate is much faster and you have to breathe deeper and faster than normal. You will probably sweat. Playing football or squash are good examples of how you might feel. For these next two questions, add up all the time you spend in physical activity each day.

Figure 3.2. Definition of physical activity and intensity used in Take PART questionnaire

This measure was found to be reliable with an intraclass correlation coefficient (ICC) of 0.77. The measure also correlated significantly with accelerometer data ($r = 0.40$, $p<0.001$) (Prochaska et al., 2001). These figures are comparable to a recent review of seventeen self-report instruments for youth physical activity, with reliabilities ranging from 0.60 to 0.98 and correlations ranging from 0.02 to 0.88 (only two measures had correlations over 0.50).

This screening measure has also been used in the 2002 Health Behaviours of School Children, a cross-national research study in Europe designed to inform and influence health promotion for school aged children at national and international level (Currie et al., 2001).

The main strengths of this measure are that it is suitable for adolescents, it is easy to score and also its brevity. The measure is also consistent with the recent recommendations for youth to accumulate 60 minutes of MVPA on most or all days of the week. Although Prochaska and colleagues specify five days or more per week as meeting the guidelines, for the purpose of the Take PART study four or more days was used to classify regularly active participants. There is considerable debate regarding the guidelines, with some studies comprehending **most days** of the week as four days and others five days.

Leisure-time Physical Activity (LTPA)

A past-year physical activity grid was used to measure leisure time activities. This grid originated from the Modifiable Activity Questionnaire (Kriska et al., 1990) which was validated on Pima Indians. This questionnaire was further adapted for adolescents (Aaron et al., 1995).

The purpose of this measure is to assess participant's leisure time activities (outside of PE class) that they had participated in at least ten times during the past year. The participant has to choose the activities and then provide information on the associated frequency and duration of participation during the past year. An estimate of the average number of hours per week can then be calculated for each activity and also for total activity providing leisure time physical activity duration in minutes.

A study of 100 adolescents, aged 15-18 years, provided reliable and valid results (Aaron et al., 1995). Participants completed four 7-day recalls every 3 months. These recall questionnaires were identical to the past year questionnaire, however the time period reflected only the past 7 days. The average of the four recalls were utilised as the criterion measure. One-month and one-year test-retest (Spearman correlation due to non-parametric data) showed that the measure was reproducible ($r=0.79$ for one-month, $r=0.66$ for one-year; $p<0.01$). The relationship between past year questionnaire and average of the four past-week questionnaires was found to be high ($r=0.76$, $p<0.01$).

TV watching

The question on TV watching was also taken from the HBSC international standard version for the 2001/2002 surveys (Currie et al., 2001). The question was separated into weekdays and weekends and students had to choose the frequency with which they watched TV on a scale of 1-9 (1 = none at all, 9 = 7 or more hours a day). A composite score was calculated by taking the average of the weekday and weekend score. High sedentary living in terms of TV watching is classified as watching TV for more than 2 hours per day, based on the Healthy People Targets 2010 (U.S.Department of Health and Human Services, 2000).

Commuting to School

In order to classify participants as active or inactive commuters, students were asked how they travelled the majority of their journey to school, with five options included, the latter three identified as inactive modes:

1. Foot
2. Bicycle
3. Car
4. Bus
5. Train

This section also asked what distance and how long it took them to get to school.

Transtheoretical Model (TTM)

The core components of the TTM were measured, namely:

- Stage of Change
- Processes of Change
- Self-Efficacy
- Decisional Balance

Stage of Change Questionnaire (SCQ)

Participant's current exercise behaviour was measured by the ordered-categorical stage of change instrument, with the original measure developed by Prochaska and DiClemente (1983) for smoking cessation (Prochaska & DiClemente, 1983). The measure used in this study was developed for use in the Scottish Physical Activity Questionnaire (SPAQ) (Lowther, Mutrie, Loughlan, & McFarlane, 1999) The "stages of behaviour change model" describes five stages that a person moves through from being sedentary to regularly active (Fig. 3.3). The individual must select the stage that most accurately describes their behaviour at that time.

Take PART

Q.6 Please read through all statements listed below and tick ONE box for the statement that best describes your physical activity over the last 6 months.

1.	I am not regularly physically active and do not intend to be so in the next 6 months	1 ❑
2.	I am not regularly physically active but am thinking about starting to do so in the next 6 months	2 ❑
3.	I do some physical activity but not enough to meet the description of regular physical activity given above. I intend to be physically active in the next 30 days	3 ❑
4.	I am regularly physically active but only began in the last 6 months	4 ❑
5.	I am regularly physically active and have been so for longer than 6 months	5 ❑

Figure 3.3. Stage of Change measure taken from Take PART questionnaire

The SCQ includes a definition of regular physical activity and this was modified to incorporate the current guidelines for youth physical activity, i.e. 60 minutes of MVPA on most or all days of the week. The examples of sports were also modified, so that they would be more specific to Irish adolescents. Hurling, Football, Basketball, Athletics and Swimming were given as examples of sports. Brisk walking and washing the car were given as examples of general activity.

A change was also made to the Preparation stage category definition. According to Reed et al. (1997), the preparation stage should represent a stronger intention to change in the very near future, which is often in the next 30 days, along with the behaviour. This has been referred to as the "classic" interpretation of preparation stage or the "I WILL" stage and has not often been used in previous studies (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997).

This measure has been shown to be reliable with a 2-week test producing a kappa index reliability of 0.78 (Marcus, Selby, Niaura, & Rossi, 1992c). A number of studies have shown that this measure is valid for both adults (Wyse et al., 1995) and adolescents (Lee et al., 2001) and objective physical activity scores follow a linear gradient of improvement across the stages of exercise (Cardinal, 1995).

Processes of Change Questionnaire (PCQ)

In 1992, Marcus et al. modified the original PCQ to suit exercise behaviour. However, the validity of this measure was questioned due to the fact that 17 of the 39

items were modified from the smoking PCQ, by replacing the word "smoking" with the word "exercise". In 1999, Nigg and colleagues redeveloped the scale, with the aim of improving the construct validity (Nigg, Norman, Rossi, & Benisovich, 1999) and also to make the measure more user-friendly.

A 68-item inventory was created, including newly generated items (developed by experts in the field of exercise science and health psychology) and also the 39 items from Marcus' instrument. A random-telephone interview with 346 adults (aged 18-75, 62% female) was carried out with each participant completing the 68-item inventory. This inventory was then reduced to 30 items by restrictive factor analysis. The final scales were internally consistent (alpha range = 0.67-0.86). This measure asks participants how frequently over the past month, they have experienced a range of behaviours and events. The 30-items are rated on a 5 point Likert scale, with 1 being "Never" and 5 being "Repeatedly".

Self-Efficacy Questionnaire (SEQ)

For this study a 10-item measure assessing self-efficacy was used. This is an expanded version of the original 5-item SEQ developed by Marcus et al. (1992) and has been used with adolescent populations (Nigg et al., 1998). Participants were asked how confident they are that they can participate in regular physical activity under various conditions. The term "physical activity" replaced exercise in this construct as there was a need to standardise the terms. It was felt that physical activity represented all types of activities, whereas exercise is only a subset of physical activity. An 11-point Likert scale asked participants to rate their confidence from 0 being "not at all confident" to 10 being "very confident". Test-Retest reliability for the original 5-item SEQ was 0.90 (n=20), with the test period being two weeks (Marcus et al., 1992c). The 10-item SEQ yielded a calculated alpha of 0.85 (Nigg et al., 1998). The new items included in this measure were developed specifically for adolescents. They are as follows:

1. I have homework to do
2. My friends call me to go out
3. I need to do house chores
4. There is a good TV show on
5. I am on my own

Decisional Balance Questionnaire (DBQ)

A 6-item decisional balance measure was used for this study. This measure was an abbreviated version of the DBQ used to measure the decision making process in regard to smoking cigarettes and exercise behaviour (Marcus et al., 1992a). It was composed of a 3-item "pro" scale, which measures the benefits of being physically active, and a 3-item "con" scale, which measures the costs of being physically active. Again, the term "physically active" was used instead of "exercise" in order to standardise the terms. A 5-point Likert scale was used to rate the 6 items, with 1 being "not at all important" and 5 being "extremely important". The decisional balance measure was validated with adults only, and yielded a moderate internal reliability of α=0.56 for the cons, and an acceptable reliability score for the pros α=0.70 (Marcus et al., 1992a; Vincent, 1999). A reliability analysis of both the exercise pros and cons scales will be carried out for the Take PART sample to assess how a youth sample may affect the reliability scores of this instrument.

Social Support

A family and peer support scale was used in this study to measure social support. Both scales were developed for the Amherst Health and Activity Study (Sallis, Taylor, Dowda, Freedson, & Pate, 2002). The 5-item family scale was completed by adolescents and assessed the frequency with which the family encouraged, exercised with, provided transportation, watched child play sports and told the child that they were doing well in physical activity or sport. Frequency was rated on a 6-point Likert scale ranging from 0 being "never" to 5 being "everyday". A total score is then given, ranging from 0 to 25. This scale was piloted on 63 parent-child pairs and a two-week test-retest reliability test proved strong (ICC=0.88). Parent and child reports also correlated significantly ($r=0.61$, $p<0.001$).

The 5-item peer scale is similar to that of the family scale and assesses peer influence during a typical week. The individual variables that are assessed are encouragement, participation, praise, encouragement by the adolescent for peers to be physically active and peer teasing. The pilot study for this measure also produced strong 2 week test-retest reliability (ICC = 0.86) and parent-child reports correlated significantly ($r = 0.57$, $p<0.001$) (Sallis et al., 2002). The item on peer teasing is reverse coded, i.e. "everyday" is coded as 0 and "never" is coded as 5.

Physical Measures

The following physical measurements were included in the Take PART study:

- Height, Weight - BMI
- Blood Pressure
- 20 metre shuttle run test (20 MST)

Body Mass Index (BMI)

BMI is a relationship between weight and height that is associated with body fat and health risk. The Omron M5-1 Intellisense combined stadiometer and weighing scales was used for this study. Participants were asked to remove their shoes and any excess weight, e.g. keys, money etc. Weight was recorded to the nearest 0.1kg and height was recorded to the nearest 0.1cm. BMI was calculated from the following equation: BMI=weight (kg)/(height)^2(m). Table 3.1 displays the BMI categories used, which were based on an international survey designed to define childhood overweight and obesity (Cole et al., 2000). Underweight was defined as less than 18.5 kg/m^2 and normal weight was from 18.5 to the specified overweight category.

Table 3.1. BMI categories of overweight and obese for adolescents

	Overweight (kg.m^2)		Obese (kg.m^2)	
Age (yrs)	Male	Female	Male	Female
15	23.445 – 28.449	24.055 – 29.19	≥ 28.45	≥ 29.2
16	24.045 – 28.969	24.455 – 29.494	≥ 28.97	≥ 29.495
17	24.595 – 29.554	24.775 – 29.764	≥ 29.555	≥ 29.765

Note. Underweight is <18.5kg.m^2, normal weight is ≥ 18.5 kg.m^2, with overweight and obese ranges given in table.

Blood Pressure

Blood pressure refers to the pressure of the blood in the main arteries, which rises and falls as the muscles of the body cope with varying demands (e.g. exercise, stress, sleep). There are two types of pressure that are measured: 1) systolic pressure, created by the contraction of the heart muscle pushing blood into the vessels, and 2) diastolic pressure, when the heart is at rest between beats. A reading of 120/80 is said

to be the normal range. The Omron M5-1 fully automated blood pressure monitor was used to assess blood pressure. Participants were seated in a comfortable position with feet flat on the ground. The cuff was wrapped around the left bare arm and the monitor switched on. This gave a systolic and diastolic blood pressure reading in mmHg.

While a manual cuff would have been preferable for use in this study, the automated monitor was favoured for a number of reasons. Due to the time pressure associated with the school timetable, an automatic cuff was chosen for its speediness. Also, testing was usually carried out in a large hall and noise levels are often high. This would make it very difficult to hear the heart rate with the manual cuff. Three cuff sizes were used in this study – small (child size), medium and large.

20m Shuttle Run (20 MST)

Ramsbottom's (1988) 20-metre shuttle run was used to assess aerobic fitness (Ramsbottom, Brewer, & Williams, 1988). The 'bleep' test involves running continuously between two points that are 20m apart. These shuttle runs are done in time to pre-recorded 'bleep' sounds on a pre-recorded audiocassette. The time between the recorded bleeps decreases after each minute. Each level lasts 60 seconds. A level is basically a series of 20 metre shuttle runs. The starting speed began at 8.5 km/hr and then increased by 0.5km/hr with each new level. The audiotape informed participants of the start of a new level. If a participant failed to reach the line in time with the bleep, they were warned and two consecutive misses results in elimination. Results are expressed as total number of runs. The 20MST took place either in the sports hall (if >20m long) or else on an outdoors concrete court.

A study of the reliability of the 20-metre shuttle run test (Liu, Plowman, & Looney, 1992) with 12-15 year olds found the test to be reliable, via a one-week test-retest with 20 boys and girls (ICC=.91, n=12 males, ICC=.87, n=8 females) and valid, with the number of laps completed correlating significantly with VO2 peak ($r=.69$, $p<0.001$; $N=48$). This test was also used on a sample of Northern Irish students aged 9 and 15 (Boreham et al., 2001).

Pilot Studies

Pre-Pilot Studies

Pilot testing was undertaken by the research team to become more efficient with the testing procedures. Students from 1st year Sport Science and Health participated in three sessions of testing, where all physical measures were carried out. The main issues were to decide in what order to do the testing and how to distribute the research team. The most efficient way of managing the 20MST was the most difficult to decide upon, as it required at least 2 researchers at all times. It was decided that one member of the research team would count the level and shuttle numbers and take note if someone dropped out. The other person would then take note of the ID number of the participants in the order that they dropped out in, whilst also providing encouragement and feedback. At this stage, it was also decided that participants would wear a numbered bib while running. The number of the bib would correspond to the participants ID number and a researcher would record all numbers prior to the run.

The questionnaire was administered to a group of transition year students (N=21; 11 male, 10 female) from a local school. Time taken and questions asked were noted and feedback on the clarity of questions was then asked for. The researcher did have to clarify how to complete the past-year leisure time grid, so therefore it was decided to add this to the instructions given prior to completing the questionnaire. The average time taken to complete the questionnaire was 34 minutes, the shortest being 28 minutes and the longest being 42 minutes.

Pilot Study

Two weeks prior to the beginning of testing, a final pilot test was carried out in a different local school with transition year students (N=29; 13 male, 16 female). An explanation of the study was given and informed consent was obtained. Following this, the students completed the questionnaire in a large classroom. Once a student finished their questionnaire, they were brought to the sports hall, where their physical measurements were taken. As soon as ten participants were measured, they began the bleep test, with the remaining students giving support and encouragement. The total time taken from start to finish of the testing was 2 hours and 5 minutes.

This final pilot study proved a success and there were only a few minor changes, such as re-formatting layout of some questions, to be made before visiting the first school.

Data Treatment

Data storage

All data were stored and analysed using SPSS (Statistical Package for Social Sciences). Once all data was entered into the database, it was then examined for missing, incomplete and incorrect data. Any data that was entered wrongly was rechecked with the original questionnaire. Data that was deliberately missed by participants were given a value of 999, whereas data values, which were missed due to other reasons, were left blank. If a value was missing from a subscale (which had 3 or more items) then the mean value of the remaining scale items was entered.

There was a discrepancy between the total sample size of 939 participants and the individual sample size for each measure (questionnaire, 20MST, B.M.I. and blood pressure). This was due to various reasons, including injury, no sports gear, unwillingness to have certain measures taken, absent for questionnaire. A breakdown of the sample numbers and the proportion that took part in each measure is presented in Table 3.2. Detail of those who completed the questionnaire and each measure is also included. Thirty-seven participants did not complete the questionnaire, however these students were involved in the other measures.

Table 3.2. Proportion of participants who completed each measure and those who completed questionnaire.

	All Measures Completed	
	N	**%**
Total N	939	100
Questionnaire	902	96.06
BMI	876	93.29
BP	871	92.76
W-H-R	823	87.65
20MST	702	74.76

Data Analyses

To determine which statistical procedures would be appropriate to use, the data was initially explored for homogeneity of variance, covariance, normality and outliers. Some of the data collected e.g. habitual physical activity, was categorical and required the use of non-parametric statistics. All continuous data met the assumptions for parametric statistics apart from LTPA. There were a number of outliers in the LTPA section, with minutes of LTPA ranging from 20 minutes to 2,500 minutes. Some participants included walking as a LTPA and reported estimates of 3-6 hours a day, every day of the year. Based on an estimation of possible leisure time available for activity, answers resulting in more than 21 hours (3 hrs X 7 days = 1260 minutes) per week were omitted from this analysis. Twenty answers were removed through this process. A skewness value greater than 1 indicates a distribution that differs significantly from a normal symmetrical distribution. Following analysis of skewness levels, box-plots and histograms, it was evident that all measures were normally distributed with the exception of LTPA (1.084). Due to the large sample size LTPA was considered normally distributed as it was only slightly above 1 (+.084).

Descriptive statistics are reported through means, medians, standard deviations and proportions where appropriate. Figures and Tables visually present this data. Independent t-tests are used to compare the means of the interval data that was normally distributed. Categorical or non-normally distributed data are analysed using non-parametric tests including chi-square and Mann-Whitney tests. For parametric data, one-way analysis of variance (ANOVA) was used as a means of testing whether several group means were equal in the population. A tukey post-hoc with Bonferroni correction was also used to determine where these differences were. Logistic regressions were employed to examine whether the TTM and social support variables were able to predict the dichotomous outcome of activity status (Regularly Active/ Not Regularly Active). From this analysis, odds ratios were calculated indicating the strength of each variable in producing a change in the outcome.

Structural Equation Modeling (SEM) was used to test the fit of the TTM to the empirical data. SEM is a combination of factor analysis and regression or path analysis. It allows the researcher to examine theoretical constructs, which are represented by latent factors. SEM was used to investigate whether the TTM

adequately described the data collected and to further investigate the contribution of social support to the framework. As the dependent outcome variable, physical activity was represented by aerobic fitness, leisure time physical activity and habitual physical activity. The independent variables included self-efficacy, pros, cons and processes of change, with stage of change acting as a mediating variable. For the purpose of SEM, the Take PART sample was reduced to cases with full data sets, that is questionnaire data and aerobic fitness. This resulted in the exclusion of 264 data sets, with the new sample size being 675.

A very important assumption associated with SEM is that the data be of normal distribution (Byrne, 2001). To examine the distribution of the data, box-plots, histograms and normality probability plots were analysed. This analysis suggested that the variables were normally distributed with the exception of leisure time physical activity and cons. A further investigation indicated that all variables had an acceptable level of skewness. In general, a skewness value of greater than one indicates a distribution that significantly differs from a normal symmetric distribution (SPSS, 2004). Again, LTPA exceeds the cut off value of one, however as its value of 1.14 is only marginally over the criteria, it will be included in the SEM as a normally distributed variable (Table 3.3).

Table 3.3. Skewness values for SEM variables (n=675)

Variable	Mean	S.D.	Skewness
Average Physical Activity (days)	3.19	1.72	0.26
LTPA (mins. per wk)	302.66	272.81	1.14
Aerobic Fitness (runs)	52.26	27.59	0.58
Stage of Change	3.81	1.16	-0.35
Self-Efficacy	53.27	17.68	-0.15
Experiential processes	44.94	9.86	-0.21
Behavioural processes	41.69	11.61	0.03
Pros	11.10	2.64	-0.49
Cons	6.04	2.48	0.90
Family Social Support	12.93	4.34	0.08
Peer Social Support	15.43	3.36	0.01

Acceptable model fit is generally indicated by a goodness of fit index (GFI) and adjusted GFI (AGFI) greater than 0.90. The effectiveness of the model in explaining the variance observed in the samples physical activity is assessed via the squared multiple correlation (R^2).

Chapter 4: Results

This chapter presents the main findings of the Take PART study and will be divided into four sections. The first section will detail the baseline physical activity and health data with descriptive statistics and will include both the self-report and physical data. The second section will consist of the descriptive behaviour change data, with logistic regression analyses of this data and the physical activity data forming the third section. Finally, the fourth section will concentrate on the development of the TTM through structural equation modeling. The fit of the TTM will be examined with the Irish data. Following this the social support variable will be introduced to determine its role in behaviour change.

Section 1: Physical activity and health status

The baseline results will be presented under the following headings:

- Gender (Male/ Female)
- Age (15/16/17 years)
- Activity category (Regularly Active/ Not Regularly Active)
- Residence (Urban/ Rural)
- Socioeconomic Status (Manual/ Non-Manual)

These headings will be referred to as characteristics within the text.

Take PART Participants

From the 13 schools that participated in the Take PART project, a total of 939 students were involved. The sample's mean age was 16.04 years (± 0.66 years: range =15-17 years) with 60% female and 40% male. Twenty percent of the participants were aged 15; with 55% aged 16 and 25% aged 17 years. Twelve percent of the participants were city dwellers (> 500,000 inhabitants), 35% lived in the suburbs or outskirts of the city, 29% lived in a town (< 50,000) and 24% lived in a village or rural area (< 5,000 inhabitants). Forty seven percent were therefore classified as urban dwellers and 53% rural dwellers. The urban dwellers were split 50:50 male and female, whereas 64% of rural dwellers were female with 36% male.

The proportional representation of the sample by school classification and type, in relation to all eligible schools in the ECAHB region, is presented in Table 4.1.

Table 4.1. Comparison between eligible schools and the Take PART schools by school classification and school type

School Classification	% Schools in ECAHB (n=51)	% Schools in Take PART (n=13)
School provides education through the medium of Irish for some or all of its pupils (SC1)	3.8%	8%
School caters for day pupils only, all of whom receive free education (SC2)	63.5%	61%
School caters for boarders and day pupils only, all of whom pay fees (SC5)	32.7%	31%
Type of School		
Secondary Schools	71%	77%
Vocational Schools & Community Colleges	17%	15%
Community & Comprehensive Schools	12%	8%

An analysis of socio-economic status based on parent's profession indicated that 75% of the sample was from non-manual, which includes professional, managerial and technical and non-manual occupations, while 18% were from the manual sector, which comprises of skilled, semi-skilled and unskilled manual occupations (Figure 4.1). The remaining 7% of the sample were classified as 'all others gainfully occupied and unknown'. Due to the small number of participants in some social classes, in particular SC 5, 6 and 7, results will be compared under the headings non-manual and manual.

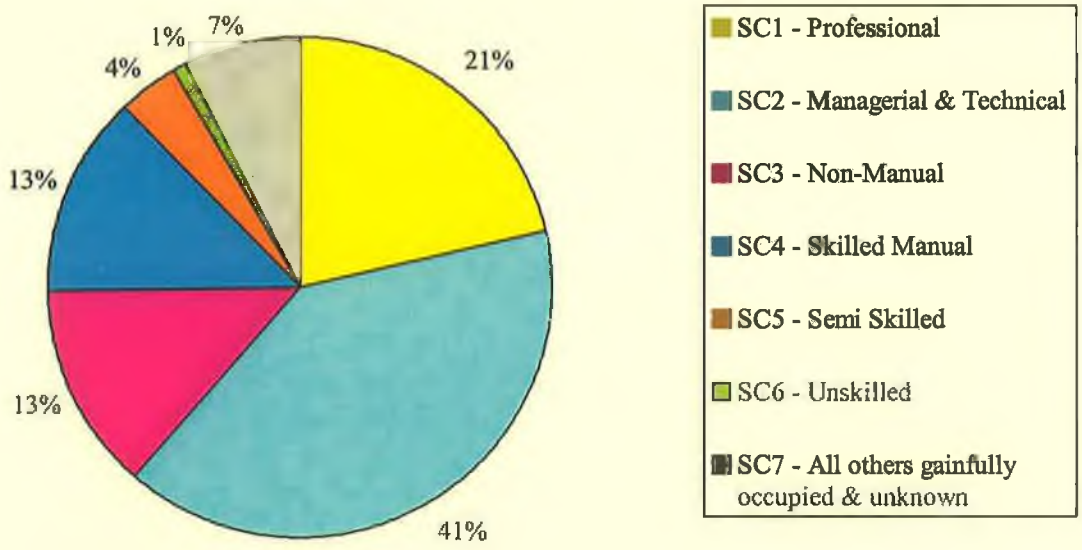


Figure 4.1. Socio-economic status of participants.

Self-Report Measures

Habitual Physical Activity

Habitual physical activity was measured for the past 7 days and for a typical week. There was a high level of agreement between the two questions (α=0.87, cronbach's alpha). During a typical week, 4% of males and 5% of females participated in no physical activity, whereas these figures increased to 5% and 11% respectively when asked about the previous 7 days (Fig. 4.2).

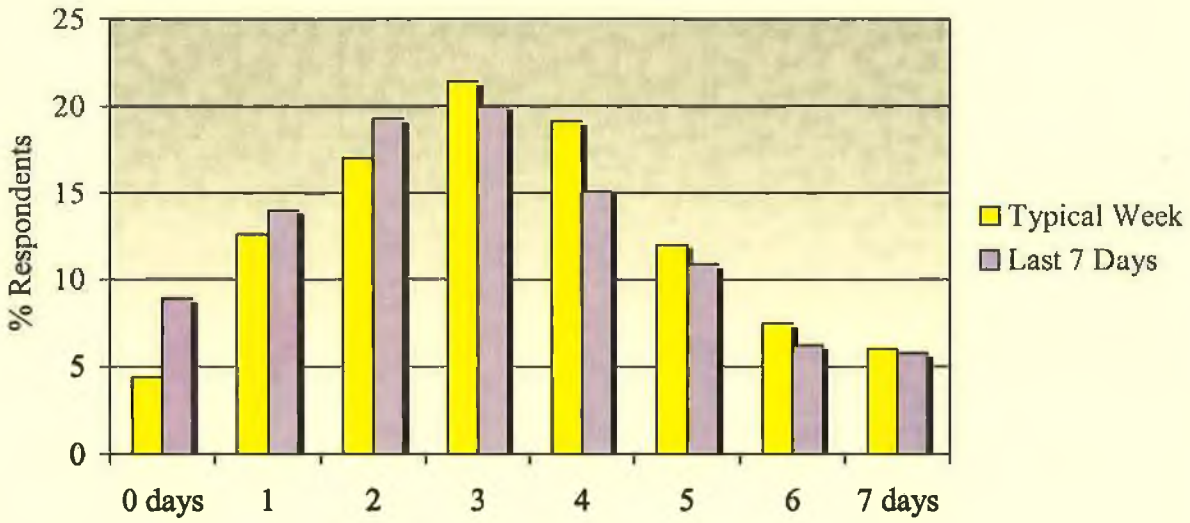


Figure 4.2. Number of days per week on which respondents were physically active for at least 60 minutes per day

Based on recommendations for regular activity, respondents were categorised as regularly active (those who met the requirements of 60 minutes of MVPA $\geq$ 4 days per week) or not regularly active (those who did not meet the requirements, that is < 4 days per week). Sixty five percent (n=583) of the respondents indicated that they were not regularly active. Higher proportions of females than males were not regularly active (69.9% versus 57.6%; χ^2 (1, n=902) =14.32, p<0.001) (Figures 4.2a and 4.2b).

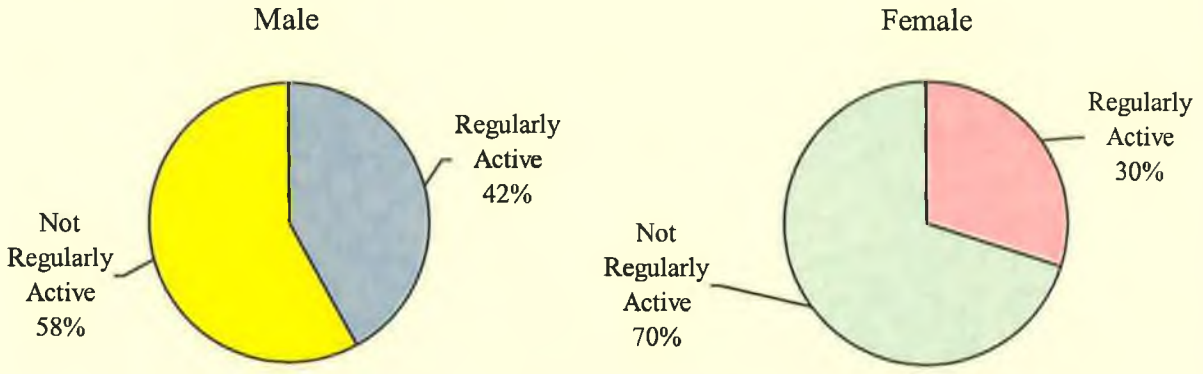


Figure 4.2a and 4.2b. Proportion of males and females who met the minimum recommended amounts of physical activity.

A higher proportion of 17-year-olds were not regularly active compared to 15 and 16 year olds (73.2% compared to 63.7% of 15 and 63% of 16 yr. olds), however this result was not significant. A chi square analysis revealed that rural adolescents were more likely to be not regularly active compared to urban adolescents (68.3% vs. 61.8%; χ^2(1, n=894) =4.13, p<0.05). Due to the higher proportion of females in the rural category (64%), further analysis was carried out to investigate whether there was a gender effect. This result indicated that urban males were more likely to be not regularly active than rural males (62.3% vs. 51.6%; χ^2(1, n=365) =4.22, p<0.05), with no difference evident for the females. There was no significant relationship between social class category and physical activity level, therefore individuals were as likely to be regularly active as not regularly active for both categories of social class. These results can be seen in Table 4.2.

Table 4.2. Proportion of participants (n=902) by activity level based on characteristics

Characteristic	RA (n=368) %	NRA (n=538) %
Age:		
15 yrs	36.3	63.7
16 yrs	37	63
17 yrs	29.8	73.2
Area of Residence:		
Urban	38.2	61.8
Rural	31.7	68.3*
SES:		
Non-Manual	34.4	65.6
Manual	41.3	58.7

Note. *$p<0.05$

Leisure Time Physical Activity (LTPA)

Leisure time physical activity correlated significantly with habitual physical activity (rho=0.516, $p<0.01$; two-tailed). The total amount of LTPA reported by participants ranged from 20 to 1260 minutes per week. The types of LTPA listed by the participants were divided into team-based activities and individual activity. Of the team-based activities listed, soccer (13%, n=326) was the most popular, with tennis (8%, n=196) and Gaelic football (5%, n=131) following (Figure 4.3).

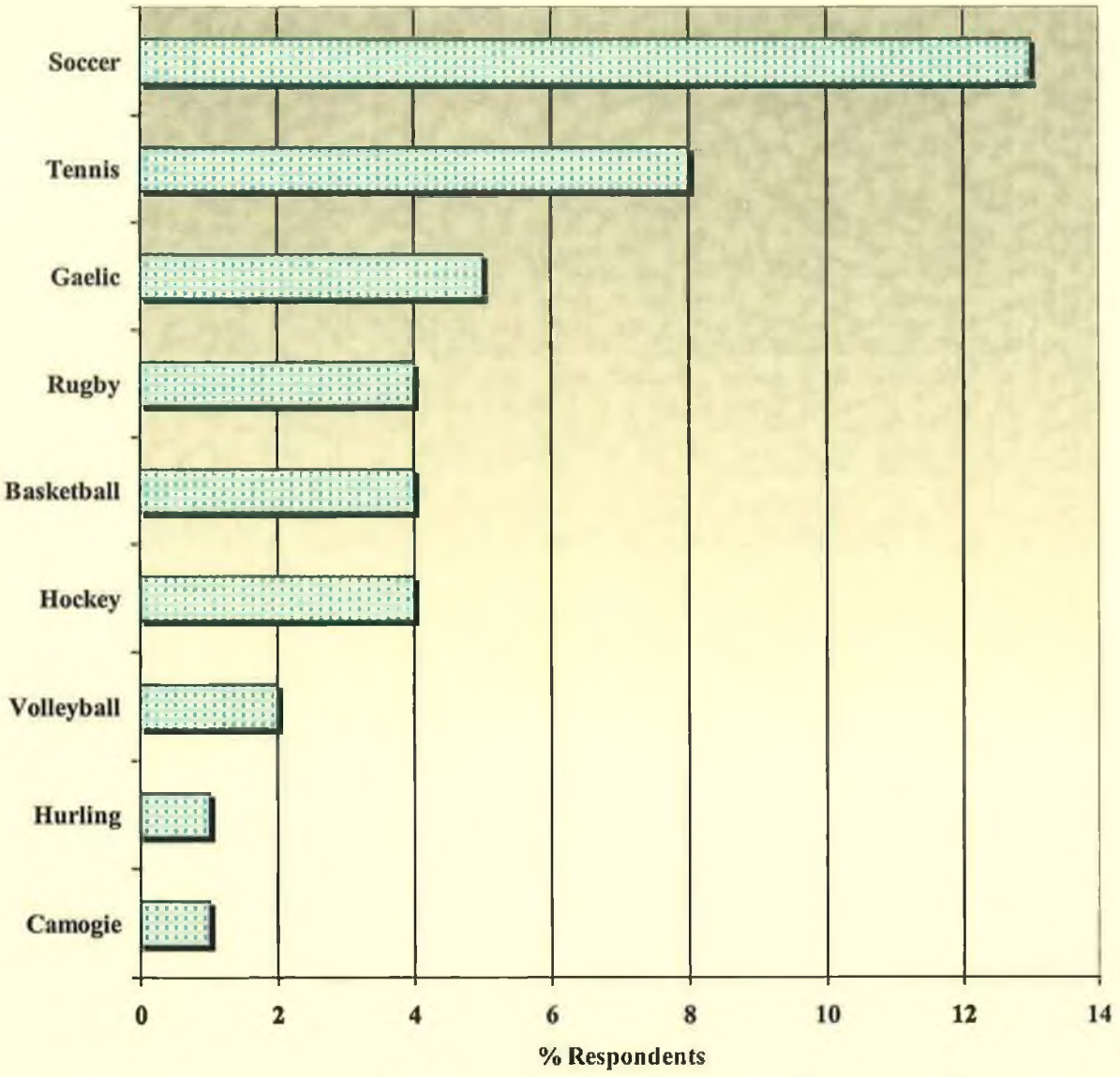


Figure 4.3. Group-based leisure time physical activities of adolescents in the Take PART sample

Fifty one percent of activities listed were individual-based activities. The most popular of these were swimming (13%, n=329), running (11%, n=282) and bicycling (7%, n=187) (Figure 4.4). Activities that were listed by less than 1% of the sample were categorised as "Others". These accounted for 7% of all activities, and included handball, boxing, badminton, skateboarding and squash.

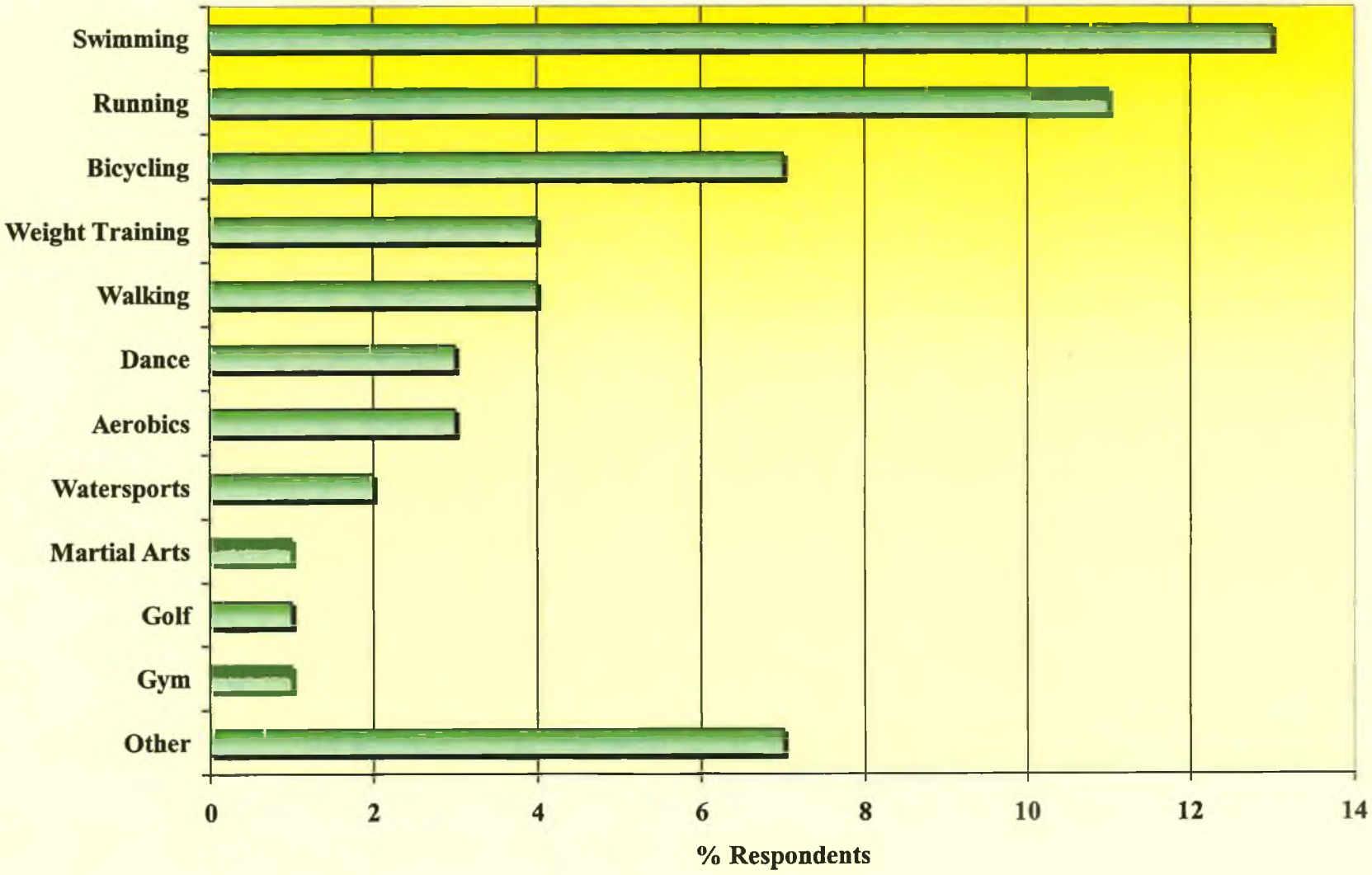


Figure 4.4. Individual leisure time physical activities of adolescents in the Take PART sample

Regularly active individuals reported more minutes per week of LTPA than those who were not regularly active (483 Vs 260 minutes; t=-11.281, df=481, $p<0.001$, one tailed). Males reported more minutes of LTPA per week than females (428 Vs 280 minutes; t=7.636, df=617, $p<0.001$, one-tailed) (Fig. 4.5).

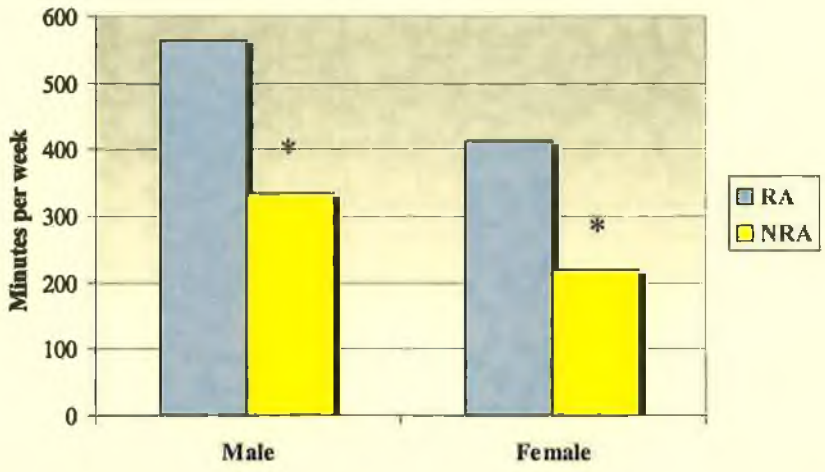


Figure 4.5. Minutes of LTPA per week, based on gender and physical activity
Note. $p<0.001$

Significant differences ($p<0.001$) were found between males and females across all characteristics, with the exception of LTPA for 17 year olds (Table 4.3). When analysed within gender, there were no significant differences found between ages. RA males reported significantly more LTPA minutes than NRA males (564 vs. 333 minutes; t=-7.62, df=255, $p<0.01$; one-tailed). For females, RA's also reported significantly more LTPA minutes than NRA females (412 vs. 218 minutes; t=-7.83, df=235, $p<0.01$, one-tailed) respectively.

Table 4.3. Means and standard deviations of LTPA based on characteristics

	LTPA (mean mins. ± S.D.)		Between gender comparisons
Charateristic	Male	Female	*p*
Age:			
15 yrs	421.1 ± 261.2	263.4 ± 214.1	<0.001
16 yrs	456.6 ± 291.3	272.2 ± 240.6	<0.001
17 yrs	347.8 ± 307	312.8 ± 274.7	0.424
Area of Residence:	430.7 ± 295.9	271.8 ± 227.2	<0.001
Urban	428.1 ± 271.9	287.8 ± 256.2	<0.001
Rural			
Activity level:			
RA	564.2 ± 285.1*	412 ± 271.1**	<0.001
NRA	332.8 ± 242.7	218.2 ± 204.5	<0.001
SES:			
Non-Manual	427.1 ± 280.7	286.8 ± 250.8	<0.001
Manual	433.7 ± 290.5	249.8 ± 223.2	<0.001

Note. Within gender comparisons *p<0.01

Sedentary Leisure Habits (SLH)

On average, males viewed more TV per day than females (2.4 hrs Vs 2.1 hrs; t=4.45, df=903, p<0.001(two-tailed)). Based on the criteria for high TV watching behaviours (U.S.Department of Health and Human Services, 2000), a higher proportion of males reported watching more than 2 hours of TV per day compared to females (53.7% vs. 36.8%; χ^2 (1)=25.39, p<0.001). Not regularly active males were more likely to have a high TV viewing behaviour than their regularly active counterparts (59% vs. 46%; χ^2 (1)=5.93, p<0.05). More participants from the manual SES category reported high TV watching behaviour compared to participants from a non-manual SES background (55% vs. 41.6%;χ^2 (1)=8.9, p<0.01). Figures 4.6 and 4.7 shows the distribution of TV watching for males and females on weekdays and weekends respectively. It is evident that females have much higher TV watching behaviours at weekends (42% watching more than 2 hours) compared to weekends (25% watching more than 2 hours). Similarly a lower proportion of males have high TV watching habits on weekdays (38%) compared to weekends (50%).

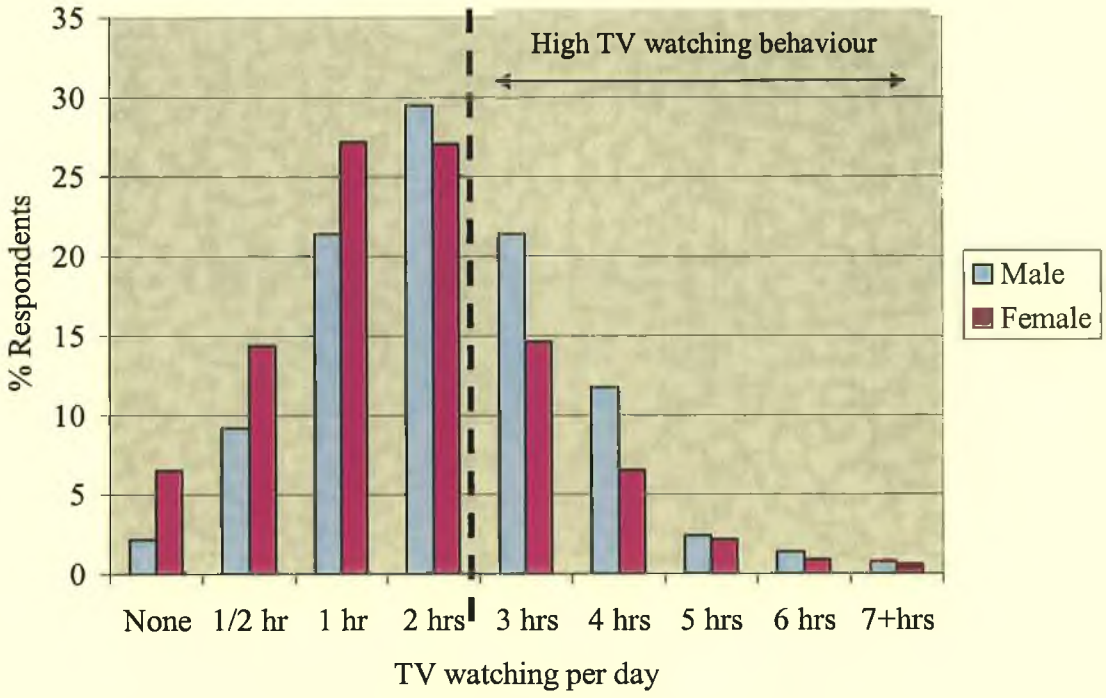


Figure 4.6. Hours of TV watching per day on weekdays divided by gender

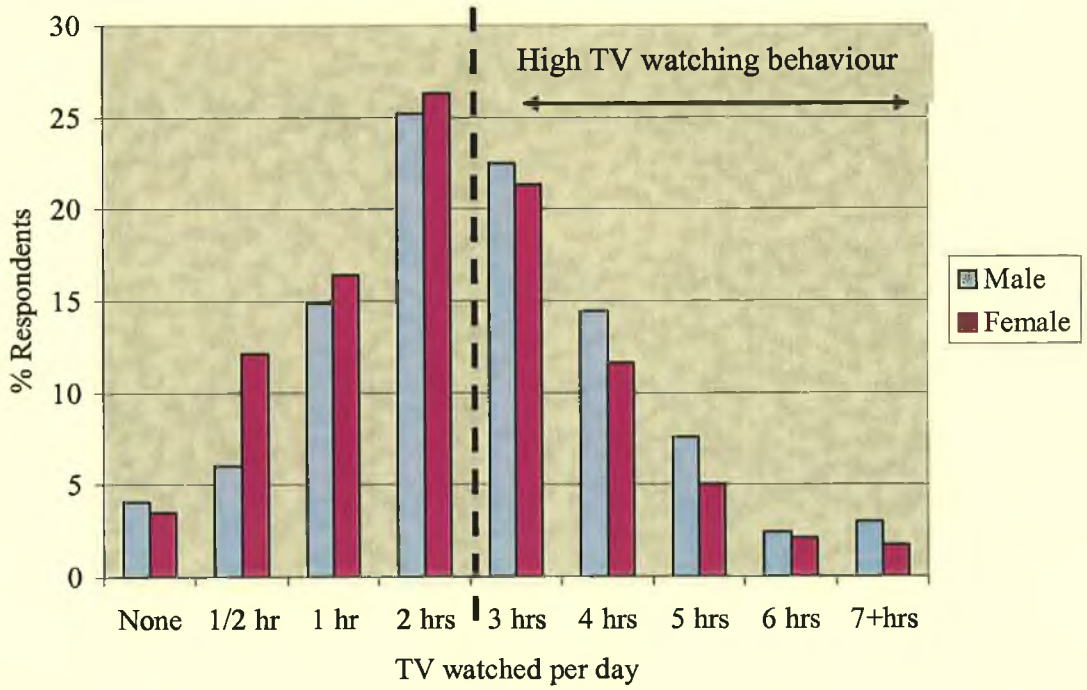


Figure 4.7. Hours of TV watching per day on weekends divided by gender

Commuting to School

Walking and cycling to school represent active commuting, producing a total of 39% active commuters. One-third (34%) of students reported that they walked to school and 5% reported that they cycled to school. Inactive commuters are those who travel by automated methods of transport, which in this study are bus (31%), car (28%) and train (2%). A detailed breakdown of transport mode can be seen in Table 4.4.

Table 4.4. Mode of transport used by participants based on characteristics.

	Foot %	Bicycle %	Car %	Bus %	Train %
Gender:					
Male	30.8	8.5	28	28.8	3.8
Female	37.1	3.0	27.8	31.8	0.4
Age:					
15 yrs	34.6	7.7	25.8	29.7	2.2
16 yrs	33.5	5	28.1	31.5	1.8
17 yrs	36.7	3.8	29	29	1.4
Activity category:					
RA	33.3	4.5	28.4	32.2	1.6
NRA	36.7	6.7	26.8	27.5	2.2
Residence:					
Urban	34.9	9.1	30.3	25	0.7
Rural	34	1.9	25.8	35.5	2.7
SES category:					
Non-manual	32	6	29.6	30.1	2.4
Manual	44.3	2.7	16.1	36.9	0

No relationship was found between activity status and commuting status, however participants from a manual socio-economic class were significantly more likely to be active commuters compared to those from a non-manual SES (47% vs. 37.9%; χ^2 (1)=4.13, p<0.05).

Table 4.5 shows the average distance and time taken to travel to school. Twenty two percent of car users and 3% of bus users commuted one mile or less to school. A further 17% of car users, 12% of bus users and 10% of train users commuted less than or equal to two miles. Fourteen percent of the participants indicated a commuting time of over 40 minutes to school (one way).

Table 4.5. Mode of transport, average distance (miles) and time taken (minutes) to travel to school

	Foot	Bicycle	Car	Bus	Train
Proportion of participants	34%	5%	28%	31%	2%
Distance (miles)	1.2	2.1	4.2	8	12
Range (miles)	(0.2 – 5)	(0.5 – 6)	(0.25 – 30)	(0.5 – 30)	(2 – 26)
Time (mins)	15.5	15.5	18.3	30	34.3
Range (mins)	(5 – 45)	(5 – 45)	(2 – 60)	(4 – 70)	(2 –60)

Physical Measurements

Aerobic Fitness

Aerobic fitness measured via the 20-metre shuttle run test, correlated significantly with habitual physical activity (rho=0.32, p<0.01; Two-tailed) and LTPA (r=0.37, p<0.01; two-tailed). Participants scored an average of 52.54 $\pm$ 27.36 completed laps in the 20MST, with scores ranging from 4 laps to 136 laps. Regularly active individuals completed significantly more laps than those who were not regularly active (62.74 Vs 46.45 runs; t= -7.215, df=420, p<0.001; one-tailed). Males completed significantly more laps than females (74.95 Vs 39.1 runs; t=20.1, df=431.9, p<0.001; one-tailed). There was no significant difference on total number of laps completed across age groups (15, 16 or 17 years) for each gender. Table 4.6 presents the 20MST results for each characteristic with results split by gender due to the genetic aerobic fitness differences between males and females. Of note, males from a non-manual SES completed more laps than males from a manual SES (t=2.25, df=229, p<0.05) and urban females completed more laps than their rural counterparts (t=3.07, df=410, p<0.01).

Table 4.6. Aerobic fitness split by gender for each characteristic

Characteristic	20MST (mean laps ± S.D.)	
	Male	Female
Age:		
15 yrs	72.9 ± 27.7	39.3 ± 15.5
16 yrs	77.6 ± 23.5	38.1 ± 18.3
17 yrs	70.1 ± 25.9	40.9 ± 20.7
Area of Residence:		
Urban	74.7 ± 25.7	41.2 ± 18.6*
Rural	75.3 ± 24.3	35.8 ± 16.8
Activity level:		
RA	84.4 ± 25.1*	44.7 ± 20.3*
NRA	68.4 ± 23	34.9 ± 15.4
SES:		
Non-Manual	78.3 ± 25.3**	38.9 ± 18.2
Manual	68.7 ± 22.3	35.4 ± 17.5

Note. *$p<0.01$, **$p<0.05$

Anthropometric and Blood Pressure Measures

The physical measurements of height, weight and blood pressure were taken as indicators of health status. Table 4.7 shows these variables based on personal characteristics. Males had significantly higher values for height, weight, and systolic blood pressure (SBP) ($p<0.01$) than females. Regularly active adolescents were taller ($p<0.01$) and heavier than the not regularly active adolescents ($p<0.05$). Urban adolescents were significantly taller than rural adolescents ($p<0.001$) and those from a manual SES background had higher systolic blood pressure than those from a non-manual SES background.

A significant negative relationship was found between aerobic fitness and systolic blood pressure for males (r=-0.261, $p<0.01$, pearson), indicating that higher systolic blood pressure was associated with lower aerobic fitness. This relationship was not significant for females.

Table 4.7. Physical measurements of participants across characteristics

	Height (m)	Weight (kg)	SBP(mmHg)	DBP(mmHg)
Gender:				
Male	1.8±0.1*	68.6±12.8*	135.3±16.3*	75.1±10.3
Female	1.6±0.1	60.6±10.2	121.9±13.4	74.7±9.2
Age:				
15 yrs	1.7±0.1	63.2±12.3	126.3±15.2	73.7±9.0
16 yrs	1.7±0.1	64±11.5	127.4±16.1	74.9±9.8
17 yrs	1.7±0.1	64.4±12.8	128.5±16.6	75.7±10.0
Activity category:				
RA	1.7±0.1*	65.3±11.5**	128.7±16.2	74.9±9.5
NRA	1.7±0.1	63.2±12.2	127.1±16.1	75.1±9.8
Residence:				
Urban	1.7±0.1*	64.7±11.9	127.6±14.8	75.1±8.9
Rural	1.7±0.1	63.6±11.9	127.8±17.1	74.9±10.2
SES category:				
Non-manual	1.7±0.1	63.9±11.6	126.4±14.5	74.9±9.3
Manual	1.7±0.1	64.1±12.8	130.7±17.9*	76.2±10.3

Note. $p < 0.01$

BMI.

Twenty two percent of the participants were either overweight (17%) or obese (5%), with 9% underweight (Figure 4.8). The distribution across BMI categories was similar for both males and females (Figures 4.7 a & b).

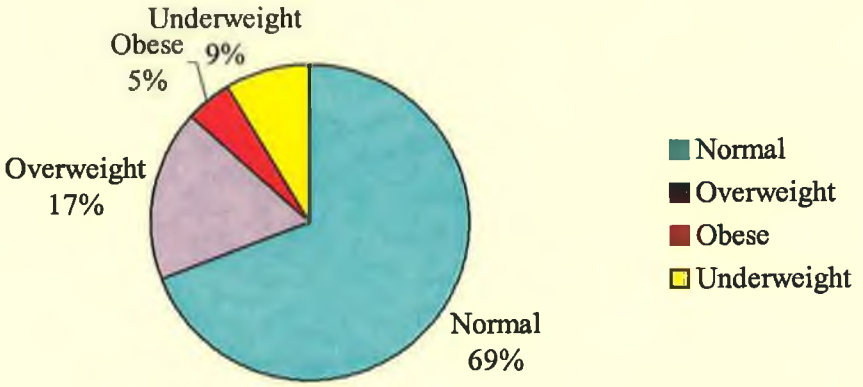


Figure 4.8. Proportions of Take PART sample in each category of BMI.

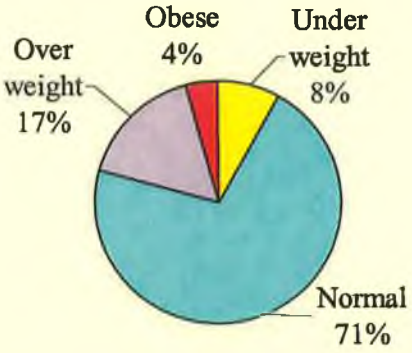


Figure 4.8a and 4.8b. Male and Female BMI proportions respectively

The distribution of the sample across BMI categories can be seen in Table 4.8. An examination of the proportions of individuals in each category of BMI by characteristics did not reveal any significant associations (Table 4.8). A further analysis of BMI proportions stratified by gender revealed that females from a non-manual SES were more likely to be in the normal weight category compared to females from a manual SES (74.2% v 58.8%; χ^2 (3)=8.73, p<0.05).

Table 4.8. BMI categories across characteristics.

Characteristic	Underweight %	Normal weight %	Overweight %	Obese %
Gender:				
Male	8.5	68.7	17.6	5.2
Female	8.2	70.9	16.6	4.3
Age:				
15 yrs	9.4	66.1	17.2	7.2
16 yrs	7.7	71.5	17.1	3.8
17 yrs	8.8	69.9	16.7	4.6
Activity category:				
RA	9	69.8	16.6	4.7
NRA	8.1	69.1	18.1	4.6
Area of Residence:				
Urban	6.9	73.8	14.7	4.6
Rural	9.3	65.6	20.2	4.9
SES:				
Non-Manual	7.5	72.6	16.1	3.7
Manual	9.2	62.7	21.8	6.3

Note. * p<0.05

Sixty six percent of overweight and 64% of obese individuals did not meet the minimum PA requirements for health benefits. A one-way analysis of variance (ANOVA) indicated that obese individual's aerobic fitness differs significantly from all other weight groups (Table 4.9). Although a trend was evident for lower levels of LTPA among the obese group, this result was not significant.

Table 4.9. One-way ANOVA and categories of BMI (mean ± S.D.) for aerobic fitness and LTPA

	Underweight	**Normal**	**Overweight**	**Obese**	**F**	***p***
20 MST	53.7 ± 26.1	55.6 ± 27.3	45 ± 27.5	32.6 ± 18.9	10.73	0.000[a]
LTPA	325.1 ± 285.9	353.3 ± 273.7	335.2 ± 271.9	267.2 ± 221	1.22	0.301

[a] Underweight, Normal > Obese, Normal > Overweight

These variables were then analysed by gender (Table 4.10), with Tukey post hoc results indicating that the aerobic fitness was significantly lower for obese males compared to all other BMI categories. There were no gender effects evident for the LTPA results. Overweight males also had lower aerobic fitness than normal weight males. Obese females had lower aerobic fitness levels than underweight and normal, while normal weight females were also higher than overweight females.

Table 4.10. One-way ANOVA and categories of BMI (mean ± S.D.) for aerobic fitness split by gender

	Underweight	**Normal**	**Overweight**	**Obese**	**F**	***p***
20MST Male	73.2±20.9	79.7±22.6	67.8±29.9	42.3±18.2	14.01	0.00[a]
20MST Female	38.7±18.8	41.5±18.5	32.7±16.1	22.3±13.7	9.348	0.00[b]

Note. [a] Underweight, Normal, Overweight > Obese; Normal > Overweight
[b] Underweight, Normal > Obese; Normal > Overweight

The relationship between BMI and TV watching was also examined with an ANOVA with bonferroni corrections. Obese individuals reported watching significantly more television than normal and underweight individuals.

	Under-Weight	Normal	Over-Weight	Obese	F	*p*
TV watching (hrs per day)	2.08 ± 1.3	2.15 ± 1.2	2.46 ± 1.3	2.93 ± 1.4	6.88	0.000_a

$_a$ Obese > Normal, Underweight

Summary

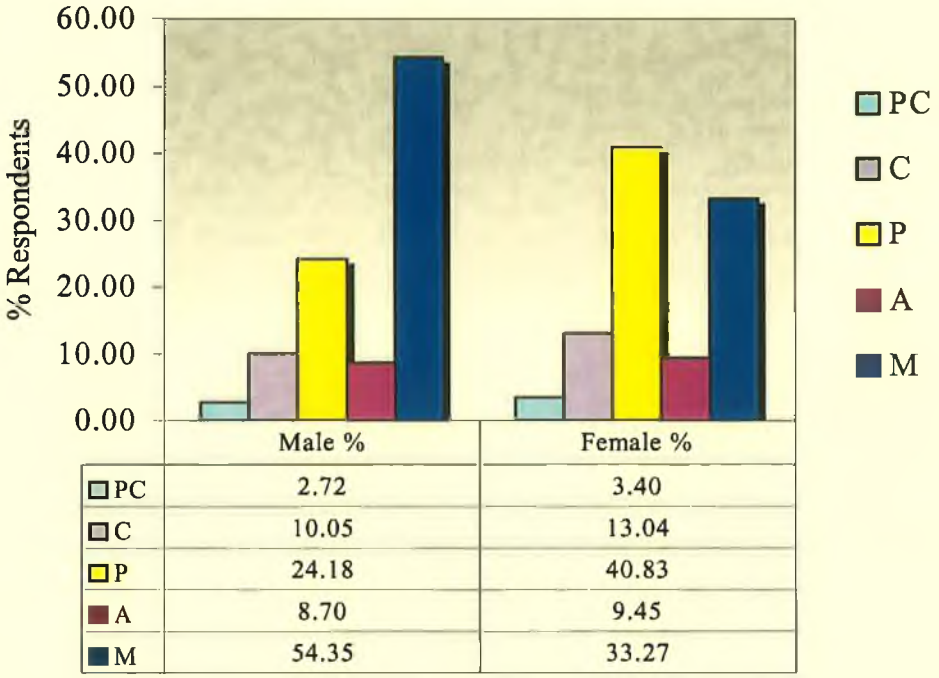
The majority of adolescents sampled in this project were not meeting the recommended amount of physical activity, with more females classified as not regularly active than males. Those classified as not regularly active reported less leisure time physical activity and scored lower on aerobic fitness than regularly active adolescents. A higher proportion of participants from an urban area of residence were regularly active compared to those from a rural area. This was reflected in the mode of commuting with more urban adolescents actively commuting to school.

Section 2: Determinants of Behaviour Change

This section will look at the determinants of behaviour change, namely the TTM variables of self-efficacy, exercise decisional balance and processes of change. Also included in this section will be family and peer social support results. These results will be presented across the stages of change and also activity status.

Stage of Change for Physical Activity

The stage distribution of the overall sample was Precontemplation (PC: 3.1%); Contemplation (C: 11.8%); Preparation (P: 34%); Action (A: 9.1%); Maintenance (M: 41.9%) (Fig. 4.9). When analysed by gender, it can be seen that the pattern is almost reversed, with the majority of males in maintenance and the majority of females in the preparation stage. Significantly more females than males (57% vs. 37%, χ^2 (1, n=439)=35.87, p<0.001) were in the precontemplation, contemplation or preparation stages of change.



	Male %	Female %
PC	2.72	3.40
C	10.05	13.04
P	24.18	40.83
A	8.70	9.45
M	54.35	33.27

Figure 4.9. Stage distribution of participants

Based on the categorisation of regularly active (RA) and not regularly active (NRA), 65% of NRA's accurately selected a pre-action stage i.e. Precontemplation, Comtemplation or Preparation. Eighty percent of RAs accurately selected the Action/ Maintenance stage, which shows good correlation with the habitual physical activity measure reported earlier ($r=0.57$, $n=894$, $p<0.01$; Spearmans Rho).

The stage distribution for each characteristic can be seen in Table 4.11. The distribution across stages differs slightly for each characteristic. There is little difference between non-manual and manual SES, urban and rural residence. When analysed by age, 54% of 17 yr olds are in the pre-action stages, compared to 48% of 15 yr olds and 47% of 16 yr olds.

Table 4.11. Stage distribution across each characteristic.

	Stage				
Characteristic	PC (%)	C (%)	P (%)	A (%)	M (%)
Age:					
15 yrs	2.21	8.29	37.57	7.73	44.20
16 yrs	2.79	12.35	32.07	9.56	43.23
17 yrs	4.67	13.55	35.51	9.35	36.92
Activity category:					
NRA	4.33	16.44	43.94	7.96	27.34
RA	0.95	3.16	15.82	11.39	68.67
Area of Residence:					
Urban	1.20	10.58	34.86	9.86	43.51
Rural	4.86	12.90	33.40	8.46	40.38
SES:					
Non-Manual	3.26	10.25	34.32	9.16	43.01
Manual	3.38	13.51	31.08	8.78	43.24

Processes of Change

The means and standard deviations of the processes of change across each of the stages of change are displayed in Table 4.12. Also displayed are the Cronbachs alpha reliability scores for each process. An ANOVA with a Tukey post-hoc test was also carried out on the ten processes to investigate the differences between stages. This post-hoc was corrected for family wise error using the Bonferroni correction, making the significance level 0.012. All processes significantly differed across the stages, with the post hoc test indicating where the differences were.

A pictorial representation of the average Experiential (or thinking) processes of change scores can be seen in Figures 4.10. It is evident that self-reevaluation and social liberation are used more frequently than all other experiential processes at all stages, increasing in use from 7.6 and 9.7 to 12.2 and 11.2 respectively. Consciousness raising is the least used process for all stages, beginning at a low value (4) and increasing to 7.3. This process exhibits the most number of significant differences, with PC, C and P all significantly lower in use than M.

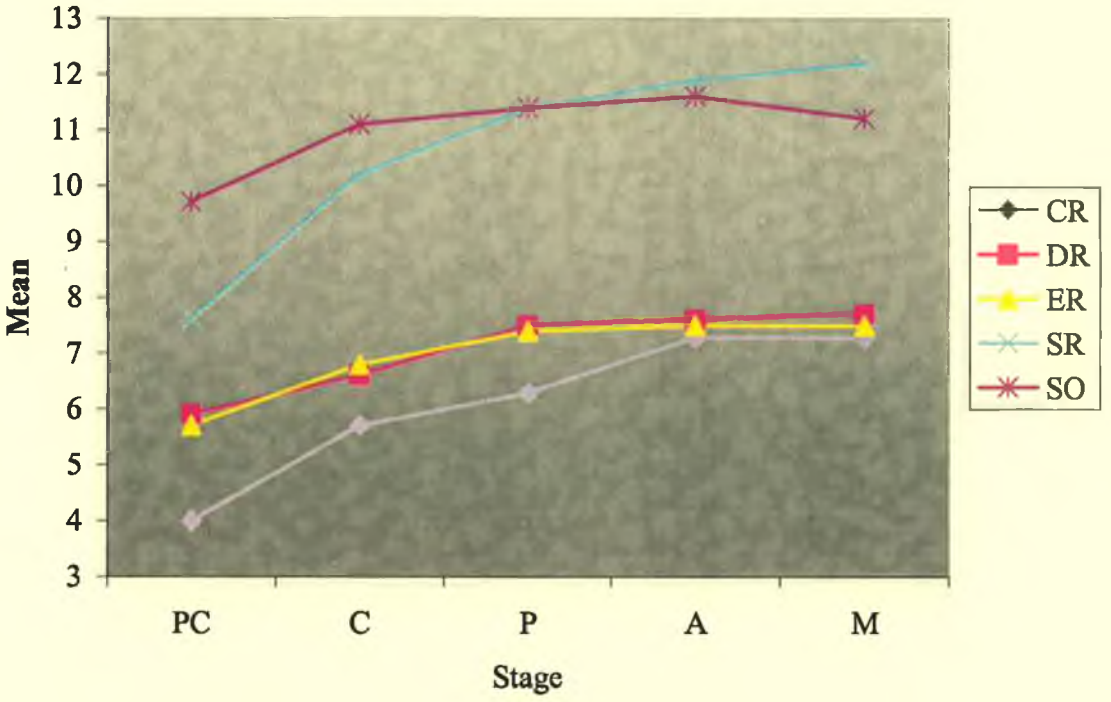


Figure 4.10. Experiential Processes of Change across Stage of Change
PC = Precontemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance. CR=Consciousness Raising, DR=Dramatic Relief, ER=Environmental Re-evaluation, SR=Self-Reevaluation, SO=Social Liberation,

It can be seen in Figure 4.11 that the five Behavioural (or action) processes increase in use from Precontemplation to Maintenance. Reinforcement management and self-liberation are the most frequently used processes across all stages increasing from 5.7 and 6.1 to 10.9 and 11.5 respectively. Stimulus control is the least used process across all stages increasing from 3.7 to 7.3. Precontemplators and contemplators use the behavioural processes significantly less than those in action and maintenance. Also for each behavioural process, there are at least three significant differentiations between stages compared to the experiential processes, which range from 1 to 3.

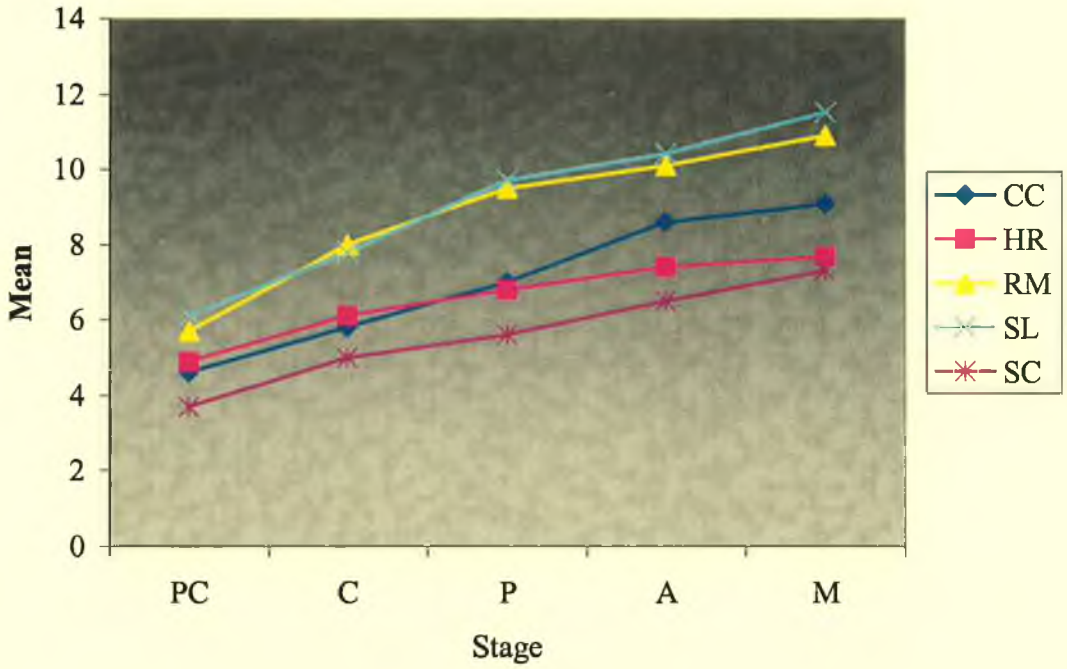


Figure 4.11. Behavioural Processes of Change across Stages of Change
PC = Precontemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance
RM=Reinforcement Management, SC=Stimulus Control, HR=Helping Relationships, CC=Counterconditioning and SL=Self-Liberation.

It can be seen from Table 4.12 that precontemplators are significantly lower than all other stages (PC<C, P, A, M) for consciousness raising, self-reevaluation, reinforcement management and self-liberation. No process exhibits significant differences across all stages. Self-liberation increases significantly across all stages with the exception of Preparation to Action. Environmental reevaluation displays the least amount of change, with the only significant increase between Precontemplation and Maintenance (PC<M).

Table 4.12. ANOVA including means ± S.D. of processes across stages of change

Process (Range 3-15)	PC	C	P	A	M	α	F	P	
Exp. POC									PC<C,P,A,M C<A,M P<M
CR	4 ± 2	5.7 ± 2.3	6.3 ± 2.7	7.3 ± 3	7.3 ± 2.9	.78	16.73	.000*	PC<P,M C<M PC<M
DR	5.9 ± 2.4	6.6 ± 2.3	7.5 ± 2.7	7.6 ± 2.6	7.7 ± 3	.60	5.77	.000*	PC<C,P,A,M C<P,A,M
ER	5.7 ± 2.4	6.8 ± 2.6	7.4 ± 2.8	7.5 ± 2.7	7.5 ± 3	.62	3.4	.000*	PC<P,A
SR	7.6 ± 3.1	10.2 ± 3.2	11.4 ± 2.6	11.9 ± 2.8	12.2 ± 2.7	.81	26.38	.009*	PC<P,A,M C<P,A,M P<M
SO	9.7 ± 3	11.1 ± 2.3	11.4 ± 2.4	11.6 ± 2.5	11.2 ± 2.5	.57	3.73	.000*	PC<P,A,M C<A,M P<M
Beh. POC									
CC	4.6 ± 2.4	5.8 ± 2.3	7 ± 2.4	8.6 ± 2.7	9.1 ± 2.9	.71	54.92	.005*	PC<C,P,A,M C<P,A,M P<M
HR	4.9 ± 2.2	6.1 ± 3.1	6.8 ± 2.9	7.4 ± 3.1	7.7 ± 3.2	.79	11.2	.000*	PC<P,A,M C<A,M P<M
RM	5.7 ± 2.8	8 ± 3.2	9.5 ± 2.9	10.1 ± 2.8	10.9 ± 3	.78	36.06	.000*	PC<C,P,A,M C<P,A,M P<M
SL	6.1 ± 2.5	7.8 ± 2.5	9.7 ± 2.6	10.4 ± 2.8	11.5 ± 2.8	.72	61.64	.000*	PC<C,P,A,M C<P,A,M P,A<M
SC	3.7 ± 1.7	5 ± 2.1	5.6 ± 2.4	6.5 ± 2.7	7.3 ± 3	.63	31.67	.000*	PC<P,A,M C<A,M P<M

Note. *p<0.012; PC = Precontemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance. CR=Consciousness Raising, DR=Dramatic Relief, ER=Environmental Re-evaluation, SR=Self-Reevaluation, SO=Social Liberation, RM=Reinforcement Management, SC=Stimulus Control, HR=Helping Relationships, CC=Counterconditioning and SL=Self-Liberation.

Self-Efficacy

The alpha reliability for self-efficacy was 0.81 indicating that the ten questions had a good internal reliability. An ANOVA, with bonferroni corrected post-hoc analyses, found that self-efficacy was significantly different across all stages ($F_{(4, 883)}=72.78, p<0.01$). All self-efficacy scores increase from Precontemplation to Maintenance, with significant increases occurring between precontemplation and preparation, action and maintenance (PC<P, A, M). Individuals in contemplation and preparation score significantly lower on self-efficacy than those in action and maintenance. Maintainers are also significantly higher than those in the action stage.

The mean exercise self-efficacy scores for males and females by stage of change are shown on Figure 4.12. Males in the contemplation, preparation and maintenance stages scored significantly higher than females ($p<0.05$).

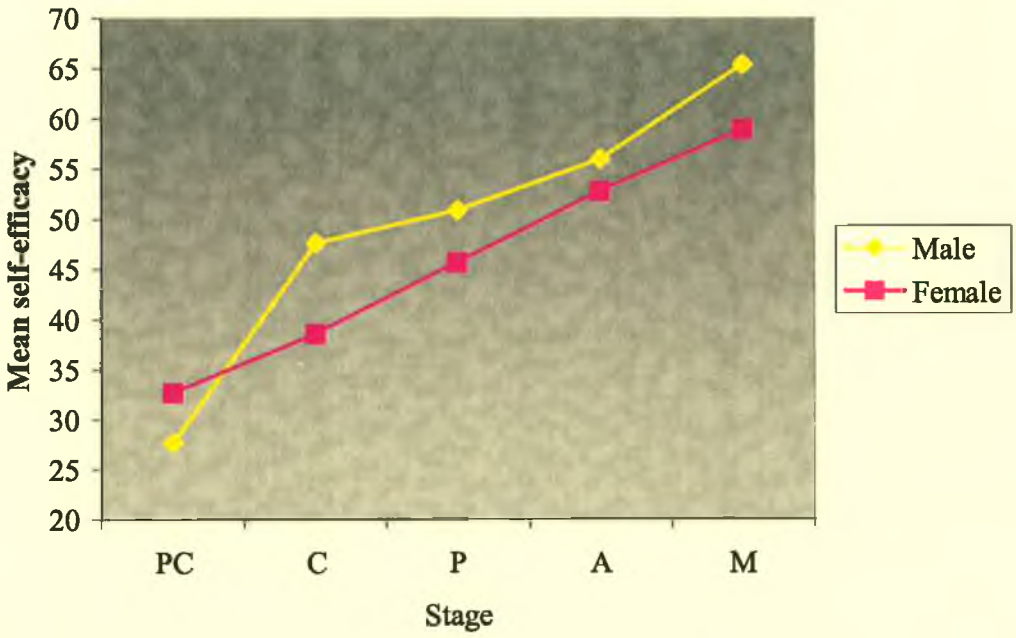


Figure 4.12. Total Self -Efficacy by gender across stages of change

Figure 4.13 shows the mean exercise self-efficacy for males and females for physical activity level (days per week). Females scored significantly lower in self-efficacy scores than males (58.4 Vs 49.3; t=7.74, df=894, $p<0.001$) Not regularly active individuals also reported lower self-efficacy than regularly active individuals (61.26 vs. 48.46; t=-10.95, df=891, $p<0.001$). This was true for both males and females.

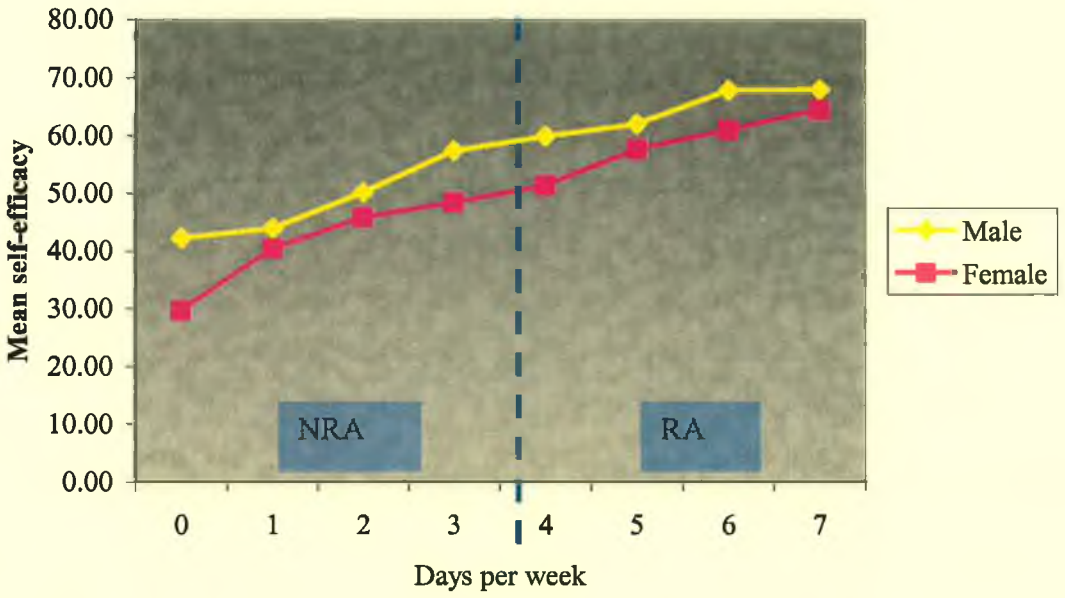


Figure 4.13. Mean Self-Efficacy by gender according to physical activity level (days per week)

Decisional Balance

Table 4.13 shows the distribution of the decisional balance scales across the stages of change. Following an ANOVA with a bonferroni correction of $p<0.012$, only exercise pros shows significant change across stages ($F_{(4, 884)}=8.73$, $p<.001$). For exercise pros, precontemplators were significantly lower than all other stages. There was no significant change in exercise cons across stages. The reliability analysis of the cons scale produced an internal reliability of $\alpha=0.56$, which is identical to that found by Marcus and colleagues on their adult population. An internal reliability of 0.67 was found for exercise pros, which is slightly lower than the study carried out with adults.

Table 4.13. Decisional Balance (means ± standard deviations) across stages of change, with alpha reliability and ANOVA values.

Variable (Range 1-5)	**PC**	**C**	**P**	**A**	**M**	**α**	***F***	***p***	**Tukey post-hoc**
Exercise Pros	8.2±2.6	10.4±2.8	11±2.6	11.1±2.8	11.1±2.6	.67	8.73	.000*	PC<C,P, A,M
Exercise Cons	7±2.8	6.4±2.5	5.9±2.4	6.1±2.6	5.9±2.6	.56	2.64	.033	

Note. *$p<0.012$

Figure 4.14 shows exercise pros and cons across the stages for both males and females. For males, there was no significant difference between stages for exercise pros or cons. Pros for females were significant across stages ($F_{(4, 522)}=7.58$, $p<.001$) with PC significantly lower than all other stages.

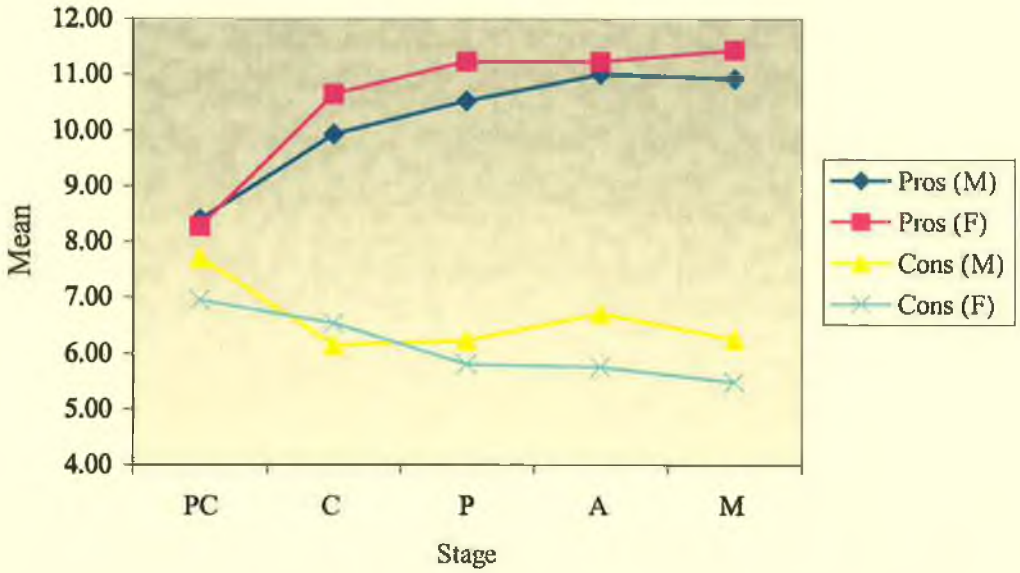


Figure 4.14. Decisional Balance across Stage of Change for Males (M) and Females (F)

To allow for comparison with other studies, scores were translated to t-scores which are standardised values based on a mean of 50 and standard deviation of 10. Figure 4.15 shows the t-scores crossing at preparation stage.

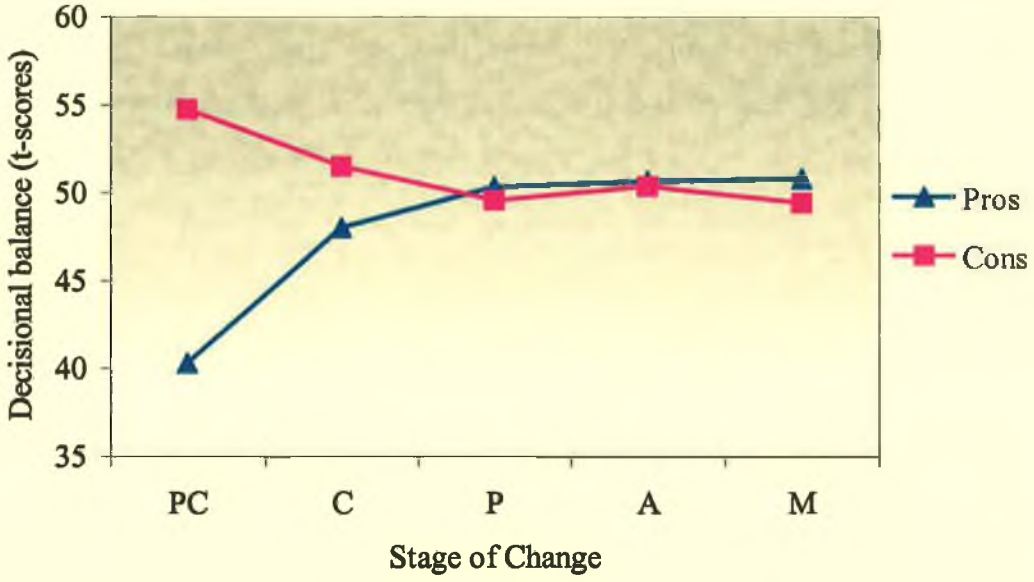


Figure 4.15. Decisional Balance t-scores represented across stages of change

Social Support

Both family and peer social support increase across stage of change, with the mean scores and alpha reliabilities for both scales presented in Table 4.14. Also included are the results of an ANOVA (bonferroni corrected), which show that there is at least one stage difference for both family and peer social support.

Table 4.14. Family and peer social support (means ± standard deviations) presented across stage of change, with alpha reliability and AVOVA values.

Variable (Range 1-5)	**PC**	**C**	**P**	**A**	**M**	**α**	**F**	***p***	**Tukey Post-Hoc**
Social Support Family	10.1 ± 3.8	10.6 ± 3.6	11.7 ± 3.8	13.3 ± 3.9	14.8 ± 4.1	.76	40.36	.000*	PC, C, P<A,M
Social Support Peer	11.3 ± 3.1	13.5 ± 3.1	14.5 ± 3	15.3 ± 2.5	16.9 ± 3.2	.67	52.14	.000*	PC<C,P,A,M C<A,M P,A<M

Note. *p<.012

Tukey post-hoc tests revealed that family social support was significantly higher for the action and maintenance stages compared to the pre-action stages, with no differences found between the earlier stages. Individuals in the precontemplation stage reported significantly lower levels of peer support than all other stages, and contemplators scored significantly lower than those in action and maintenance. Individuals in maintenance reported significantly higher levels of peer support than all other stages. The pattern of increase for both measures of social support can be seen in Figure 4.16.

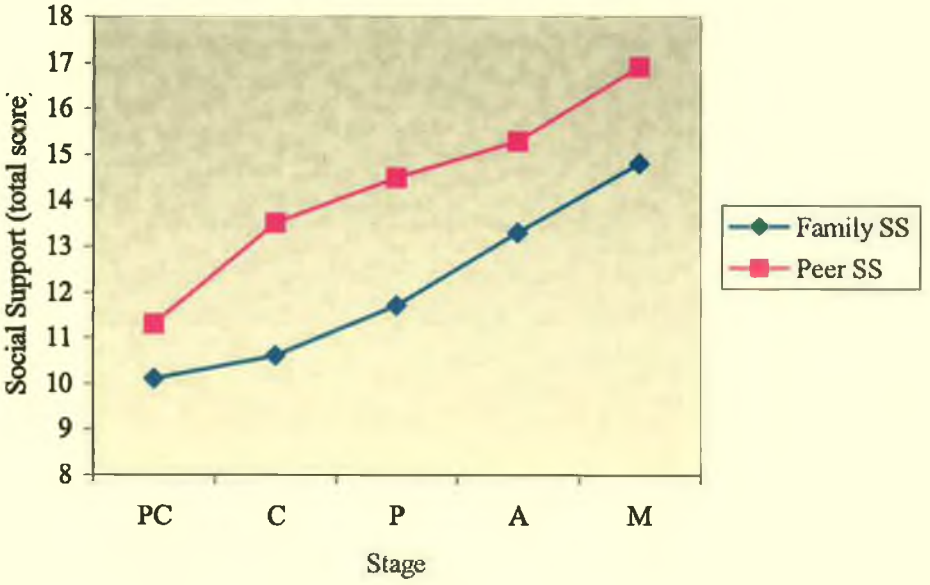


Figure 4.16. Family and Peer Social Support across stage of change

Males, in general, scored higher on both family (13.7 vs. 12.4; t=4.351, df=897, $p<0.001$) and peer (16.3 vs. 14.8; t=6.432, df=897, $p<0.001$, two-tailed) support scales than the females. The RA group reported significantly higher levels of social support than their NRA counterparts, with RA males scoring significantly higher on the peer (17.3 vs. 15.4; t=-5.3, df=362, $p<0.001$) and the family social support scale (15.1 vs. 12.6; t=-6.1, df=362, $p<0.001$) than the NRA males. Similarly RA females scored significantly higher on the peer (15.8 vs. 14.4; t=-4.9, df= 530, $p<0.001$) and family (14.1 vs. 11.7; t=-6.1, df=530, $p<0.001$) support scales than the NRA females.

A similar pattern of increase was observed for social support from 0 days of activity to 7 days of activity, with significant differences found for family social support ($F_{(7,888)}=18.984$, $p<0.001$) and peer social support ($F_{(7,888)}=20.453$, $p<0.001$) across the days of activity (Figure 4.17). Family social support is highest for those doing 6 days of physical activity per week, whereas peer social support is highest at 7 days of activity.

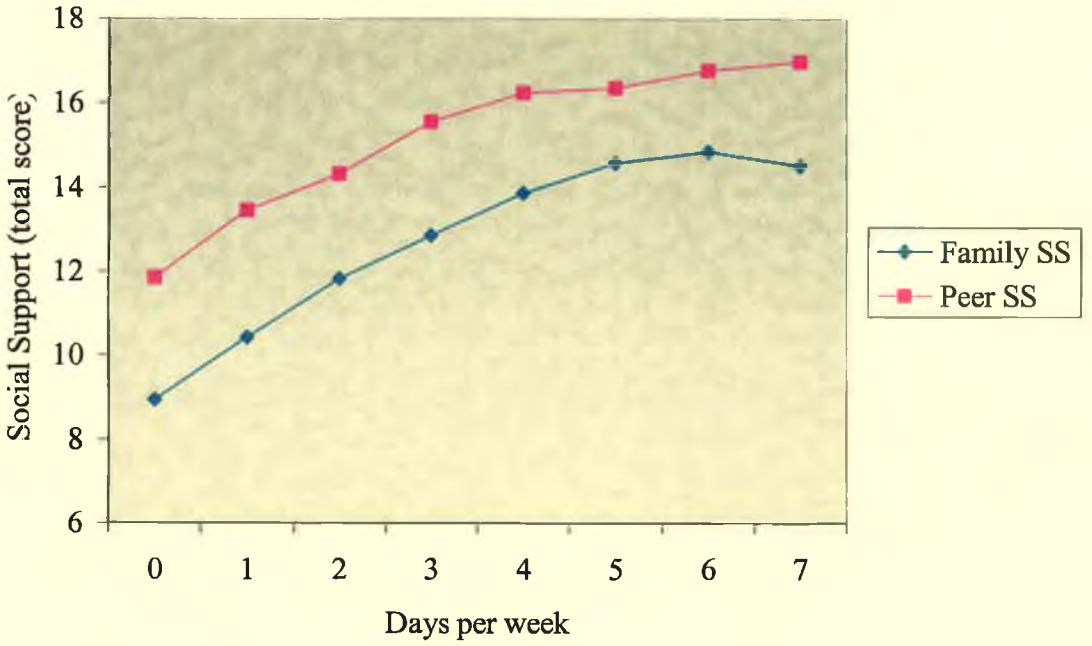


Figure 4.17. Social Support values for days of 60 minutes physical activity per week

Section 3: Regression Analyses

For this analysis, only cases with all TTM variables, social support and physical activity status were retained, resulting in a total of 858 cases. A logistic regression analysis was performed with activity level as the dependent variable. The TTM constructs were entered as predictor variables (stage of change, processes of change (10 items), self-efficacy and decisional balance index). The full model was found to be significantly reliable ($\chi^2 = 229.5$, df = 14, $p < 0.0001$). This model accounted for between 23.5% and 32.2% of the variance in activity status, with 75.1% of the participants being correctly predicted as regularly active or not regularly active. Stage of change, self-efficacy, counterconditioning and self-reevaluation were all significant predictors of activity level. A one-stage increase in the stage of change construct was associated with a 90% increase in the odds of being regularly active. A one unit increase in pros and self-efficacy was associated with a 10% and 2% increase respectively in the odds of being regularly active. A one unit increase in counterconditioning was associated with a 15% increase in the odds of being regularly active, whereas a one-unit increase in social-liberation was associated with a 12% decrease in the odds of being regularly active.

The analysis was repeated, with the inclusion of family and peer social support. The model remained significant (χ^2 =235.6, df = 16, p <0.0001) and accounted for between 24% and 33% of the variance. Prediction was also improved slightly, with 75.2% of cases correctly predicted. From table 4.15, it can be seen that family social support was also a significant predictor of activity. A one-unit increase in family social support was associated with a 6% increase in the odds of being regularly active. With the inclusion of social support, the association between stage of change and the regular activity decreased in odds from 1.90 to 1.80.

Table 4.15. Results of logistic regression analysis of TTM variables on regular physical activity, Model II (including social support)

Variable	Odds Ratio	95% C.I.	p
Self-Efficacy	1.01	(1.0, 1.03)	<0.05
Pros	1.1	(1.02, 1.19)	<0.05
Cons	1.03	(0.96, 1.10)	0.37
Processes of Change			
CR	1.03	(0.95, 1.10)	0.50
DR	1.02	(0.94, 1.09)	0.74
ER	0.99	(0.91, 1.05)	0.53
SO	0.88	(0.79, 0.96)	<0.01
SR	1.01	(0.92, 1.08)	0.92
CC	1.14	(1.06, 1.24)	<0.01
HR	1.00	(0.94, 1.07)	0.99
RM	1.02	(0.93, 1.11)	0.75
SL	1.05	(0.96, 1.15)	0.30
SC	1.02	(0.95, 1.10)	0.63
Stage of Change	1.80	(1.50, 2.17)	<0.0001
Social Support			
Family Social Support	1.06	(1.01, 1.11)	<0.05
Peer Social Support	1.00	(0.94, 1.07)	0.95

Note. 75.2% correctly predicted

The data was split by gender and both regression models were repeated separately for males and females. Model I (excluding social support) was significant for males (χ^2 =84.49, df = 14, p <0.0001) and accounted for between 21% and 29% of the variance. The model correctly predicted 74.4% of the male participants. Pros were a significant predictor of regular physical activity, with an associated odds ratio of 1.13. Therefore a one-unit increase in pros was associated with a 13% increase in

the odds of being regularly active. Counterconditioning was also significant ($p<0.05$) with an associated odds ratio of 14%. A one-stage increase in the stage of change construct for males, was associated with a 70% increase in the likelihood of being regularly active.

Model II, which included the social support construct, was also a significant model for males ($\chi^2 = 90.48$, df = 16, $p < 0.0001$) and accounted for between 23% and 31% of the variance. This model was also a better predictor of category membership, with 75.5% of the male participants correctly predicted. As can be seen from Table 4.16, pros, counterconditioning and stage of change remained significant predictors of regular physical activity. Family social support was also a significant predictor and a one-unit increase was associated with an odds ratio of 1.08.

Table 4.16. Results of logistic regression analysis of TTM variables associated with regular physical activity for male participants, Model II (including social support)

Variable	**Odds Ratio**	**95% C.I.**	***p***
Pros	1.14	(1.02, 1.27)	<0.05
Cons	0.98	(0.89, 1.08)	0.69
Self-Efficacy	1.01	(0.99, 1.02)	0.52
Processes of Change			
CR	1.10	(0.99, 1.23)	0.08
DR	1.05	(0.94, 1.17)	0.41
ER	0.98	(0.88, 1.08)	0.65
SR	0.87	(0.75, 1.01)	0.08
SO	1.02	(0.90, 1.16)	0.79
CC	1.14	(1.01, 1.28)	<0.05
HR	1.02	(0.93, 1.12)	0.69
RM	0.97	(0.84, 1.11)	0.64
SL	1.04	(0.90, 1.21)	0.56
SC	0.98	(0.89, 1.10)	0.78
Stage of Change	1.54	(1.17, 2.04)	<0.001
Social Support			
Family	1.08	(1.01, 1.16)	<0.05
Peer	1.03	(0.94, 1.13)	0.54

Note. 75.5% correctly predicted

Model I for female participants was significant ($\chi^2 = 148$, df = 14, $p < 0.0001$) and accounted for between 25 and 36% of the variance. This model correctly predicted 76% of the female participants. Self-efficacy was a significant predictor for regular activity ($p<0.05$) and a one-unit increase was associated with a 2% increase in odds of being regularly active. Unlike the male participants, pros were not a

significant predictor for the females. Self-reevaluation was significant, however this relationship was inverse and was associated with a 15% decrease in odds of being regularly active. Counterconditioning and stage of change were also significant, with associated odds ratios of 1.13 and 2.02 respectively.

Model II for female participants was significant (χ^2 =150.3, df = 16, p <0.0001) and accounted for 26-36% of the variance. Model II (Table 4.17) was a slight improvement on model I as it correctly predicted 76.3% of the female participants activity group. There is no change in the predictors of regular activity, as self-efficacy, self-reevaluation, counterconditioning and stage of change remained the significant predictors. Neither family nor peer social support were found to be significant predictors.

Table 4.17. Logistic Regression examining the TTM variables associated with regular physical activity for female participants, Model II (including social support)

Variable	**Odds Ratio**	**95% C.I.**	***p***
Pros	1.07	(0.96, 1.19)	0.24
Cons	1.07	(0.97, 1.18)	0.16
Self-Efficacy	1.02	(1.01, 1.04)	<0.05
Processes of Change			
CR	0.96	(0.87, 1.07)	0.48
DR	0.98	(0.89, 1.09)	0.71
ER	0.98	(0.89, 1.09)	0.71
SR	0.86	(0.74, 0.99)	<0.05
SO	0.98	(0.87, 1.10)	0.69
CC	1.13	(1.00, 1.27)	<0.05
HR	0.98	(0.89, 1.08)	0.72
RM	1.08	(0.94, 1.23)	0.27
SL	1.04	(0.91, 1.19)	0.54
SC	1.06	(0.95, 1.19)	0.28
Stage of Change	2.00	(1.56, 2.56)	<0.001
Social Support			
Family	1.05	(0.98, 1.12)	0.14
Peer	0.96	(0.87, 1.06)	0.41

Note. 76.3% prediction

Aerobic fitness & LTPA

A logistic regression analyses was also performed with aerobic fitness and leisure time physical activity as independent variables and physical activity status as the dependent variable. The total number of cases analysed in this test was 601. The model was significantly reliable (χ^2 =103.58, df = 2, p <0.0001) and accounted for 15.8% and 21.6% of the variance. The model correctly predicted 70.9% of the

participants activity group. Both variables were significant predictors of activity status, with 1.012 odds ratio for aerobic fitness and 1.003 odds ratio for LTPA. Therefore an increase of 1 shuttle run in the aerobic fitness test would equate to a 1.2% increase in the likelihood of being regularly active. An increase of 1 minute LTPA would result in a 0.3% of the likelihood of being regularly active.

The analysis was repeated with LTPA identified as hour per week as opposed to minutes per week. The model was significantly reliable (χ^2 =102.83, df = 2, p <0.0001) and accounted for 15.4% and 21% of the variance. The model correctly similarly predicted 70.9% of the participants activity group. The odds ratio for LTPA (hours per week) was 1.153, indicating a 15.3% increase in odds of being regularly active for a 1 hour increase in LTPA.

Section 4: Structural Equation Modelling

A four-step model building approach was taken to examine a theoretical model of physical activity, with the TTM guiding the design of the model. The first step was to build a hypothesised model that represented the TTM. The latent variables of self-efficacy, pros, cons and stage of change were represented by single item factors, whereas the process of change variable was composed of experiential and behavioural factors. The composite measure of physical activity was made up of habitual physical activity, leisure time physical activity and aerobic fitness. The hypothesised model can be seen in Figure 4.18. This model contained 9 observed variables and 17 unobserved variables (11 error terms and 6 latent variables).

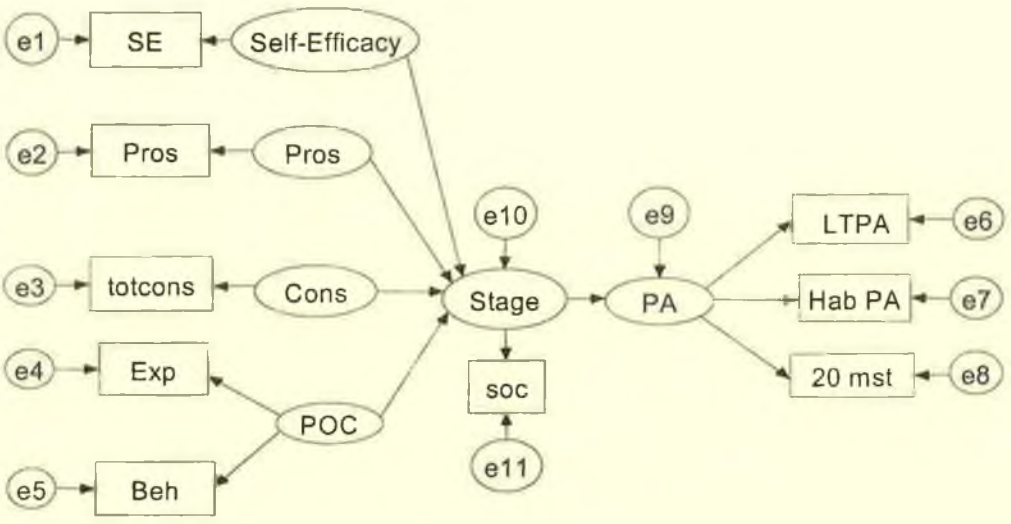


Figure 4.18. Hypothesised model of physical activity

The initial test of the hypothesised measurement model indicated a poor fit to the data (χ^2(20, n=675)=285.69, p=0.00, GFI=0.918, AGFI=0.815, RMSEA=0.14) with the significant p value indicating that there is a significant difference between the model and the data. The model explained 67% of the variance in physical activity and 32% of the variance in stage of change. Goodness of fit index (GFI) and adjusted GFI (AGFI) are absolute indexes of fit as they compare the hypothesised model with no model at all, and values close to 1.00 are indicative of good fit. Root mean square error of approximation (RMSEA) is an important fit statistic as it takes into account the error of approximation in the population and is sensitive to the number of estimated parameters in the model. RMSEA values less than 0.05 indicate good fit, and values as high as .08 represent reasonable errors of approximation in the population (Byrne, 2001). Based on Bandura's theory of self-efficacy, it was decided to include a direct pathway from self-efficacy to physical activity. The introduction of this pathway improved the fit of the hypothesised model (χ^2(19, n=675)=194.35, p=0.00, GFI=0.943, AGFI=0.866, RMSEA=0.117), however the p value remained significant.

In order to improve the development of the model, theoretically based modifications were made. On inspection of the modification indices, five modifications were made to the hypothesised model (figure 4.19). Links were made between the following error variances:

1. Self-Efficacy and 20m shuttle run test
2. Pros and Experiential POC
3. Behavioural POC and Habitual PA
4. Experiential POC and 20m shuttle run test
5. LTPA and 20m shuttle run test

The fit statistics of model one were good (χ^2(14, n=675)=21.94, p=0.08, GFI=0.99, AGFI=0.98, RMSEA=0.03) with the non-significant p value indicating that the model was not significantly different from the data. The model explained 67% of the variance in physical activity and 29% of the stage variance. The value of .39 was the expected change in stage for a one-standard deviation shift in self-efficacy while controlling for all other variables in the model. The indirect effect of self-efficacy on physical activity was .23, with the direct effect equalling .36, resulting in a total effect of .59. A one-standard deviation change in the processes of change shifted stage by .24. Of concern in this model was the non-significant effect of pros and cons on stage of change. A one standard deviation change in pros would impact stage negatively by –.02, while cons would impact by .02. Following these results, pros and cons were excluded to produce a simpler model. The new model produced adequate fit statistics (χ^2(7, n=675)=13.71, p=0.06, GFI=0.99, AGFI=0.98, RMSEA=0.04) with 66% of the variance in physical activity explained. The impact of self-efficacy and processes remained the same for the new model.

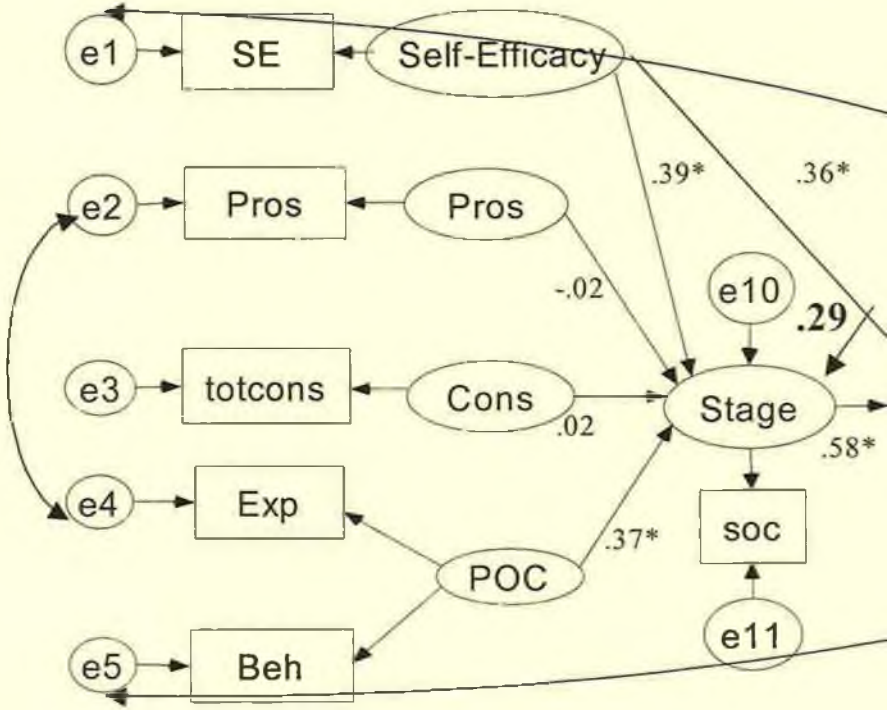
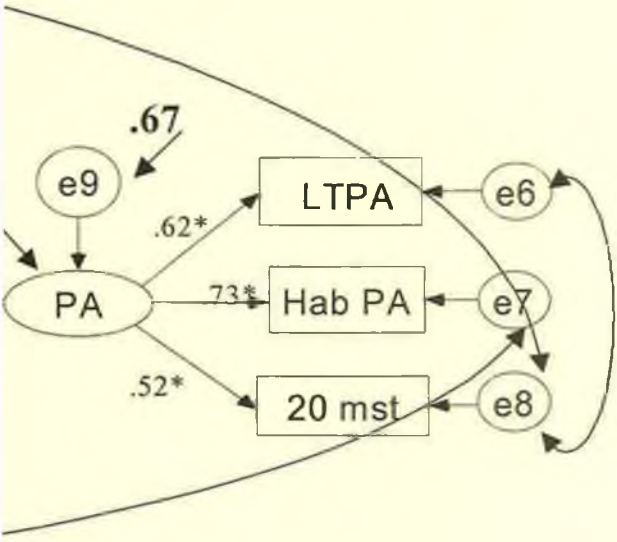


Figure 4.19. Model one with modifications.


.67
e9
LTPA
e6
.62*
PA
.73*
Hab PA
e7
.52*
20 mst
e8

Of the physical activity measures in model one, the model was able to predict habitual physical activity the most (73%), followed by LTPA (62%) and aerobic fitness (52%).

The final stage of the model building was to investigate the inclusion of social support. The model was tested with family and peer social support included as separate variables, however this inclusion resulted in unsatisfactory model fit statistics. Social support was therefore included as a single latent variable, made up of family and peer social support, and was linked indirectly (through stage) and directly to physical activity. A subsequent modification was made to the model by correlating the error in peer social support and aerobic fitness. Due to the nature of the test, many of the participants rely on peer support when completing the test. Fit statistics indicated that the fit of the structural model was good ($\chi^2(15, n=675)=18.71$, $p=0.23$, GFI=0.99, AGFI=0.98, RMSEA=0.02). Moreover, the model explained 70% of the variance in physical activity. With the addition of social support, the impact of self-efficacy and processes on stage increased from .23 to .24 and from .24 to .08 respectively, with the direct impact of self-efficacy on physical activity decreasing from .36 to .26. Social support has a strong effect on physical activity both indirectly (.19) and directly (.31).

Similar to model one, this model was best able to predict habitual physical activity (73%), followed by LTPA (63%) and then aerobic fitness (49%).

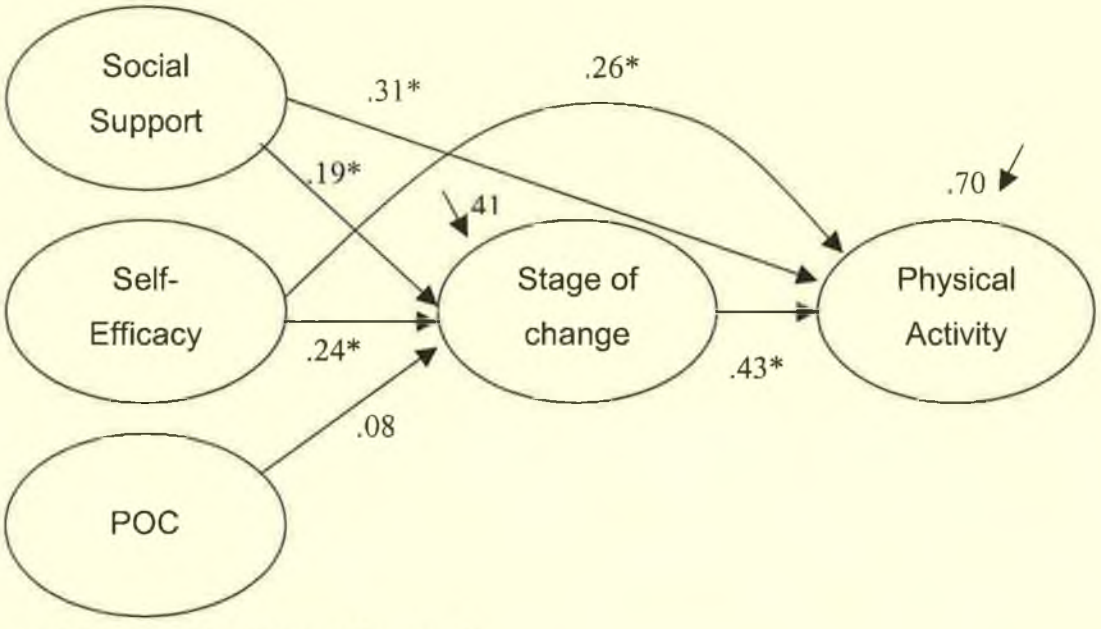


Figure 4.20. Model with social support

In conclusion, the SEM indicated that self-efficacy, processes of change and social support are the most influential determinants of physical activity for Irish adolescents. By adding social support to the model, the amount of variance accounted for increased by 4%. This model was obtained by adding a pathway from social support to stage and also a direct pathway to physical activity.

Chapter Five: Discussion

Physical Activity & Health

This study provides both physical and self-report data on the physical activity behaviours, aerobic fitness and physical health of Irish 15-17 year olds. Results show that 65% of 15-17 year olds reported not meeting physical activity guidelines, which recommends that youth should be physically active on most or all days of the week for at least 60 minutes and this activity should be of at least moderate intensity. The Health Behaviours of School-aged Children (HBSC) study included two questions on physical activity, one of which was also used in the Take PART study. The HBSC results indicated that 47% of the 15-17 yr old sample was not regularly active based on the question of habitual physical activity (Corrigan, personal communication, September 22, 2003). This highlights that the adolescents in the Take PART study were not as active as the national sample. Although, both studies included the same question, the HBSC questionnaire did not define physical activity or intensity. The Take PART study included both a definition of physical activity and a definition of moderate and vigorous intensity. It also instructed to only consider moderate and vigorous activity for this question. In the absence of definitions, the HBSC sample may have reported on all intensities of physical activity, including light intensity. The second question used in the HBSC study found that 65% of 15-17 year olds did not participate in physical activity on four or more days (Kelleher et al., 2003). However, this question referred to vigorous physical activity and did not include how much time per day was to be spent being active.

In this study, regular physical activity has been categorised as 4 or more days per week. Other studies have used 5 or more days as the cut off point (Prochaska et al., 2001), however if this criterion were used, the amount of participants fitting the not regularly active category would have been even more alarming (80%). This recommendation includes the idea of adding up activity over the course of the day, so for those adolescents who do not take part in sports teams, clubs etc., the hour of activity is achievable by accumulating short bouts of activities (Pate et al., 1998). The Take PART results point to a possible problem with the current guidelines. Firstly, the guidelines are very much open to interpretation, so more definition is required particularly in relation to number of days per week. Secondly, as a high proportion of

adolescents are not meeting the guidelines, then perhaps these recommendations need to be altered to reflect a more realistic approach.

It is well known that females are most at risk for being inactive (Sallis et al., 2000) and the findings of this study support this claim. Female participants reported significantly less physical activity than males, both in terms of leisure time physical activity (minutes) and average weekly activity. Along with this, the female participants recorded low levels of aerobic fitness with an average of 39 runs in the 20MST. This equates to a VO_{2max} of approximately 32 ml.kg.min^{-1}, which is poor according to norms (Reibold & Schvartz, 1990). The number of laps completed by females was also lower than that found in a study of 15-year old students in Northern Ireland, which reported an average of 44 laps for females (Boreham et al., 2001). An earlier study in Northern Ireland also found higher fitness levels for 15 year old females (45 laps) (Boreham et al., 1997). As low physical fitness has been identified as a risk factor for CHD (Nielsen et al., 2003), female adolescents need to be targeted for physical interventions that focuses on the attributes associated with physical fitness, e.g. muscular strength and cardiovascular endurance.

Regularly active individuals spent more time in LTPA than not regularly active individuals, with males spending significantly more time in LTPA than females. There was no difference in time spent between 17-year old males and females compared to the large gender difference observed for 15 and 16 year olds. Compared to females, whose LTPA increases with age, male LTPA is at its highest for the 16 year olds. The results the fitness test supports this, with laps completed increasing for 16 year olds and then decreasing for 17 year olds. Therefore, older adolescent males appear to be more at risk of being inactive or decreasing their physical activity habits. This finding suggests that the development of physical activity patterns is different for male and female adolescents.

Almost half of the participants reported being involved in team sports, with the types of activities similar to those found by Connor (1999) in a study of 3,315 adolescents. This study of Waterford adolescents found soccer, Gaelic football and basketball to be the most popular team sports, while the Take PART study found soccer, tennis and Gaelic football to be the most popular. Individual activities accounted for the remaining 51% of activities, with swimming, running and bicycling listed the most frequently. Connor (1999) reported swimming to be the most popular

activity, followed by tennis and bicycling, which indicates that Irish adolescents report participating in similar activities and sports regardless of geographic location.

An increase in aerobic fitness and LTPA were both significantly associated with an increase in the odds of being regularly active. As the units of both measures were quite small (laps, minutes), the odds ratios were small also. When the unit of LTPA was changed to hours, these odds increased to 1.153 from 1.003, suggesting that an extra hour of LTPA increases the likelihood of being regularly active by 15%.

The results of the blood pressure analysis support the findings of Nielson and colleagues (Nielsen et al., 2003) with male adolescents having a significantly higher systolic blood pressure than females. However, there was no relationship found between blood pressure and aerobic fitness. Normal blood pressure is defined as 120 mm Hg (SBP) and 80 mmHg (DBP), so the mean SBP of 135.3 for males in this study was well above the normal range. Raised blood pressure is a major risk factor for cardiovascular (CV) disease and trends in adolescents are a marker of the future population burden of CV disease (Watkins et al., 2004).

Validity of measures

The significant correlation found between habitual physical activity and leisure time physical activity confirms that there is a non-chance relationship between the two measures. It also highlights the positive linear association between these self-report measures. A certain degree of positive association was expected between the two measures, however habitual physical activity was defined as any activity that increases your heart rate and makes you get out of breath some of the time. This type of activity can be accumulated over the course of the day including activities like walking to school, playing with children and playing sport. Leisure time physical activities on the other hand are more structured activities participated in more than ten times over the past year. While an individual may report high levels of habitual physical activity this might not necessarily be leisure time activity, but activities like housework and walking to school.

The degree of association between aerobic fitness and the physical activity measures were also flagged as significant, also confirming that there is a non-chance relationship between the measures. According to Vincent (1999), correlations less than 0.5 are too small to be useful in predicting individual scores (Vincent, 1999). As aerobic fitness can be influenced by many factors outside of physical activity

participation levels, for example genetics, a high degree of association between self-report measures of physical activity was not expected.

BMI

Over one-fifth of the population surveyed were categorised as either overweight (17%) or obese (5%). There was no gender difference observed for BMI levels, with similar proportions in each weight category. The main strength of this result is that it was objectively measured and is therefore not open to estimation. The only Irish data available on adolescent BMI reports that 17% of the sample were 'at risk of overweight' with 4% overweight (Lissau et al., 2004). Although these results are similar, it is difficult to make a comparison to the Take PART results, as this study used self-reported values and also uses the 85th and 95th percentiles for identifying overweight individuals and those 'at risk' of overweight. However, it does suggest that one in every five adolescents is either overweight or obese. The results are also similar to the Canadian values (Janssen et al., 2004), which reported 15% overweight and 4.6% obese.

BMI and Physical Activity

Two-thirds of overweight and obese individuals are not meeting the recommended guidelines for physical activity. Although the self-report measure of LTPA did not show any significant differences between weight categories, it did show a trend towards inactivity, with LTPA levels decreasing from normal weight to overweight and obese categories. The LTPA measure required students to report on activities they participated in over the previous year and the number of minutes per day. It may be that this measure is too broad to differentiate by body mass levels. A more stringent measure is needed to allow for differentiation.

The physical measure of aerobic fitness differentiated obese individuals as having significantly lower aerobic capacity than normal and under weights and overweight individuals having significantly lower levels of aerobic fitness than normal weights. Therefore, adolescents with higher BMI levels are more likely to have lower aerobic fitness, which may be as a result of low physical activity levels (Janssen et al., 2004). Low aerobic fitness and high BMI levels are both risk factors for Coronary Heart Disease so these results are worrying (Wang, 2004). When these

risk factors are present at such a young age, then the risk of developing adulthood diseases such as obesity, CHD, diabetes and other disease are high.

Sedentary behaviour

Over half of males compared to 37% of females were categorised as having high TV watching behaviour, as defined by the US Department of Health and Human Services. Not regularly active males were more likely to have high TV watching behaviours compared to their RA counterparts, thus supporting the belief that TV watching is linked to inactivity. Previous studies have found that increased levels of physical activity are associated with a lower BMI and less TV watching (Eisenmann, Bartee, & Wang, 2002). This association was not evident amongst the females, however based on the low physical activity levels found for females in this study, it is likely that females are engaging in other types of sedentary behaviours. Sitting talking to friends either on the phone or face to face represents a sedentary behaviour popular with adolescent females (Marshall et al., 2002). Further investigation of the types of sedentary behaviours is required to explain the low levels of physical activity among adolescent females.

Adolescents from a manual SES background were also more likely to have high TV watching levels, compared to those for a non-manual background. This finding does not support the hypothesis that high sedentary behaviour is associated with low physical activity as a higher proportion of participants from a non-manual background were classified as not regularly active. However, as three-quarters of the sample were from a non-manual background, this result is inconclusive. Also, adolescents from the higher social classes may be more likely to participate in sedentary activities other than TV watching, such as Internet surfing and computer games, that perhaps those from a lower SES do not have access to.

Recent studies have reported that obesity is significantly associated with high levels of TV watching, and the results of this study support this association. Obese individuals watched significantly more TV than their normal and underweight counterparts. A longitudinal study in New Zealand found that television viewing in childhood and adolescence was associated with overweight, poor fitness, smoking and raised cholesterol in adulthood (Hancox, Milne, & Poulton, 2004). TV viewing from 1019 individuals was assessed from age 3 to age 26 years. The cause for this association is not fully understood and many theories have been postulated. Apart

from displacing time which otherwise could be spent being active, it may be that TV watching encourages unhealthy behaviours such as unhealthy eating habits and smoking. Television advertising tends to promote an unhealthy diet with high energy, high sugar content food ads being aimed at the younger populations. To counteract this, the Broadcasting Commission of Ireland (BCI) has banned celebrity endorsement of food and drink advertising in Ireland, unless it is part of a public health campaign. The code, which will come into effect on the 1st of January 2005, also states that ads for junk food aimed at children will have to carry a health warning 'in moderation as part of a balanced diet'.

Commuting

Commuting to school offers an opportunity for adolescents to be active (Cooper et al., 2003). Only 39% of the Take PART participants actively commuted to school, travelling an average of 1.5 miles for an average duration of 15 minutes. Many of the inactive commuters were travelling distances of less than a mile, in particular 22% of car users. In comparison to the 2002 census, which found that 31% of Irish youth were actively commuting to school, our finding of 39% is very positive. On the other hand, the census surveyed 13-18 year olds, whereas this study only examined 15-17 year olds. The older sample may explain the higher level of active commuters, as younger teenagers may not be allowed to walk or cycle to school.

Another interesting finding from this section was that students from a manual SES background were more likely to be active commuters compared to those from a non-manual SES. A community college principal, whose school had 50% of students from a manual SES, commented that many of the less well off students were forced to walk or cycle to school as their parents were either working or did not have access to a car. In this case, it would seem that the lower SES was positively influencing physical activity.

The Transtheoretical Model (TTM)

The TTM was assessed for its applicability to Irish adolescent physical activity behaviour. In general, the results supported the TTM, with all components from the core constructs significantly discriminating at least one stage of change. There was also support for the concept that the different constructs are more or less important at different stages.

Stage of Change

Courneya and Nigg (1998) reported a similar pattern of stage distribution to that of the Take PART project, with 28.7% in the preparation stage and 49.3% in the maintenance stage, compared to 34% and 41.9% respectively. The proportion of precontemplators is also similar, with Nigg reporting 2.1% compared to 3.1% in the Take PART sample. The overrepresentation of females (60%) in the Take PART study might explain the higher percentage of adolescents in the preparation stage and likewise the lower percentage in the maintenance stage. Nigg (2001) reported similarly high baseline figures for the maintenance stage (47.5%) in a longitudinal study of adolescent behaviour change. This suggests that Irish adolescents are similar to American adolescents in terms of stage of readiness to change exercise behaviour.

Processes of Change

The results of the Take PART study provides support for the processes of change construct, with all processes being significant discriminators of at least one stage of change. As previously mentioned there is a general consensus that individuals use experiential processes more frequently in the early stages, whereas behavioural processes are used more frequently in the later stages (Marcus, Rossi, Selby, Niaura, & Abrams, 1992b). The results of this study also support this consensus indicating that adolescents utilize the processes in a similar fashion to adult populations. Although the main pattern is similar, there are some individual process differences across the stages.

The SEM analysis revealed that processes of change were an important feature of the TTM. The indirect effect of processes on physical activity through stage supports the notion that the profile of each stage is dependent on a different mix of process use. It also indicates that adolescents use processes more frequently in the action stages of change.

Experiential processes

Of the five experiential processes, Self-Reevaluation (SR) and Social liberation (SO) are the most frequently used processes throughout all stages. Social Liberation begins at a very high level for PC's indicating that all adolescents regardless of activity level use this process frequently. Precontemplators do not intend to become active, however it seems that they are still aware of the social

acceptance associated with active lifestyles, but may ignore this influence. Once the individual starts to consider exercise, they take more notice of the importance that society places on being active and this intention turns into behaviour. SO levels peak at the action stage and then decreases slightly at the maintenance stage, suggesting that this process is most important at the action stage.

Self-reevaluation is extremely important for this population, showing significant increases from PC to P and P to M. This strategy requires the individual to re-appraise their image and values and to question whether they are better off with or without exercise and the high levels reported for all stages suggest that adolescents are frequently thinking about the benefits of regular exercise for their body and mind. SR increases significantly from PC to C and from C to P suggesting that an increase in SR brings about the change in intention. Nigg's results are similar to these, however he also found a significant decrease from A to M, which is not shown in the Take PART results. Self-reevaluation in fact peaks at the maintenance stage, suggesting that re-evaluation is increasingly important as activity behaviour increases. This may not be a re-evaluation as such, but rather an appraisal of their current image.

Consciousness raising increases significantly from PC to C and from C to A, which is similar to the findings of Nigg and Courneya. This indicates that Irish adolescents seek out information about physical activity at similar stages to American adolescents. The first significant increase from PC to C highlights the importance of increasing awareness about physical activity in order to change intentions. The increase from C to A signifies further awareness about physical activity in order to incorporate more activity into one's lifestyle. The adolescent might read literature on weight training or surf the Internet to find out about new methods of exercising.

Similar to the American sample, there is a significant increase in the use of dramatic relief from PC to P. This signifies that Irish adolescents in the early stages of behaviour change have fewer emotional experiences related to physical activity. The significant shifts observed in the early stages suggest that as the adolescent begins to think about becoming regularly active, they have more emotional experiences about the consequences of inactivity. Adolescents in preparation stage use the dramatic relief process almost as frequently as those in action and maintenance suggesting that this process is best promoted in the early stages.

Environmental re-evaluation increases in use from PC to P and then levels off, which is similar to results of other studies (Nigg et al., 1998; Marcus et al., 1992b).

The only significant difference for ER is between PC and M. Like dramatic relief, ER increases in use over the early stages and then remains constant over action and maintenance. In the pre-action stages, adolescents consider more and more about how their inactivity affects their physical and social environment, thus leading them to think about engaging in regular physical activity. A potential intervention based on environmental re-evaluation could concentrate on promoting active commuting to school by emphasising the pollution caused by motorised transport. This type of intervention could also incorporate dramatic relief by highlighting the negative effects of pollution to health.

The results of the regression analysis found that social liberation was a significant negative predictor of physical activity status, defined as regularly active/ not regularly active. A one-unit increase in SO would result in a 12% decrease in odds of being regularly active. As SO was initially very high, it might be that efforts to promote the importance society places on being active are overpowering for adolescents. Many adolescents may be aware that society applauds physical activity, however this may in fact lead the adolescent to rebel against the norm. This also supports the construction of a self-identity during this time, as the adolescent peer group might not place as much importance on physical activity compared to society in general and the adolescent thus rejects the behaviour.

Behavioural processes

The behavioural processes did not begin at comparable high levels as some of the experiential processes, which reflect the high levels of inactivity in the sample and is also consistent with previous research. Self-liberation was the most frequently used process for precontemplators and increases significantly PC to C and C to P, continuing to rise throughout the remaining stages. These results support those of a meta-analysis on the TTM, which found that SL produced the largest effect size from PC to C. The occurrence of this sharp increase during the early stages coincides with the change in intentions and behaviour. Self-efficacy is also increasing, so the individual believes in their abilities to become a regular exerciser in the near future. The continuous increase in this process highlights the enhanced confidence that the individual gains from exercising regularly.

Reinforcement management is the next most frequently used process, with significant increases evident from PC to C and from C to P. Maintenance is also

significantly higher than P suggesting that those engaging in long-term physical activity use this process more frequently. This process included items regarding the benefits that one gets from being physically active, so it is only when the adolescent experiences physical activity that they realise the benefits. Therefore the increase in physical activity also leads to an increased realisation of the importance.

Counter Conditioning (CC) increases significantly from PC and C to all other stages indicating that this strategy is important when making the transition from no exercise to some exercise and then regular exercise. There is also a further significant increase between P and M highlighting the importance of this technique in increasing the amount of activity. Nigg and Courneya (1998) found very similar results, with the only exception being a further significant differentiation between P, A and M. This technique of using exercise as a substitute for sedentary behaviours e.g. TV watching or napping, is essential as it cuts down on sedentary behaviours while increasing time spent in physical activity, allowing the individual to meet the recommended guidelines for regular physical activity. This result is also supported by the logistic regression, which found CC to be a significant predictor of activity status, with a one-unit increase resulting in a 15% increase in the odds of being regularly active.

The pattern of use for Helping Relationships (HR) is different to that of the American adolescents. The use of HR by the Take PART sample significantly distinguishes PC from P, A and M, unlike Nigg's results which found PC and P to be significantly lower than A and M. Our results also found C to significantly lower than A and M, with P also significantly lower than M. This suggests that Irish adolescents in the later stages receive more support from significant others than those in the earlier stages. While Nigg found that HR decreased from A to M, Irish adolescents require and receive more social support the more active they are.

The final process, stimulus control (SC), increases in use from PC to M, however this increase is not significant between all stages. Precontemplators are significantly lower than those in P, A and M, while C is lower than A and M. Those in preparation are significantly lower than those in M. Therefore the more active the individual, the more frequently they take control of situations that may trigger inactivity, such as always having a clean set of exercise clothes. Nigg and Courneya (1998) found a significant distinction between the pre-action stages and the action

stages highlighting the importance of always having reminders to exercise, regardless of stage.

As with all cross sectional studies, it is difficult to understand these results in the light of stage transition. Although this data provides valuable information about the process use of Irish adolescents, a longitudinal study is required to ascertain which processes are most important for forward stage movement. It is unclear as to whether high levels of process use, such as social liberation, by precontemplators is beneficial or inhibiting. Perhaps it is the processes that are infrequently used in the early stages that need to be addressed. It may be that factors, such as consciousness raising, are not being promoted effectively for adolescents.

Self-Efficacy

Self-efficacy results were consistent with the literature, confirming that this construct is one of the strongest determinants of exercise. Results showed that self-efficacy increased linearly from PC to M, with significant increases observed between all stages with the exception of PC to C and C to P. Nigg and Courneya found similar patterns for self-efficacy. These results indicate that adolescents participating in physical activity have more confidence in their ability to perform a behaviour that will result in an expected outcome (Biddle and Nigg, 2000). In turn, those with high levels of self-efficacy will participate in physical activity regardless of barriers such as bad weather and tiredness.

Self-efficacy was also examined across activity level. As activity level increases, so does exercise self-efficacy for both males and females. RA individuals also exhibited significantly higher levels of exercise self-efficacy than the NRA's. Whilst this finding supports other research (Nigg et al., 1998; Plotnikoff et al., 2001; Plotnikoff et al., 2001), it clearly indicates the importance to young people of getting involved in activities that develops confidence in their abilities.

The direction of the relationship between self-efficacy and exercise behaviour is still unknown, that is whether exercise behaviour leads to self-efficacy or self-efficacy leads to exercise stage or behaviour. Due to the cross-sectional nature of this study, it is difficult to answer this question as we can only compare groups of individuals rather than the same individual over time. Dishman et. al. (2004) found that increased self-efficacy directly results in an increase in physical activity among adolescent girls (Dishman et al., 2004). An experimental (n=1049) and control

(n=1038) group were assessed pre and post a yearlong intervention with the experimental group. The intervention aimed to enhance self-efficacy and development of behavioural skills by using curricular activities within PE and health education classes. Results indicated that the intervention had a direct effect on self-efficacy and also that self-efficacy partially mediated the effects of the intervention on physical activity. This is the first study to provide evidence for the direction of influence from self-efficacy to physical activity.

Decisional Balance

The results for the decisional balance measure are in agreement with research findings of adult and high school populations (Marcus et al., 1994; Nigg et al., 1998), whereby pros increase across stages of change and cons decrease across stages of change. Significant differences were found only for the pros, with PC significantly lower than all other stages. This suggests that adolescents with no intention to be physically active do not realise the benefit of leading an active lifestyle.

Following the logistic regression, pros also emerged, as a significant predictor of being in the regularly active category. A one-unit increase in pros would result in a 10% increase in the odds of being regularly active. In particular, exercise pros were a significant predictor for males and not for females, signifying that the benefits of being regularly active are more important to males. Unlike females, males perceive athletic competence to be more important than academic and social competence. Therefore males view the pros of being active with more importance than females.

In order to compare decisional balance results with other studies, t-scores were used. Pros and cons were found to intersect at the preparation level, so it is at this point that pros are viewed with more importance than cons. Nigg and Courneya (1998) found that the intersection occurred at the action level, however they used the 16-item measure, which includes 10 pro items and 6 con items. Marcus (1992) who also used the 6-item measure with an American sample also found the intersection occurring at preparation, suggesting that the length of measure may be an influencing factor.

This 6-item measure did not produce high levels of internal reliability, with the exercise cons measure moderate (0.56) compared to the exercise pros (0.67). The results were similar to those found by Marcus and colleagues on their adult sample, suggesting that the weakness of this measure might be in its layout or question format.

The weakness of this measure was also highlighted in the SEM, resulting in both exercise pros and cons being dropped from the model due to their non-significant input to the model.

Social Support

Social support increased from precontemplation to maintenance stage and also increased from 0 days to 7 days. The differences observed for family support between pre-action and action stages suggests that this source of support is important for adolescents who are doing some activity but are trying to become regularly active and install physical activity as a lifestyle behaviour. Adolescents should receive positive reinforcement and encouragement from all family members when making the transition (Smith, 2003). Direct support such as providing transport, buying a new pair of football boots or shooting hoops with the individual may also be beneficial. Males reported higher levels of family social support than the female and this source of support was also a significant predictor of physical activity status for males only. Female adolescents may not be receiving enough support to be active from their families and this might be one of the main barriers experienced by females. Many of the inequalities between males and females are due to gender stereotyping. From an early age, this stereotyping can be seen. Boys, in general, are allowed more freedom to explore and are often enrolled in sports clubs at an early age. Girls are not socialised into sport as much as boys and are often discouraged to participate in activities that might be perceived as too rough, noisy or active (Choi, 2000).

Peer support appears to be important during the early stages, when the adolescent is contemplating becoming active. The significant difference between precontemplation and contemplation indicates that this source of support is beneficial to those who are thinking about changing their behaviour. Adolescents in the maintenance stage reported significantly higher levels of peer support than those in preparation and action, highlighting that this source of support is particularly important for establishing long-term physical activity patterns. The reason for this may be that maintaining behaviour needs approval from friends, as some behaviour acquisition might just be short term in accordance with whatever is seen to be 'cool' at that time. Peers exert the most influence through modeling behaviours. Adolescents in particular, often compare themselves to their social group and follow the crowd in an attempt to be 'popular'. Regularly active adolescents reported higher

levels of peer support than those who were not regularly active, confirming that regularly active individuals are providing and receiving encouragement from their friends to be active and are participating in activity together.

SEM development

The final model constructed by SEM incorporates the variables self-efficacy, processes of change and social support, accounting for 70% of the variance in physical activity. During the development of this model, both exercise pros and cons were excluded due to their non-significant input to the model. As suggested, this may be due to the physical activity measures included in the model or it may be that the decisional balance measure is was not relevant to Irish adolescents.

The SEM also emphasised the importance of self-efficacy on adolescent physical activity behaviour. The strong direct effect (0.39) of self-efficacy on physical activity indicates how influential self-efficacy is as a determinant of physical activity. It must be remembered that physical activity comprised of both self-report and physical data, making this result more significant. The indirect effect of self-efficacy mediated through stage is also significant, highlighting the importance of this construct as a variable in the TTM.

The addition of social support strengthens the model by accounting for an extra 4% of the variance. The direct effect of the social support on physical activity is significant, supporting the importance of social support as a stand-alone theory that is strongly related to physical activity. Social support also plays a significant role as part of the TTM. The addition of an indirect link from social support to physical activity via stage improved the model, supporting the hypothesis that this construct would be a valuable tool for measuring readiness to change. In determining which source of social support was the most influential in the model, the social support construct was separated into family and peer support. However, this separation reduced the models predictive ability and produced unfavorable fit statistics. Therefore it is evident that the combination of both family and peer social support is an important factor in physical activity level.

Even though the processes of change construct was a significant predictor in the final model, its influence decreased substantially from .24 to .08 following the addition of social support. This suggests a crossover between some of the processes and social support, for example helping relationships.

The results for the prediction of the three physical activity measures indicated that the model was best able to predict habitual physical activity. There are two possible reasons for this. Firstly, habitual physical activity was measured via self-report, as were the independent variables of stage, self-efficacy, processes and social support. Secondly, both the habitual physical activity measure and the stage of change measure included definitions of physical activity and were concerned with general everyday physical activity of moderate and vigorous intensity. Leisure time physical activity was also self-reported, however this type of activity is mainly organised activity that takes place outside of school hours.

The new model constructed without decisional balance provides an alternative model for measuring readiness to change in relation to physical activity. Also it provides evidence for the use of these measures in predicting overall physical activity, which includes habitual, leisure time and aerobic fitness. This model can be used in future studies that uses just the self report measures of self-efficacy, processes, social support and stage.

Critique of TTM

Although many of the TTM results were similar to those found in other International studies (Courneya and Nigg, 1998; Nigg, 2001), it is difficult to use these results in the design of an intervention. The results of this study, similar to the work of (Nigg et al., 1998; Plotnikoff et al., 2001; Plotnikoff et al., 2001) in that they support the use of self-efficacy as an integral part of any physical activity programme. However, if a stage-matched intervention is to be implemented, the right blend and temporal sequencing of process use is needed. The cross-sectional nature of this study does not tell us whether the use of the processes are use of the processes is antecedents of physical activity or as a consequence of physical activity. For example, self liberation, a behavioural process of change, received a significantly higher frequency of use score by those in preparation in comparison to those in the preparation stage of change. As the same individual was not tracked over time (as in a longitudinal study), there is no way of knowing if the higher use of this process of change in preparation was due to an increase in physical activity or if an increase in physical activity could be attributed to the increase in self liberation. In summary, there is a need for longitudinal data to establish what processes of change are key for behaviour change at different stages and when these processes should be introduced

or removed from the intervention. It is also possible that for an adolescent population, contrary to the thinking of Prochaska and DiClemente for smoking cessation behaviour a stage matched intervention for those in early stages would need a combination of cognitive (learning about the benefits of physical activity) and behaviour (experiencing the benefits of physical activity) approaches, rather than a purely cognitive approach as advocated (Prochaska & DiClemente, 1983).

The addition of social support to the hypothesized model resulted in a decrease in the amount of variance in physical activity explained by the processes of change. This would suggest that social support and self-efficacy are more influential factors for adolescent physical activity in Ireland. It may also be that the processes incorporate aspects of both social support and self-efficacy, especially through processes like helping relationships, self liberation and self-reevaluation. Family and peer support may supersede the processes, due to the importance that the Irish culture places on these networks.

While the similarity of the results to other adolescent studies allows us to incorporate elements of other international interventions, it is important that we examine the effect of the different variables on Irish adolescent physical activity over time. This research would need to take into account the changing interplay between personal, environmental and behavioural factors as the adolescent is forming their identity during this period.

Limitations

Full sets of data were not available for all students, due to various reasons. The following reasons were given:

- Injury or illness preventing participation in the shuttle run test
- Students being late for school
- Students choosing not to have measurements taken
- Students having to leave during the testing for an external reason such as doctor's appointment

Some of the students might not have wanted to have some of the measurements taken, however it may be those students who are most at risk of unhealthy behaviours. Future studies should account for any student who refuses to participate in various aspects of the study. While these students cannot be forced to

participate, information from their questionnaires might show a common trend. As only full data sets could be used in the SEM analysis, the sample size was reduced to 675.

Another limitation of this study was the inadequate facilities experienced in some schools. While only schools with facilities to run the shuttle run test were included, some of the halls were just barely 20 metres, meaning that the students had little room to turn. Due to the shortage of schools with indoor halls long enough for the fitness test, some schools with outdoor courts were included. Outdoor conditions such as wind resistance and surface may have affected fitness results.

As the testing time was usually given a scheduled time of 3 classes (120-140 minutes) some of the testing went overtime, depending on group size. For some of the fitness tests, not all the group were available to encourage their classmates. This may have affected the motivation of some of the students.

Chapter 6: Conclusions & Recommendations

The main aim of this study was to investigate the relationship between physical activity and health behaviours, the transtheoretical model and social support for Irish adolescents. The results of this study support other international findings of diminishing activity levels among this age group and confirm the premise that a large number of Irish adolescents are not active enough. Almost two-thirds of the adolescents did not meet the recommendations for regular physical activity and based on the knowledge that there is a high level of tracking from adolescence to adulthood, there is a high probability that many of these individuals will never be regularly active. Female adolescents are particularly at risk with 70% of females not meeting the current physical activity recommendations for their age. The profile of a not regularly active adolescent includes a number of characteristics that would be defined as physical and psychosocial risk factors. In comparison to adolescents who participate in regular physical activity, not regularly active adolescents scored significantly lower in the aerobic fitness test and reported lower leisure time physical activity. Not regularly active individuals also had lower levels of self-efficacy and social support.

With a quarter of the sample categorised as overweight or obese at such a young age, it is possible that the healthcare system will be overburdened in the future as the likelihood of being obese as an adult is greatly increased if overweight/obese as an adolescent. Therefore it is probable that the rates of obesity will continue to rise amongst the Irish population. For this reason physical activity is extremely important, as it is the only modifiable factor in energy expenditure.

Another important aim of the Take PART study was to examine the applicability of the TTM for Irish adolescents. The results generally support those of other studies of adolescent behaviour change, suggesting that adolescents behave similarly regardless of environment. Although the cross sectional nature of this research does not allow us to conclude about the antecedents of successful behaviour change, it does provide us with data that is useful for designing interventions. Also, because the results are similar to those of other studies, it is now possible for us to implement interventions that have been successful in other countries. However, there are some differences in the Take PART results that are useful for designing interventions in the Irish context. For example, the large amount of females in the

preparation stage warrants immediate intervention as this group are on the verge of becoming regular exercisers. Also the processes of change analysis indicated that Irish adolescents require and receive more social support the more active they are, unlike their American counterparts.

Self-efficacy should be an integral part of any physical activity intervention. Although the question remains as to whether self-efficacy follows increased physical activity or vice-versa, this variable is nevertheless an important factor for adolescents. Self-efficacy should be promoted via performance accomplishments, vicarious experiences, verbal persuasion and emotional arousal (Bandura, 1977).

The modelling approach indicates that physical activity behaviour can be predicted using the combination of self-efficacy, processes of change, social support and stage of change. It also shows that social support is a vital element of physical activity behaviour for Irish adolescents and efforts to include both peer and family support should be made when designing a physical activity programme.

Recommendations for Future Research

Although cross-sectional studies are beneficial for providing baseline data on behaviour, they are but a starting point. Further longitudinal studies are now needed to track individual's physical activity behaviours over time, in order to determine the mediators and moderators of stage transition. More conclusive evidence would also come from experimental stage-matched studies to conclude what types of interventions work for each stage. These longitudinal studies should also track health indicators such as BMI, blood pressure and smoking to determine the relationship between physical activity level and health.

Second, there is an increasing need for standardisation of measurement, particularly for self-report measures. The diversity of measures and the array of definitions being used make it extremely difficult to compare findings of other studies. The validity and reliability of the TTM measures for use with adolescent populations also requires more attention.

Finally, the hypothesized physical activity model including social support should be investigated further. A confirmatory analysis is required to test whether this model can accurately predict physical activity behaviour. This analysis should include two measurements over time, examining whether the self-report data from time 1 can predict the physical activity behaviour at time 2.

Recommendations for Intervention

Intervention is needed immediately to redress the health consequences of low levels of physical activity and physical inactivity. A two-strand approach is recommended to tackle this high level of inactivity. One strand should focus on reducing sedentary behaviours such as TV watching, while the other strand should emphasise ways of becoming active. Intervention can be made at four different levels and this framework can be seen in Table 5.1.

Table 5.1. Physical activity intervention levels and examples.

Level	Example
Level 1: Legislative/ Policy	Compulsory school PE, transport policies, access policies
Level 2: Organisational/ Environmental	Schools, workplace, mass media approaches, provision of safe bike routes
Level 3: Inter-personal	Peer led group, increased choice of activities, teaching approaches
Level 4: Individual	Written material, postal contact, GP referral

Note. Adapted from King, A. C. (1994). Clinical and Community Interventions to Promote and Support Physical Activity Participation. In R.K.Dishman (Ed.), *Advances in Exercise Adherence* (1st ed., pp. 183-212). Champaign, IL: Human Kinetics.

Intervention must be made at the highest levels to prevent the proportion of adolescents not meeting the guidelines increasing and also to reverse the trend of inactivity. An example of policy change is the smoking ban. Not only are non-smokers reaping the benefits of reduced secondary smoke, but also many smokers have cut-down or quit smoking. Policies such as compulsory PE in schools may have a huge impact on activity levels. However, whether or not policies or legislations come into effect regarding physical education, schools have a major role to play in encouraging students to lead a physically active lifestyle. In their review of interventions, Kahn et al. (2002) strongly recommend the use of school-based P.E. interventions to promote physical activity (Kahn et al., 2002). As a behavioural and social approach, this intervention focuses on increasing physical activity by teaching

widely applicable behavioural management skills and by organising the social environment to provide support for people trying to initiate or maintain behaviour change.

A school based P.E. intervention generally involves increasing the amount of time students spend in moderate to vigorous activity while in PE class. In order to achieve this increase, the amount of time spent in P.E. class must be increased or else the amount of time that the students are active in class must be increased. This is an effective approach, however it must involve policy and curriculum modification. There is a need for the Department of Education to standardise Physical Education, so that all children and youth receive adequate physical activity during school hours. This policy change must favour more P.E. classes and thus reflect the recent guidelines proposed for children and youth. Many of the schools sampled in the Take PART study did not offer P.E. to the senior cycle and in some cases, P.E. was not available to any students. In the schools that did include P.E. in the curriculum, classes varied from 40 minutes per week to 80 minutes per week, with one school providing an option of 4 classes (approx. 150 minutes) of P.E./ Games.

In addition to P.E., schools can promote physical activity in a variety of other ways. Similar to the IHF "busy breaks" initiative, 5-minute aerobic activities could be used to break up the school day. P.E. teachers could provide classroom teachers with ideas for these fitness breaks. A health promoting school should also have a strong community link, with schools coordinating physical activity with community agencies. School or community facilities could be used interchangeably allowing for lower costs and fewer cancellations. These facilities should be made available before and after school hours and during holiday periods. Teachers and parents should also establish extracurricular activities of a competitive and non-competitive nature. With the cooperation of local councils, schools should develop a safe route to school initiative to encourage walking and cycling. Perhaps making a traffic free zone during certain hours would encourage students to actively travel to school and also reduce parent's worry about their child's safety.

With one in five adolescents either overweight or obese, there is much concern for the future. Health promotion in Ireland is currently addressing some of the factors contributing to the obesity problem, for example:

- Healthy lunchtime policies (nutrition only)

- SPHE curriculum (Physical health including physical activity and nutrition)
- Bans and restrictions imposed by the Advertising Authority in Ireland.

Other factors lie outside the remit of the health sector, for example providing a safe physical environment for play. Many of the changes required need a joint approach between government departments, local government and local agencies which will be discussed later. Unfortunately, many of the initiatives developed to tackle obesity are focused on nutrition. However, if obesity is the end result of a continuous mismatch between energy expenditure and energy intake, physical activity should also be a major focus of health initiatives. For example, healthy lunchtime policies address the schools policy on lunchtime eating, such as vending machines, provision of healthy options in the canteen etc. Schools should also be attempting to provide more opportunities to be active during lunchtime.

The school system is an important site for health promotion as it occupies a large amount of the youths time and it's primary function is to provide a context for learning (Fox & Harris, 2003). Outside of physical education, many schools do not promote a physically active environment by discouraging break time activity or by not making school facilities accessible. Often students engage in sedentary behaviours during break time, for example sitting talking to friends or sitting in cafes or canteens. In some cases, the school does not have adequate indoor or outdoor facilities for students to be active during break time or else supervision from teachers is not made available. If students are to accumulate some of their physical activity minutes during school time, then provision must be made for short bouts of activity. The Irish Heart Foundation has recently launched a new initiative called "Busy Breaks" which is aimed at primary school children. The resource, which includes a CD and booklet for teachers, promotes activity in the classroom. Exercises such as marching and shoulder shrugs allow the child to be active in a small space. A session of activity is recommended to break up class lessons while also improving concentration of the children. Although this resource is designed for children, a similar resource for adolescents would be welcomed at intervals throughout the day especially during a double class.

Commuting also presents an opportunity for physical activity. Although many of the bus and train users might not have a choice in their mode of commuting, they should try to include some walking into their journey. For example, private bus

companies could drop students off further from the destination or students travelling on public transport could get off at a stop further from school. The low proportion of adolescents cycling to school in both the Take PART sample and also the Census national sample highlights an area that could be promoted. Students may not be cycling to school because of inadequate infrastructure. There are few cycle lanes in Ireland and students may not feel safe. Also, schools may not provide facilities for students to store their bikes. While more promotion of cycling is needed, local councils should also adapt the environment to make it bicycle friendly. Schools also have a responsibility in promoting this mode of transport by ensuring that there are adequate and safe storage areas for bicycles. The school, in conjunction with bicycle companies, could offer a special discount to students purchasing a bike and the relevant safety equipment.

Future interventions for not regularly active adolescents should concentrate on promoting self re-evaluation, self liberation and reinforcement management techniques. These processes displayed the most dramatic increases in use over the stages of change. Programmes that foster confidence and allow the adolescent to experience achievement would be ideal for adolescents in the early stages of change. Teachers, coaches and parents should organise tasks or competitions that will end with a positive result, thus allowing the adolescent to feel a sense of accomplishment. Also with the aid of some consciousness raising, the adolescents should be made aware of the variety of physical activity available, so that they realise that playing sport is not the only way of being physically active. Reinforcement management can be incorporated by rewarding positive behaviour such as active commuting and punishing negative behaviour such as sitting during lunchtime.

This study has also highlighted the importance of social support for active adolescents. Programmes should aim to incorporate some aspect of both parental and peer social support. The programme might try to get groups of friends trying out new forms of exercise together or promote parents to encourage their children to go bowling or skating instead of the cinema.

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Appendices

Appendix 1:

Telephone Script

Hello is that .....(check name of school). My name is .....and I am phoning you from the Centre for Sport Science and Health at Dublin City University. The Department of Education have given us the contact details of your school for a research study, however we are looking for a few specific details regarding your school. Would you have a few minutes to answer these questions?

If **YES,** proceed to section 2.

If **NO,** ask when a convenient time would be to call back or they would prefer it in letterform.

If letter is required, then check the address and find out whom best to address the letter to.

Section 2: Questions

1. How many students are there per year in the Senior Cycle i.e. 4th, 5th and 6th year (incl. Transition Year)?

   If the person is unable to answer this immediately, offer to phone back at another time or provide them with our fax number (7008888).
2. Ask for a gender breakdown for the above and an average age and class size.
3. What kind of indoor sports facilities have the school? Also, probe them on the size of the sports hall i.e. is it a full size Basketball court or is it quite small?
4. Do the school have holidays during the February/ March 2003 period? If so, when?
5. When are the school mock exams? Do they use the Sports Hall for this?

Thank you for your time. We may be in contact in the coming weeks with more details.

N.B.

If they want to know more details, tell them to contact:

Dr. Catherine Woods

Centre for Sport Science & Health

01-7008008

Appendix 2:

Parental Consent

Take PART

Physical Activity Research 4 Teenagers

DCU

Research Informed Consent form

Dear Parent,

In conjunction with the East Coast Area Health Board, the Centre for Sport Science and Health in DCU has put together the "Take PART" project. A number of studies have shown that the physical activity levels of 15 –17 year olds in Ireland decline dramatically. Therefore, the reason for this study is to establish activity patterns in 15-17 year olds and to examine the various influences on physical activity.

Your child's school has been randomly selected as part of a representative sample from the East Coast area. All participating students will be involved in the following:

- Completing a questionnaire, which asks about lifestyle and views on physical activity. These questions have been used with other young people.

- A qualified person will measure height, weight, hip and waist width, and blood pressure.

- A fitness test, which requires students to run between 2 lines (20m apart) in time to a bleep sound. This test will approximately last between 3 and 12 minutes, depending on the child's fitness level and is called the 20m shuttle run test.

- Attend a presentation on physical activity and health, given by the research team. This will be followed by a quiz, where prizes are up for grabs.

- Participants will also be given questionnaires for their parents to complete. The questionnaire will be similar to that completed by the child. An envelope will be provided to return the completed questionnaire to the research team, thus ensuring confidentiality.

I agree to allow my child _____**(please print childs name)** to take part in the "Take PART" project, which is being conducted by the Centre for Sport Science and Health at Dublin City University. I do not have to allow my child to be in this study if I do not want to. My child can stop taking part at any time without giving any reason and without penalty.

- The research is not expected to cause any harm or discomfort. My child can discontinue at any time. My child's grades will not be affected if my child decides to stop taking part.

- Any information collected about your child will be treated in the strictest confidence. Your child's identity will be coded, and all data will be kept in a secured location. No individual data will be presented at any stage. The final report will provide group details only.

- I can refuse to complete the parental questionnaire and this will not affect my child's participation.

- The project coordinator, Ms. Eimear Foley will answer any questions about the research, now or during the course of the project, and can be contacted at 01-7008470(w), 087-2923867 (m) or email: eimear.foley5@mail.dcu.ie

- I understand the study procedures described in the information sheet. My questions have been answered and I agree to allow my child to take part in this study.

Signed: _____
Signature

_____
Printed name

Date: _____

Witness: _____
Signature

_____
Printed name

Appendix 3:

Informed Consent - Student

Take PART

Physical Activity Research 4 Teenagers

DCU

Research Informed Consent form

1. **Project Title:**

The "Take PART" project: An investigation of the influences in physical activity among Irish 15-17 year olds.

2. **Introduction to the study:**

Physical activity has been shown to be extremely beneficial to young people, however in order to develop effective physical activity programmes for your age group, it is important that researchers understand what influences young people in Ireland to become active or remain active.

3. **This is what will happen during the research project:**

You will take part in a 2-hour session, which will take place in your school. The session will involve:

- Completing a questionnaire, which asks you about your lifestyle and your views on physical activity. These questions have been used with other students of your age.
- A qualified person will measure your height, weight, hip and waist width, and blood pressure.
- A fitness test, which requires you to run between 2 lines (20m apart) in time to a bleep sound. This test will approximately last between 3 and 12 minutes, depending on your fitness level and is called the 20m shuttle run test.
- Attend a presentation on physical activity and health, given by the research team. This will be followed by a quiz, where prizes are up for grabs.

- Following this session, each student will be required to bring a questionnaire home to their parent/guardian and return the completed questionnaire to their PE teacher.

All information gathered will be treated in the strictest confidence. To ensure this is the case, your name will be removed from your questionnaire and replaced with an ID number. Only the researcher and yourself will know the ID number.

Signature:

I have read and understood the information on this form. The researchers have answered all my questions. I consent to take part in this research project "An investigation of the influences on physical activity among Irish 15-17 year olds." I understand that I can withdraw from the study at any stage should I choose to do so. I will not be penalised in any way for doing this.

Signed: _____

Signature

_____

Printed name

Date: _____

Witness: _____

Signature

_____

Printed name

Appendix 4:

Questionnaire

Questionnaire
Physical Activity Research 4 Teenagers

Take PART

DCU

Take PART

Section 1: Physical Activity

Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are Hurling, Football, Aerobics, Basketball, Weight Training, Athletics, and Swimming.

For the following questions on physical activity, please try and think carefully and be as accurate as possible with your answers and only include activities of either moderate or vigorous intensity.

Light Intensity – Your heart rate and breathing rate are no different from what they are when you are standing, sitting, etc.

Moderate Intensity – Your heart rate and breathing rate are faster than normal. You may also sweat a little. Brisk walking or jogging are good examples of how you might feel.

Vigorous Intensity – Your heart rate is much faster and you have to breathe deeper and faster than normal. You will probably sweat. Playing football or squash are good examples of how you might feel. For these next two questions, add up all the time you spend in physical activity each day.

1. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?

0 ❑	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑	6 ❑	7 ❑
0 days	**1**	**2**	**3**	**4**	**5**	**6**	**7 days**

2. Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes per day?

0 ❑	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑	6 ❑	7 ❑
0 days	**1**	**2**	**3**	**4**	**5**	**6**	**7 days**

Time Spent Sitting

3. About how many hours a day do you usually watch television (including videos) in your free time?
Please tick one box for weekdays and one box for weekend

Weekdays		Weekend	
1 ❑	None at all	1 ❑	None at all
2 ❑	About half an hour a day	2 ❑	About half an hour a day
3 ❑	About 1 hour a day	3 ❑	About 1 hour a day
4 ❑	About 2 hours a day	4 ❑	About 2 hours a day
5 ❑	About 3 hours a day	5 ❑	About 3 hours a day
6 ❑	About 4 hours a day	6 ❑	About 4 hours a day
7 ❑	About 5 hours a day	7 ❑	About 5 hours a day
8 ❑	About 6 hours a day	8 ❑	About 6 hours a day
9 ❑	About 7 or more hours a day	9 ❑	About 7 or more hours a day

Take PART

REGULAR PHYSICAL ACTIVITY RELATES TO:

EXERCISE	e.g. weight-training, aerobics on most or all days of the week, for a minimum of 60 minutes per day.
SPORT	e.g. Hurling, Football, Basketball, Athletics, and Swimming etc. on most or all days of the week, for a minimum of 60 minutes per day
GENERAL	e.g. brisk walking, washing the car on most or all days of the week, for a minimum of 60 minutes per day
	Remember, do not include light intensity activities!

Q.6 Please read through all statements listed below and tick ONE box for the statement that best describes your physical activity over the last 6 months.

1.	I am not regularly physically active and do not intend to be so in the next 6 months	1 ❑
2.	I am not regularly physically active but am thinking about starting to do so in the next 6 months	2 ❑
3.	I do some physical activity but not enough to meet the description of regular physical activity given above. I intend to be physically active in the next 30 days	3 ❑
4.	I am regularly physically active but only began in the last 6 months	4 ❑
5.	I am regularly physically active and have been so for longer than 6 months	5 ❑

Take PART

Section 2: Physical Environment

1. Convenient Facilities

For each of these physical activity related places, please indicate if it is on a frequently travelled route (for example, to and from school) or within a 5-minute drive or 10-minute walk from your home. Also mark if you can afford to use this place.

	Is One Convenient to You?			Can You Afford to Use It?		
	No	Yes	Don't Know	No	Yes	Don't Know
1. Aerobic dance studio	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
2. Basketball court	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
3. Bike lane	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
4. Bowling alley	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
5. Golf course	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
6. Health spa/gym	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
7. Public park	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
8. Community Centre	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
9. Handball/Squash court	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
10. Running track	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
11. Skating rink	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
12. Soccer or football field	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
13. Sporting goods store	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
14. Swimming pool	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
15. Tennis court	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑
16. All Weather Pitch	1 ❑	2 ❑	3 ❑	1 ❑	2 ❑	3 ❑

2. Neighbourhood Surroundings

Please tick the box that best applies to you and your neighbourhood.

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
1. There are trees along the streets in my neighbourhood	1 ❑	2 ❑	3 ❑	4 ❑
2. Trees give shade for the footpaths in my neighbourhood	1 ❑	2 ❑	3 ❑	4 ❑

Take PART

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
9. When walking in my community there are a lot of exhaust fumes (such as from cars and buses)	1 ❑	2 ❑	3 ❑	4 ❑
10. I see and speak to other people when I am walking in my community.	1 ❑	2 ❑	3 ❑	4 ❑
11. There is a high crime rate in my community	1 ❑	2 ❑	3 ❑	4 ❑
12. The crime rate in my community makes it unsafe to go walking during the day	1 ❑	2 ❑	3 ❑	4 ❑
13. The crime rate in my community makes it unsafe to go walking at night	1 ❑	2 ❑	3 ❑	4 ❑

4. Transport to Schools

A. How do you usually travel to school?

Please tick one box only – for the longest distance of your usual journey to school.

By foot 1 ❑ Bicycle 2 ❑ Car 3 ❑ Bus 4 ❑

B. What distance is your journey and how long does it usually take?

_____ Miles _____ Minutes

5. Area of Residence

This question refers to the permanent area of residence or city you live in. Would you describe the place that you live in as:

1. 1 ❑ A big city (more than than 500, 000 inhabitants)
2. 2 ❑ Suburbs or outskirts of city (less than 500, 000 inhabitants.)
3. 3 ❑ Town (less than 50, 000 inhabitants)
4. 4 ❑ Village / Rural area (less than 5,000 inhabitants)

Take PART

	False	Mostly False	More False than True	More True than False	Mostly True	True
	1	2	3	4	5	6
20. I THINK I COULD RUN A LONG WAY WITHOUT GETTING TIRED	☐	☐	☐	☐	☐	☐
21. MY STOMACH IS TOO BIG	☐	☐	☐	☐	☐	☐
22. I AM BETTER AT SPORTS THAN MOST OF MY FRIENDS	☐	☐	☐	☐	☐	☐
23. I AM GOOD LOOKING	☐	☐	☐	☐	☐	☐
24. I WOULD DO WELL IN A TEST OF STRENGTH	☐	☐	☐	☐	☐	☐
25. I CAN BE PHYSICALLY ACTIVE FOR A LONG PERIOD OF TIME WITHOUT GETTING TIRED	☐	☐	☐	☐	☐	☐
26. OTHER PEOPLE THINK THAT I AM FAT	☐	☐	☐	☐	☐	☐
27. I PLAY SPORTS WELL	☐	☐	☐	☐	☐	☐
28. NOBODY THINKS THAT I'M GOOD LOOKING	☐	☐	☐	☐	☐	☐
29. I AM GOOD AT LIFTING HEAVY OBJECTS	☐	☐	☐	☐	☐	☐
30. I AM GOOD AT ENDURANCE ACTIVITIES LIKE DISTANCE RUNNING, AEROBICS, BICYCLING, SWIMMING ETC.	☐	☐	☐	☐	☐	☐

Take PART

Section 5: Physical Activity Behaviours

The following experiences can affect the physical activity habits of some people. Think of similar experiences you may be currently having or have had during the past month. Then rate how frequently the event occurs by circling the appropriate number. Please answer using the following 5-point scale:

(Please note that the word exercise is used in place of physical activity and can be any type of activity that increases your heart rate and makes you get out of breath some of the time.)

1	2	3	4	5
Never	**Seldom**	**Occasionally**	**Often**	**Repeatedly**

1.	I read articles to learn more about exercise	1	2	3	4	5
2.	I get upset when I see people who would benefit from exercise but choose not to exercise	1	2	3	4	5
3.	I realise that if I don't exercise regularly, I may get ill and be a burden to others	1	2	3	4	5
4.	I feel more confident when I exercise regularly	1	2	3	4	5
5.	I have noticed that many people know that exercise is good for them	1	2	3	4	5
6.	When I feel tired, I make myself exercise anyway because I know I will feel better afterwards	1	2	3	4	5
7.	I have a friend who encourages me to exercise when I don't feel up to it	1	2	3	4	5
8.	One of the rewards of regular exercise is that it improves my mood	1	2	3	4	5
9.	I tell myself that I can keep exercising if I try hard enough	1	2	3	4	5
10.	I keep a set of exercise clothes with me so I can exercise whenever I get the time	1	2	3	4	5
11.	I look for information related to exercise	1	2	3	4	5
12.	I am afraid of the results to my health if I do not exercise	1	2	3	4	5
13.	I think that by exercising regularly I will not be a burden to the healthcare system	1	2	3	4	5

Take PART

Use the scale below (0-10) to indicate how confident you are that you could be physically active in each of the following situations:

Not at all confident					Somewhat confident					Very confident
0	1	2	3	4	5	6	7	8	9	10

I am confident I can participate in regular physical activity when…

1. I am tired _____
2. I am in a bad mood _____
3. I feel I don't have time _____
4. I am on vacation _____
5. It is raining or snowing _____
6. I have homework to do _____
7. My friends call me to go out _____
8. I need to do house chores _____
9. There is a good TV show on _____
10. I am on my own _____

The following questions ask you about how important being physically active is to you under different circumstances. (Please tick one box only for each question)

	Not at all important				Extremely important
	1	2	3	4	5
• I would be healthier if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑
• I would feel better about myself if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑
• Other people would respect me more if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑
• I would probably be sore and uncomfortable if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑
• I would feel I was wasting my time if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑
• My friends and family would get to spend less time with me if I was regularly physically active	1 ❑	2 ❑	3 ❑	4 ❑	5 ❑

Take PART

Q.4 How many times a week do you usually eat or drink .. ? (Please tick one box for each line)

	1) never	2) less than once a week	3) once a week	4) 2-4 days a week	5) 5-6 days a week	6) once a day, every day	7) Every day, more than once
1. Fruits	❑	❑	❑	❑	❑	❑	❑
2. Vegetables	❑	❑	❑	❑	❑	❑	❑
3. Sweets (candy or chocolate)	❑	❑	❑	❑	❑	❑	❑
4. Coke or other soft drinks that contain sugar	❑	❑	❑	❑	❑	❑	❑
5. Any alcoholic drink	❑	❑	❑	❑	❑	❑	❑

Q. 5 Which of the following things did you do to control your weight during the last 12 months?

	Yes	No
a. Exercise	1 ❑	2 ❑
b. Skip meals	1 ❑	2 ❑
c. Fasting (go without eating for 24 hours or more)	1 ❑	2 ❑
d. Eat less sweets	1 ❑	2 ❑
e. Eat less fat	1 ❑	2 ❑
f. Drink less soft drinks	1 ❑	2 ❑
g. Eat less (smaller amounts)	1 ❑	2 ❑
h. Eat more fruit and/or vegetables	1 ❑	2 ❑
i. Drink more water	1 ❑	2 ❑
j. Restrict my diet to one or more food groups (eat only fruit and vegetables, drink only, eat only bread and water, ...)	1 ❑	2 ❑
k. Vomiting	1 ❑	2 ❑
l. Use diet pills or laxatives	1 ❑	2 ❑
m. Smoke more	1 ❑	2 ❑
n. Diet under supervision of a professional	1 ❑	2 ❑
o. Other, namely.....	1 ❑	2 ❑

Take PART

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Section 9: Diabetes

Q.1 Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?

Yes 1 ❑ No 2 ❑ Borderline 3 ❑ Refused 4 ❑ Don't know 5 ❑

Q.1 a) How old were you when a doctor or other health professional first told you that you had diabetes or sugar diabetes? _____

Q.1 b) Are you taking insulin?

Yes 1 ❑ No 2 ❑

Q.1 c) For how long have you been taking insulin? _____

Section 10: Personal Information

At present is your father....

a) A homemaker 1 ❑
b) Employed full time 2 ❑
c) Employed part time 3 ❑
d) Unemployed seeking work 4 ❑
e) Unemployed not seeking work 5 ❑
f) Self-Employed 6 ❑
g) Engaged in full time or part time education 7 ❑

If **YES,** please say in what place he works (for example: hospital, bank, restaurant)

_____

Please write down exactly what job he does there(for example: teacher, bus driver)

_____

At present is your mother....

a) A homemaker 1 ❑
b) Employed full time 2 ❑
c) Employed part time 3 ❑
d) Unemployed seeking work 4 ❑
e) Unemployed not seeking work 5 ❑
f) Self-Employed 6 ❑
g) Engaged in full time or part time education 7 ❑

If **YES,** please say in what place she works (for example: hospital, bank, restaurant)

_____

Please write down exactly what job she does there(for example: teacher, bus driver)

_____

You have now completed the questionnaire. Thank you for your time and cooperation. Please raise your hand and wait for a member of the research team to collect your questionnaire.

Thank You.

DCU Centre for Sport Science & Health