AN EXPLORATION OF DEMAND FOR PHYSICAL ACTIVITY

A thesis submitted for the degree of Doctor of Philosophy

by

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Abstract

The aim of this thesis is to contribute to the understanding of demand for physical activity. Given the government's target to increase the proportion of the population who are physically active, we need to know the determinants of demand for physical activity in order to identify target areas for policy. The relevant components of the demand function for physical activity, which were identified from reviews of theoretical and empirical literature on physical activity behaviour, established the need to account for costs (i.e. time and money costs) and perceived benefits among other factors in explaining physical activity behaviour. To date, there is a paucity of studies looking at this issue particularly from an economic perspective, mainly due to the lack of such data. This thesis therefore focussed on fitting varied econometric models (sample selection, count, linear, and probit) to understand how costs and perceived benefits explain indicators of physical activity behaviour (total time spent, number of days, and meeting the recommended level of participation or not); controlling for socio-economic, demographic and psychological variables. Data was sourced from the Health Survey for England (2006), Health Education Authority National Survey of Activity and Health (1991), and face-face interviews conducted in 2008 using a purposive sample. The findings suggest that time and money prices (costs per occasion of participation) of physical activity are inversely correlated with physical activity, and this is mitigated where the perceived benefits of physical activity, both health and non-health, are high. Indicators of demand were price inelastic except for meeting the recommended level of participation, which was highly responsive to changes in time price. Based on the findings, various policies including the use of economic instruments such as subsidies, particularly at the point of consumption, and mass media campaigns to increase awareness about the benefits of physical activity are discussed.

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List of Abbreviations

BHF	British Heart Foundation
DCMS	Department of Culture, Media and Sports
DH	Department of Health
ELM	Elaboration Likelihood Model
EFS	Expenditure and Food Survey
GDP	Gross Domestic Product
GHS	General Household Survey
HDI	Human Development Index
HEANSAH	Health Education Authority Survey of Activity & Health
HERG	Health Economics Research Group
HSE	Health Survey for England
NatCen	National Centre for Social Research
NHS	National Health Service
NICE	National Institute for Clinical Excellence
OLS	Ordinary Least Squares
PA	Physical Activity
PB	Perceived Benefits
RIPB	Relative Importance placed on Perceived Benefits
SCT	Social Cognitive Theory
TPB	Theory of Planned Behaviour
TPS	Taking Part Survey
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
UK	United Kingdom
UKDA	United Kingdom Data Archive
US	United States of America
WHO	World Health Organisation

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Dedication

Dedicated to my wife and daughter, Rita and Nana

CHAPTER 1 Introduction

Physical inactivity is a major public health concern in England (DCMS, 2008; DH, 2004, 2005). The final report of Lord Darzi's NHS Next Stage Review (2008) that set out a vision for the NHS for the 21st century, identified physical inactivity as a major risk factor and outlined the urgent need to make 'more people more physically active'. A similar recommendation was made by Wanless (2004), who identified that no national physical activity target 'owned' by the Department of Health was implemented by the NHS'; and therefore proposed the need for strategies to incorporate physical activity into the daily lives of people.

Lack of physical activity is rated among the top ten leading causes of death in 'high income countries' (WHO, 2002) and it is associated with about 20 health conditions including coronary heart disease, cancer, diabetes, and stroke (NICE, 2008). According to current estimates, physical inactivity also causes around 1.9 million deaths globally every year (WHO, 2009). Participation in physical activity has enormous health and non health benefits (WHO, 2009; BHF, 2008). Being physically active contributes to a 50% risk reduction for stroke and diabetes, and up to a 30% risk reduction for premature death (DH, 2009). It also improves psychological wellbeing and vitality (DH, 2004; Biddle et al., 2000).

Physical inactivity also leads to costs to the economy. It has been estimated that the low levels of participation in physical activity costs the economy in England about 8.2 billion pounds annually (DCMS/Strategy Unit, 2002). Between 1.1 billion pounds and 1.8 billion pounds of the estimated annual cost include the treatment of physical inactivity related diseases with the remaining costs resulting from productivity losses due to work absenteeism and premature deaths within the working population (DH, 2009).

Despite the benefits, recent evidence in England shows that only 40% of men and 28% of women participate in physical activity of moderate intensity for a minimum of five days each week or vigorous intensity for a minimum of twenty minutes on three days each week (NHS, 2009). Therefore about three quarters of women and two thirds of men in England are not doing enough physical activity to meet the minimum recommendation. Physical activity is multi-faceted and encompasses any energy expenditure resulting from skeletal movements and thus includes a wide range of activities such as sports and exercise, housework, as well as occupational activity (WHO, 2009). This thesis however focuses on the sports and exercise component of physical activity, as it represents a planned component often aimed at attaining health benefits (DH, 2004) and as such can be easily targeted by policies to improve uptake rates. In addition, it reduces measurement errors since sports and exercise activities are usually conducted in a premeditated mode and hence are easier to recall by respondents (Craig and Mindell, 2008).

Temporal trend analysis of adult participation in physical activity from 1997-2006 shows an increase in overall participation. However, the increase is relatively small, averaging less than 0.5% in men and less than 3% in women for the whole ten year period (Stamatakis and Chaudhury, 2008). The observed increase falls below the target set by the government to achieve a yearly increase of 2% - not just in overall participation but participation that meets the minimum recommendation (DH, 2005).

The target set out in 2002 by the Cabinet Office Strategy Unit, outlined: the ‘Game Plan’ strategy to increase adult physical activity participation in England from 32% to 50% in 2010, and up to 70% in 2020; and the ‘Legacy Action Plan’ to make the UK a ‘world leading sporting nation’ by helping ‘at least two million more people in England be more active by 2012’ (DCMS, 2008).

To achieve government targets, we need to understand individual decisions to participate in the quantity and intensity of physical activity. The challenge that public health practitioners face in securing adherence to physical activity guidelines might be attributed partially to the lack of understanding of the economic factors influencing the degree to which an individual participates and is willing to change their behaviour (Pratt et al., 2004; Humphreys and Ruseski, 2006, 2007). Programmes designed to increase physical activity, if successful, may require individuals to change the way they allocate their time and money, but choices of individuals may not match the understanding or interests of public health professionals. As "Choosing activity: a physical activity action plan" (DH, 2005) points out, the key challenge facing efforts to increase physical activity across populations is "how to encourage more people to become more active".

Economics can play a key role in developing our understanding of the preferences of individuals, as it examines how the scarce resources of time and money are traded off by individuals (Sturm, 2004). Physical activity, like most commodities, gives satisfaction; hence people may want a set of goods including physical activity in order to maximise their utility (Gratton and Taylor, 2000). However, given that their wants are unlimited whilst the ability to obtain them is restricted by time and money constraints, economics offers an assessment of the choices made amongst alternative options (Downward et al., 2009). To do this, the conditions that provide an explanation of choices are identified to provide a basis for predicting how individuals may respond to variations in those conditions (Cooke, 1994).

The application of economics to understanding physical activity participation is likely to challenge insights provided by 'public health' research because the two disciplines differ in their approaches (Brouwer et al., 2006). Public health centres on a normative approach, for example, what should be done to improve the physical activity participation without giving due recognition to, inter alia, the interests of individuals and a 'positive description' of the status quo - determinants of individual physical activity behaviour, which is offered by economics (Cawley, 2005). Individuals are however the 'best judges' of their welfare and hence efforts to improve lifestyle behaviour must incorporate individual interests in order to be effective (Wanless, 2004). For example, though public health strategies may focus on maximising health benefits from physical activity participation, people may just want to participate in physical activity for non health benefits or they may not want to participate at all. The role of economics in explaining adherence to healthy behaviour, and potentially helping public health to influence it, is becoming increasingly notable (Hill et al., 2004). However, to date, there is a paucity of research in economics on participation in physical activity (Downward, 2007; Humphreys and Ruseski, 2006; Farrell and Shields, 2002; Gratton and Taylor, 2000).

This thesis adopts a utility framework, which accounts for both costs and perceived benefits, to study demand for physical activity in England. This framework, whose operationalisation was facilitated with knowledge from psychological models, particularly for the specification of perceived benefits, was identified as the most suitable for explaining physical activity behaviour. As will be developed later in the literature review, this is because it was the strongest among several categories of models. The relevance of this framework to understanding the demand for physical activity (Wu and Porrel, 2000; Cawley, 2005; Humphreys and Ruseski, 2006) stems from the intuition that individuals have unlimited wants, including physical activity, but limited resources. How much is 'demanded' depends on its costs relative to perceived benefits. Thus, people may lead a sedentary lifestyle if the costs of doing physical activity are perceived to be higher than the perceived benefits.

The overarching aim of the thesis is to understand the demand for physical activity among adults (aged 16 years and above) in England. Of particular interest is assessing the impact of cost (i.e. time and money costs) and perceived benefits of physical activity participation on physical activity behaviour.

A number of benefits can be expected from analysing the demand for physical activity. First, it will provide a better understanding of the determinants of participation in physical activity by indicating potential target areas for modification of behaviour. Such information will inform the design of physical activity interventions and support the development of policies aimed at changing such behaviour in England to help determine efficient and effective allocation of resources. These interventions are justified not only from a health perspective, to improve physical inactivity and reduce the rates of morbidity and mortality, but also in economic terms. Market failure resulting from financial costs to the NHS as a result of physical inactivity, which indirectly transfers to the physically active individuals, is a notable justification for the introduction of policy interventions to achieve efficiency (Cawley, 2004). Second, in terms of research practice, this thesis will set a policy relevant framework of analysis that takes into account costs and perceived benefits in developing a strategy for physical activity interventions. Third, it will also quantitatively analyse the impact of these factors on physical activity behaviour.

The thesis is structured in eight chapters**.** Chapter 2 presents the literatures reviewed to determine the relevant components of the demand function for physical activity and inform their operationalisation, and consists of four sections. Section 1 assesses empirically tested economic models focussing on physical activity behaviour and a range of economic models considered likely to cover the demand for physical activity. Section 2 reviews literature on costs and physical activity participation and identifies these costs as including-membership fees, entrance charges, participation fees for sports competition, license fees, hire or purchase of sports apparel, travel costs, distance of travel, parking fees, transportation costs, insurance premiums, etc. Section 3 reviews theoretical psychological models to reflect on their potential contribution to the development of economic models, particularly in terms of the specification of perceived benefits related to physical activity participation. The decision to consider psychological models was made because studies of motivation tend to offer explanation of the benefits individuals associate with behaviour (Lea et al., 1987). In addition, the efficacy of such models to explain physical activity behaviour has been well established (Spencer et al., 2006). Section 4 focusses on empirical literature about perceived benefits of physical activity participation in England.

Chapter 3 describes the theoretical framework for the empirical research and considers what evidence could be used to test the framework empirically using English or UK specific data.

Chapter 4 offers an exploration of the role of perceived benefits controlling for other factors (including the relative importance placed on the perceived benefits) in explaining physical activity participation. The main analysis involved econometric estimations (binary regression models) using data from Health Education Authority National Survey of Activity and Health (HEANSAH) 1991.

Chapter 5 considers the role of cost (among other factors) in determining physical activity participation. The chapter uses econometric models such as bivariate probit selection models to assess the impact of time costs (measured with proxies) on physical activity behaviour with data from the Health Survey for England (2006).

Chapter 6 begins to fill the gap observed in data collection on costs and physical activity participation in England. This chapter covers the development of a questionnaire on both time and money costs related to physical activity participation, and a pre-testing phase which included expert evaluation, cognitive interviews, and respondent debriefing to assess the standard properties (e.g. validity, reliability) of the questionnaire. Emphasis was placed on costs because questions on perceived benefits exist in the HEANSAH (1991) and, since these questions had been developed and administered using an English population, it was considered constructive to replicate them in a future survey.

Chapter 7 reports the results from an illustrative survey using the developed questionnaire. The chapter offers a complete empirical testing of the theoretical framework, by examining the role of costs and perceived benefits in determining demand for physical activity.

Chapter 8, which is the concluding chapter, covers the key contributions of this thesis and identifies the limitations. It also reports the policy implications of the findings and identifies areas for future research.

This thesis will contribute to knowledge in a variety of ways including; first, it identifies a theoretical economic framework, which accounts for both costs and perceived benefits, as most suitable for explaining the demand for physical activity. The operationalisation of the model also establishes the usefulness of complementing the application of economic theory with knowledge from psychological models, particularly for the specification of perceived benefits.

Second, it tackles the issue of inadequate data on costs that currently hinders the analysis of demand for physical activity in England by developing, pre-testing and piloting a questionnaire on costs of physical activity participation.

Third, it provides the first empirical analysis in the UK that explains both time and money costs and perceived benefits of participating in physical activity whilst accounting for a range of ‘control’ variables. The analysis shows that time and money costs deter participation in physical activity but that this is mitigated when perceived benefits are high.

In terms of policy relevance, it has identified subsidies as potentially effective tools to encourage physical activity participation in England by reducing the costs of participation. To ensure that people meet the recommended level of participation, these subsidies should be large (above 50%) because small reductions in costs (around 25%) could lead to people doing only an additional half a day of physical activity per month but the latter about 3 additional days. However, it would be interesting to discover whether such policies would be considered cost-effective.

This thesis has begun to influence the research agenda of the Department of Health (DH). Based on the gap identified in terms of relevant data for costs and perceived benefits, the DH has agreed to fund a nationally representative follow-up survey to the Health Survey for England (HSE) 2008 to collect data on costs (time and money) and perceived benefits of physical activity. This follow-up survey has been approved by the Information Centre of the NHS, sponsors of the HSE, and preparations are being made with the National Centre for Social Research (NatCen) to develop and test the final survey instrument which is based on the questionnaire developed in this thesis.

CHAPTER 2 Literature review

The aim of this chapter is to identify relevant components of the demand function for physical activity and inform their operationalisation. To achieve this, four literature reviews were conducted. Section 1 examines economic models of physical activity behaviour. Section 2 aims at contributing to conceptualisation of costs associated with physical activity behaviour. Section 3 assesses the role of psychological models to contribute to the development of economic models. Section 4 informs the operationalisation of perceived benefits relevant to physical activity participation in England.

Section 1 Review of economic theories of physical activity behaviour

2.1.1 Introduction

Chapter 1 indicated the usefulness of applying economic theory to explain physical activity behaviour. However, to date, economic theory has been drawn upon rarely within health economics to explain and predict behaviour change, even for physical activity behaviour (Downward, 2007; Hale, 2000). Failing to steer such research with theory could affect its contribution because direction may be lacking (Redding et al., 2000).

The aim of section 1 is to evaluate theoretical economic models of physical activity that have been tested empirically. It is important, however, to recognise that economic theories that potentially explain physical activity behaviour may be varied as demand for physical activity is likely to include investment characteristics; impacts on the time available for productive activities as well as consumption characteristics; and utility as a result of changing health. For example, physical activity participation may reflect an unavoidable life style or active choice; it could be related to working hours and the demand for leisure or may influence household welfare and the derived demand for health.

To account for potentially relevant economic theories, section 1 reviews empirically tested theories on physical activity behaviour, and a range of economic theories considered likely to cover the complex demand for physical activity: leisure-consumption decisions, health behaviour, household allocation of time, and labour supply. The objectives are to: (a) identify types of existing models that could explain the demand for physical activity; (b) determine how these models are specified; (c) assess their strengths and weaknesses; and (d) discover a set of potentially significant predictors of participation in physical activity.

The remaining part of section 1 presents the methods used to search and review the literature, results of the review and the discussion respectively.

2.1.2 Methods

The methods cover search strategy, selection criteria, and the schema for extracting data from the reviewed papers. These methods were formulated not only to locate theories that have explicitly set out to explain physical activity behaviour but also those determining variables that could be suitable proxies for physical activity.

Search strategy

The literature search, which was undertaken between 10th March and 8th September 2006, involved 6 electronic databases (Web of knowledge, Scopus[1], IBSS, Econlit, JSTOR and Econpapers). The free text terms are presented in Appendix 2.1.1 and included two terms ('exercise' and 'fitness') used in searches by NICE (2006). Search terms were contrived to retrieve papers on behaviour related to physical activity, health, leisure and allocation of time. These terms were modified to suit individual databases, given the nature of the search engines. For example IBSS and Web of Knowledge allowed only a limited number of search terms while other databases returned terms such as "need*", "want*", "model", "theor*" with irrelevant papers. Terms like "not sociolog*",

[1] It includes 100% coverage of Medline.

“not psycholog*”, “not agricult*” were also introduced to reduce irrelevant returns.

Selection criteria

A selected paper had to satisfy all the requirements of the following criteria.

1. To present economic theory that explains demand for leisure, health, physical activity or their combination.
2. The theory must be empirically tested and the data for the empirical testing should come from a high income country.[2]
3. Should set out a model and test it empirically. This is to avoid studies primarily based on atheoretical empirical analysis.
4. Written in English language as there were no resources for translation.

Review questions

Selected papers were reviewed against a set of 30 questions. These questions extracted data from reviewed papers in four main areas: background data, specification of model, strengths and weaknesses, and main findings. Appendix 2.1.2 provides the full set of review questions.

The questions related to background data intended to identify basic characteristics about the studies such as authors and year of publication. The specification of model questions was designed to highlight the arguments of models and to reveal variables influencing economic behaviour.

Questions on strengths and weakness aimed at assessing the potential ability of model to explain participation in physical activity in terms of its general validity and applicability to the research context. To do so, strengths and weaknesses of the research proffered by authors and personal assessment of models both generally and with respect to the research context were considered. The personal assessments were conducted via questions developed based on a set of contextual

[2] Since the focus of the research is England, theories tested in countries in the same income bracket like England are more likely to be easily applicable. The analogy stems from the relationship between GDP and leisure (Coombs, 2006). The Human Development Index (HDI) from the 2005 report was used as the criterion for identifying high-income countries, with countries having an HDI of 0.8 classified in the high-income bracket (Watkins, 2005). HDI is used by the UNDP (United Nations Development Programme) to measure the standard of living of countries, with Gross Domestic Product (GDP) being one of its main dimensions. (Watkins, 2005).

and general criteria. The latter was based on the attributes of a good model specified in Gujarati (2006)[3] and intended to assess the ability of models to predict their associated hypotheses and the validity of the techniques (observable via model diagnostics) used. The underlying assumption here was that an appropriate economics theoretical model ought to be verifiable by empirical testing (Freidman, 1953). For the contextual criteria, the emphasis was to examine the applicability of models to the context of this thesis in terms of unit of analysis (individual), population ('general adults'), and specification of dependent variable (physical activity).

Data extracted on the main results of studies and the evidence on significant predictors of the dependent variable constituted the main findings.

2.1.3 Results

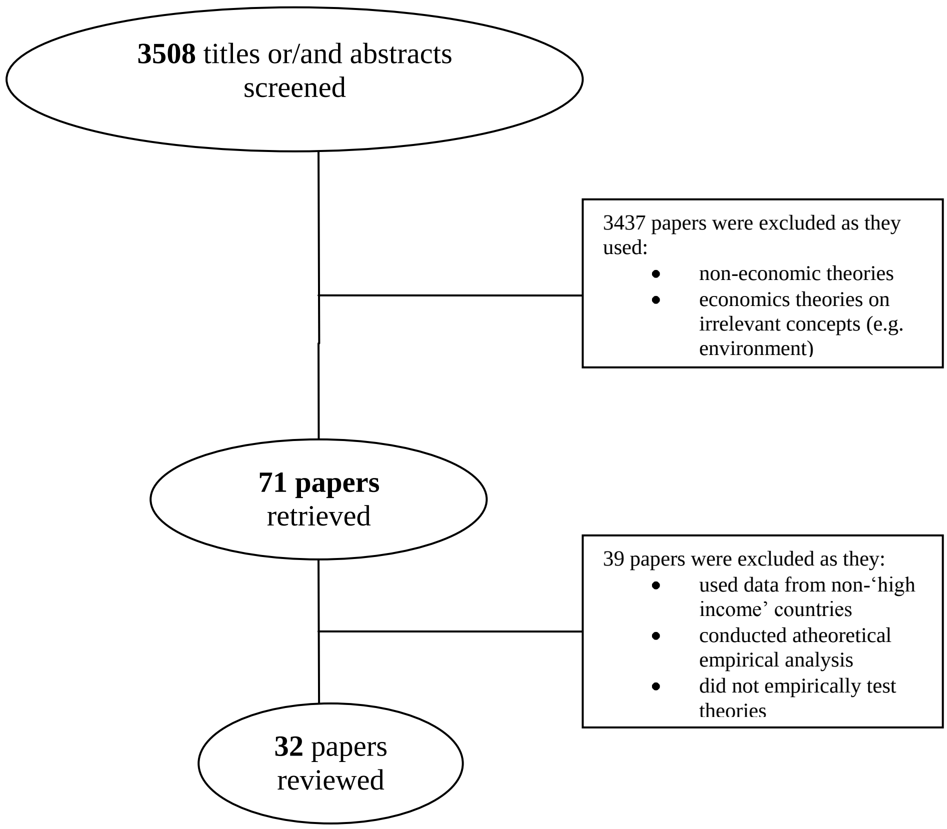
The results cover the background data of reviewed papers, description of methods, and a summary of main findings.

2.1.3.1 Background data

Figure 2.1.1 shows that titles or/ and abstracts of 3508 papers produced by the search were screened and led to identification and retrieval of 71 papers. These retrieved papers were further examined for inclusion using the selection criteria. A total of 39 papers did not merit inclusion leading to the selection of 32 papers for review. Appendix 2.1.3 lists the 32 papers reviewed.

[3] According to Gujarati (2006), the attributes of a good econometric model are: parsimony (i.e. should include key variables and exclude irrelevant variables); goodness of fit (i.e. should explain a high variation in the predicted variable); theoretical consistency (i.e. the coefficients of the predictors should have the correct signs); identifiable (i.e. the estimated parameters should have exclusive values); predictive power (i.e. the empirical predications should support the theory).

Figure 2. 1. 1 Selection of papers



The origin of the reviewed papers spanned 4 continents with 20 papers from the US, 9 from Europe (2 each from UK, Holland and France; and 1 each from Denmark, Germany and Sweden), 2 from Japan and 1 from Australia. Fifteen papers were published between 1991 and 2000.

Although they had different specific aims, a categorisation of the papers was attempted based on their broad aims. Six main categories were generated. First, papers that examined the *leisure-consumption choice* (n=10) of households and individuals fall under one category. Second, 9 papers investigated *health behaviour*. The third category includes 5 papers that investigated the *allocation of time decisions* of households and individuals. 3 papers had a common aim of examining decisions related to *labour supply*. The penultimate and last categories consist of 3 papers, which were designed to address behaviour related to *household production*, and 2 papers related to *participation in physical activity* respectively.

2.1.3.2 Unit of analysis

The theoretical formulation of 63% (n=20) of the papers focussed on individuals, with the rest focussing on households as the unit of analysis (see Table 2.1.1 for details). The proportion of studies focussed on individuals within the 6 categories of studies was highest (100%) for physical activity category followed by the leisure-consumption category (89%). For households, the proportion however was highest (100%) for the household production category followed by the ‘allocation of time’ category (80%). Looking at the distribution across categories of studies indicates that majority (n=16) of the papers that considered the individual as the unit of analysis emerged from leisure-consumption and health behaviour categories.

Table 2. 1. 1 Distribution of observed types of unit of analysis by categories of studies

Category	Individual	Household
Leisure- consumption	80% (n=8)	20% (n=2)
Health behaviour	89% (n=8)	11% (n=1)
Allocation of time	20% (n=1)	80% (n=4)
Labour supply	33% (n=1)	67% (n=2)
Household production	-	100% (n=3)
Physical activity behaviour	100% (n=2)	-

Percentages are calculated based on observations within and not across categories

The composition of the household tended to vary among studies: 67% (8 out of 12) described a two-person household where there was mostly (i.e. 5 out of the 8 studies) ‘interconnectedness’ of decisions, while the remaining studies specified a single person household. Three categories of studies accounted for the ‘interconnectedness’ of decisions, which indicated situations of explicit account of bargaining regarding say the sharing of available resources in the household or joint reaction to changes in wages (see Table 2.1.2). For example, wage increases leading to forward bending labour supply curves for workers but backward sloping supply curves for their spouses (Klaveren van et al., 2006). This was evident in studies where the two members of the household were specified as marriage partners.

Notwithstanding the unit of analysis[4] used, the influence of 'other people'[5] on decision making of representative agent(s) may be accounted for in theoretical formulation. This was facilitated via the inclusion of an extra argument in the utility function, with such an argument specified in practice as the children, or/and spouse of the representative agent(s). A few studies (n=12) from all categories of studies except physical activity behaviour used this approach, with majority (n=7) found in the health behaviour and household production categories (Table 2.1.2).

Table 2. 1. 2 Observation of 'interconnectedness' of decisions or the influence of 'other people' by categories

Category	'Interconnectedness' of decisions	Influence of other people
Leisure- consumption		✓
Health behaviour		✓
Allocation of time	✓	✓
Labour supply	✓	✓
Household production	✓	✓
Physical activity behaviour		

As shown in Table 2.1.2, allocation of time, labour supply, and household production categories specified both the 'interconnectedness' of decisions and the influence of other people in formulating the decision making of representative agents (either individuals or households). The physical activity behaviour category did neither.

2.1.3.3 Specification of theoretical models

The theoretical models employed by the papers had an analogous approach based on the utility framework. Under assumption of rational choice, an individual attempts to maximise his utility reflecting own preferences. The arguments of the utility function were mainly specified as physical activity, leisure, health, and composite good[6], with an extra argument representing general characteristics of the representative agent. This utility function was subject to either money budget

[4] Though majority (n=7) of them used household as the unit of analysis.
[5] This refers to other people apart from the representative agents comprising the unit of analysis in consideration.
[6] A set of other consumption goods.

or/and time budget constraints. A full income constraint may be derived by combining the time and money budget constraints, so that full income specified as income available to the representative agent if he were to spend all his time in the labour market, covers the costs of arguments in the utility function. The intuition behind the full income constraint was usually to offer a distinct resource constraint that combines time and goods under the notion that time is convertible into goods via income.

There were, however, differences across and within the categories of studies with regard to the structure and components of the utility function, as well as the construction of constraints (Appendix 2.1.4 provides a descriptive summary of the models used by individual papers) and these main differences are outlined next.

Structure and components of the utility function

The structure of the utility function tended to be specified as single stage (i.e. single utility function) though one study in the leisure-consumption category (Barnett, 1979) used a two stage structure (i.e. dual utility function). Barnett (1979) described a two-stage utility function that represented the consumer as maximising utility from consumption-leisure preferences, which was constrained by total income available at full employment level. The underlying premise of this utility function is the "shadow world" (i.e. under Kuhn Tucker conditions, the price of leisure is equal to wage rate and income level adjusted to full employment where the per capita of labour supply is not constrained by per capita labour demanded). This utility function was split into labour supply (where the consumer allocates full income over leisure and aggregate commodity consumption expenditure) and consumption functions (the consumer allocates aggregate expenditure over goods subject to a budget constraint). However, since conditions for the two-stage model did not exist, a Rotterdam model[7] unifying both consumption decision function and the labour supply function was estimated at the aggregate level.

[7] This shows the share of average expenditure on a set of goods in the transition period (i.e. period before the present year and the present year) must be equal to the total real per capita income, during that period, plus the price of the set of goods consumed.

Regarding the components of the utility function used in the literature, differences were noted across and within the categories of studies, as described below.

The standard arguments in the utility function presented by the **leisure consumption theories** were leisure and a ‘composite good’. The dynamic nature of these arguments may be accounted for in the utility function by incorporating linear function state parameters, which represents stock of habits that affect the preference for the arguments, using a Stone Geary utility function[8] (Phlips, 1978). The preference for leisure was found to emerge from the trade-off hypothesis involving non working time (i.e. leisure) and working time. Leisure was seen as a residual of working time, and constituted a utility whereas working time gives a disutility. In practice, leisure encompassed variety of activities including sports participation (Kooreman and Kapetyn, 1987). The ‘composite good’ referred to a set of consumption goods that included durables, non-durables, and semi-durables. Few leisure-consumption studies (n=2) included additional arguments in the utility function. For example, Owen (1971) introduced *market recreation (*specified in practice as motion picture admissions, sporting goods, television sets, radios, phonographs, and other recreational goods and services) in the utility function. The assumption was market recreation and leisure can be used together but are not necessarily complements as they could be substitutes. Atroistic (1982) also noted that the utility function was not made of only leisure and consumption goods, but also the job characteristics (denoted in practice as responsibilities, training, aspirations, targets and financial benefits of current job) of the representative agent.

The **health behaviour** studies mainly described the arguments of the utility function as health and consumption goods. Health was specified in practice as self reported assessment of general health condition or utilisation of health services by the representative agent, where the latter may be professional care or self care (Bentzen et al., 1989; Propper 2000). Dustman and Windmeijer (2000) however, offered a different specification by defining health as the participation

[8] The Stone Geary utility function allows the introduction of parameters as the utility function consists of consumption of goods and parameters that affects the level of consumption.

in sporting activities or not. The majority (60%) of papers in this category followed Grossman (1972) by noting that health is an investment involving the combination of both time and market inputs. Extra arguments introduced in the utility function specified in this category were leisure, and other goods affecting health. Sickles and Yazbeck (1998) argued that leisure and health are jointly determined because labour supply depends on the health of the individual whilst the production of health also requires leisure time input; hence modelling the health production model ought to indicate leisure as an argument in the utility function. Alternatively, Rosenweig et al. (1983) in estimating the household production of health of the child assumed a utility function that accounted for other goods affecting health of the child. These goods were specified in practice as the purchase of cigarettes (specified in practice as cost per packet of cigarettes) and milk (specified in practice as price per quart of milk).

Household production studies assumed interdependent utilities in household, which were a function of consumption goods (i.e. home produced goods and market goods) and leisure. The production of home-produced goods (e.g. meals) produced were assumed to use both time inputs of members of the household and intermediate market goods. On the other hand, market goods consisted of intermediate (i.e. raw materials for meal preparation) and finished products (e.g. meals from restaurant). One of the three household production studies described time spent on child care services as an extra argument in the utility function of the household. Measured in practice as 23 hours per week, Van Den Brink and Groot (1997) defined time spent on child care services as time allotted for child care production by mothers.

Similar to the household production models, the **labour supply** studies mainly specified a collective utility model of the household. However, the utility maximisers were identified as spouses living in the household which was not necessarily so in the case of former category. Spouses were assumed to maximise their preferences for leisure and consumption goods in addition to joint household care (Klaveren et al., 2000) and public domestic good (Couprie, 2003). No information was provided on the practical specification of joint household care but public domestic good was described as a non-rivalrous household produced good. There was however an exception in the case of Feather (2000), where the utility maximiser was an individual who maximised only the consumption of goods and leisure.

Studies in the **allocation of time** category stated the utility maximiser as allocating time to labour and non labour activities (i.e. leisure) with the former accruing disutility and the latter, utility. One study in this category, however, assumed utility to be maximised based on a range of preferences. Bhat (2004) was however a rare case, as he assumed a wider range of preferences that included: home social activities[9], home recreational activities[10], out of home social activities[11], out of home recreational activities[12], out of home shopping activities[13].

For the **physical activity behaviour studies**, the utility function was principally made up of physical activity and consumption goods. However, unlike the other categories, a preference (i.e. physical activity) of the utility maximiser was explicitly indicated by two arguments in the utility function. The two separate arguments represented physical activity participation, and duration of participation (given participation) decisions respectively (Humphreys and Ruseski, 2006). The intuition was to establish the essential behavioural decisions related to physical activity as separate though related. In practice, physical activity was specified in two ways: first, frequency of participation in light (e.g. walking, dancing, gardening, golfing, and bowling) and vigorous activities (e.g. aerobics, running, swimming, and cycling) (Wu and Porrel, 2000), and; secondly, participation or not, and given participation the amount of time spent (Humphreys and Ruseski, 2006). The reference period used in both studies was the month prior to the survey date.

[9] Conversation at home.
[10] Watching TV, exercising, hobbies undertaken at home.
[11] Visiting family and friends.
[12] Same activities as home recreational activities but undertaken outside home.
[13] Non grocery shopping activities.

Constraints facing the utility function

Whilst the broad congruence across studies specified constraints facing utility maximisation, as money or/and time constraints, there existed slight variations in specification across and within the main types of studies.

For the **leisure consumption studies**, the majority (n=7) specified only the money budget constraints where the total income available to the utility maximiser was expected to cover the costs of preferences for leisure and consumption goods. Total income available was described as income accrued from labour, and non labour ventures such as real returns from holding securities/treasury bills (Koskevic, 1999; Eichenbaum et al., 1988) or welfare benefits (Kooreman and Kapteyn, 1987). An additional money constraint in the form of wage/job characteristics relationship was identified in this category. According to Atrostic (1982), the wage/job characteristics relationship constrains the maximization of utility because wage income is a function of job characteristics which in turn is determined by human capital. In other words, human capital moderates the relationship between wage and job characteristics, with the former depending on demographic variables (e.g. marital status or socio economic status of parents of the utility maximiser).

Only a few studies (n=3) in the **leisure consumption** category identified time as a constraint facing the utility function. In such cases, a dual characterisation of time uses was established, with time available either used for labour or leisure. This dual characterisation was identified via the income-leisure trade off hypothesis, indicating that leisure being a residual of labour had an opportunity cost in foregone earnings.

Unlike the previous category, the majority of **health behaviour studies** (n=5) specified a health production function as an additional constraint alongside time or/and money budget constraints. The health production function indicates that health is generated using time and market inputs (e.g. medical services). The specification of the time and money budget constraints was similar to that already described except in Cameron et al. (1998), where the latter was typified in three ways. These specifications, which were based on varying expectations about health status, comprised the following: First, without knowledge of his health state, the individual allocates exogenous income between insurance and savings; Second, when he realises his health status, he then shares his savings between contingent consumption and assets that yields an interest between the 2 time periods, and; Third, income accrued from interests in the second period is allocated between consumption in that period and net health expenditure[14].

Similar to the former category, an additional constraint in the form of a production function was generally specified together with time and money budget constraints in the **household production** category. Here, the production function was to produce household goods for consumption or sale in the market. If these goods were marketable, a variable representing the shadow price of market consumption goods was included in the budget constraint. The production of goods in the household may be explicitly planned by its members, who also determined how available resources were shared in the household (Arronson, 2001). Each member of the household had a bargaining strength which was a function of factors like exogenous income in devising the sharing rule[15], and was thus likely to dwindle if for example the exogenous income falls. The sharing rule was assumed to result in a pareto-efficient outcome. Another constraint on the utility function of the household was the *extra environmental parameter* (EEP) defined as the opportunity cost of marriage, that is extra income available to household member if the household were to be dissolved. EEP constrains the utility function not via effects on the costs of arguments but through effects on the share of full income available to each household member.

The **labour supply** category also described a production function as an additional constraint, though a different technology was assumed. The studies tended to explicitly observe time as the only inputs allocated by members of the household to the production of household goods. Even so, the time allocated by the male member may be more effective than that of the female member (Klaveren et al., 2006).

[14] The difference between prices of health care and the reimbursement of the insurance premium.

[15] The sharing rule was evident across other categories (i.e. allocation of time, and labour supply models) though the household production category tended to specify it most.

Thus far, a dual characterisation of time uses has been mainly specified in the time constraint, suggesting that total time available is either used to work in the market (i.e. labour) or for leisure, with leisure being a broad indicator for all non working time activities. The same observation cannot however be said about the specification of time constraint in the **allocation of time category**. Here, a 'triple' time use approach was introduced: total time available was assumed to be used for labour, leisure and housework, where leisure and housework are not identical because the latter but not the former can be done by a 'surrogate' (Gronau, 1977). The introduction of housework into the time constraint was facilitated under the condition that the marginal rate of substitution between goods and consumption time is equal to the marginal product of work at home. The wage rate, which is the opportunity cost of time, was expected to be equal to the marginal rate of substitution between goods and consumption time. Hence, the allocation of time among the leisure, labour and housework is mediated by changes in opportunity cost of time. For example, an increase in opportunity cost of time will lead to a fall in time for housework, but the effect on labour supply would depend on the nature of the fall in the latter. If the magnitude of the fall is more than the increase (if it so occurs) in leisure, labour supply will rise. The direction of the effect on leisure was however treated as indeterminate as it depends on the offsetting substitution (negative) and income effects (positive).

A further extension of the time budget constraint was also considered by specifying a 'quadruple' time use approach, where total time available is used for labour, housework, leisure or travel time to labour (Solberg and Wong, 1991). The assumption here was that there is a cost involved in doing labour which ought to be accounted for explicitly in the specification of constraints facing the utility function. The cost of doing labour was indicated as involving both fixed money cost (i.e. child care fees) and cost of commuting (i.e. travel time), with the latter entering the money budget constraint and the former the time constraint.

The **physical activity behaviour** category also set out a dual constraint framework consisting of time and money budget constraints but with slight modifications. First, the money budget constraint explicitly accounted for two separate costs[16] related to physical activity but a single cost component for composite goods. The assumption was that the costs of doing physical activity may involve both time and money costs, with the latter covering fixed and variable costs. Examples of fixed costs were given as membership fees to sports clubs while variable costs included costs for maintenance of equipment for participation in physical activity (Humphreys and Ruseski, 2006). Second, the time constraint was specified by explicitly limiting available time to non working time. In other words, the time available to cover the time costs of preferences (i.e. physical activity and composite goods) of the utility maximiser was defined as time not used to do labour. Thus, indicating an implicit reference to the dichotomy of work and non-working though the arguments of the latter (i.e. time costs for physical activity and the 'composite good') was explicitly specified in the time constraint.

2.1.3.4 Nature of data

To test the theoretical models empirically, all the papers used secondary data. The principal source of data was official national surveys. For example, Kong and Lee (1998) and Asano (1997) used data compiled by US Federal National Income Reserve and the Japanese Ministry of Labour respectively. For purposes of subsequent empirical analysis of this thesis, the source of data used by the UK studies needs mentioning. Both UK studies (Couprie, 2003; Propper, 2000) used the British Panel Household Survey, which started in 1991 and uses a randomly representative sample of residents in Great Britain. The content of the questionnaire covers range of issues including general health behaviour, physical activity behaviour, and socio economic information.

The majority (n=18) of studies considered only the working population sample with the remaining using both working and non-working population samples (see Table 2.1.3). Regarding the use of only the working population, the leisure-consumption category had the highest (80%) and health behaviour category the least (22%) (Table 2.1.3). Conversely, the health behaviour category reported the

[16] The concept of budget constraint may be similar to that of the previous category (specifically Solberg and Wong, 1991), but in the latter case, the fixed cost terms though noted were not explicitly included the money budget constraint.

highest (78%) use of both non-working and working sample type and leisure consumption category the least.

Table 2. 1. 3 Distribution of observed types of samples used by categories of studies

Category	Working population	Non working & working population
Leisure- consumption	80% (n=8)	20% (n=2)
Health behaviour	22% (n=2)	78% (n=7)
Allocation of time	60% (n=3)	40% (n=2)
Labour supply	67% (n=2)	33% (n=1)
Household production	67% (n=2)	33% (n=1)
Physical activity behaviour	50% (n=1)	50% (n=1)

Percentages are calculated based on observations within and not across categories

2.1.3.5 Model diagnostics

All categories of studies provided evidence on diagnostics of the empirical estimation of theoretical models, with the physical activity behaviour category reporting the most application (100%) as shown in Table 2.1.4. These diagnostics covered assessing specification errors and goodness of fit. The measures employed to assess goodness of fit were Komolgorov-Smirnov test and the r-squared while Wald test, Hausman test, Box-Cox transformation, and Durbin–Watson test were used for the former. Where reported (n=25)[17], results of these tests indicated good specification or/and fit of the models.

Table 2. 1. 4 Distribution of application of model diagnostics by categories of studies

Category	Specification test	Goodness of fit
Leisure-consumption	50% (n=5)	50% (n=5)
Health behaviour	67% (n=6)	67% (n=6)
Allocation of time	60% (n=3)	60% (n=3)
Labour supply	33% (n=1)	67% (n=2)
Household production	100% (n=3)	67% (n=2)
Physical activity behaviour	100% (n=2)	100% (n=2)

Percentages are calculated based on observations within and not across categories

In cases (n=20) where identification of estimated parameters of a model was an issue due to the use of system of equations, the studies addressed it using

[17] Not every study that reported specification test also reported goodness of fit and vice versa.

instrumental variables, though insufficient justification was given regarding the choice of variables used as instruments.

2.1.3.6 Challenges faced by authors of papers

More than half of the studies (n=18) presented the limitations that challenged their research. The most stated limitation (n=13) was the lack of data on explanatory variables for empirical analysis. Within this, data on costs related to the dependent variables was often absent and particularly so for wages. Other author-stated limitations were associated with the use of overly restrictive assumptions such as characterising household production technology as having constant returns to scale (Arronson et al., 2001) and the lack of generalisability of findings to the target populations (Asano, 1997; Wales and Woodland, 1977).

Although nearly all categories had a mixture of missing data and limiting assumptions the physical activity behaviour category only stated lack of data as the principal limitation of their empirical analysis. For example, Humphreys and Ruseski (2006) and Wu and Porrel (2000) recognised physical activity participation as determined by associated costs and perceived benefits, but they could not account for those explanatory factors sufficiently in their empirical analysis due to lack of data. Perceived benefits were thus treated as unobservable factors whereas costs were measured with proxies (i.e. employment status, educational status) (Humphreys and Ruseski, 2007). Similarly, Wu and Porrel (2000) could not account for either perceived benefits or costs in their empirical analysis and thus treated them as unobservable factors.

2.1.3.7 Main empirical findings

Notwithstanding the challenges to interpretation of the empirical evidence, the results still provide useful insights into aspects of consumer behaviour covering the preference of leisure, health, and physical activity. These findings, which also provided empirical support[18] for the theoretical models, are summarised below by category of study.

[18] All categories of models showed predictive power

The findings of the **leisure consumption category** generally concerned the type of good leisure is, though the body of evidence was incongruent. Leisure was found to be either a normal or an inferior good. Atroistic (1982), Barnett (1979), and Owen (1971) found leisure to be a normal good as increases in income resulted in positive change in the demand for leisure with income elasticities ranging from 0.282 to 0.673 (p value (p) < 0.05). Nevertheless, using data covering a 15-year period (1957-1972), Darrough (1997) found money expenditures on leisure[19] to reduce with increases in income as part of expenditure on leisure was transferred to other goods. Income elasticity of demand for leisure over the 15 year period ranged between -0.122 and -0.367 (p <0.10). In addition, leisure was found to be a habit forming good in the sense that the number of hours spent on leisure rises over time (Phlips, 1978). Over a 28 year period (1939-1967), weekly labour hours dropped from 46 hours to 41 hours, with employees not willing to work up to 50 hours per week.

The demand for health care was also found to be positively affected by level of income in the **health behaviour category**, with increases in income leading to an increased demand for health care though with relatively small magnitude of effect, ranging between 0.001 and 0.32[20] (Propper, 2000; Cameron et al., 1998; Rosenweig et al., 1983). However, not accounting for the inter-temporal dimension (i.e. using only cross sectional data) in analysing the effect of income (particularly wage income) on health behaviour may not be helpful for policy direction as life cycle wages rather than one period wage profile of individuals gives a better indication of demand for health (Dustman and Windmeijer, 2000). Observing the effect of hourly wages between 1984 and 1995, evolutionary wage effects on health investment were found to be negative (coefficient (CF) =-0.031, p < 0.10), but the effect of permanent wage was found to be positive (CF= 0.148 to 36.168, p < 0.10). Thus though health support policies may tend to target people with current low wages, it may be a wrong target group, since these people may in fact, be investing heavily in health because of their high life cycle wage profile. Similar to the previous study, Sickles and Yazbeck (1998) advocated the use of a dynamic framework for empirical analysis of health

[19] Leisure was specified as present leisure in that study.
[20] The p values were set between 1% and 10% level.

behaviour, but with a different purpose: to assess the influence of past health on the current preference for health. Their findings indicated a small effect (CF=0.010, $p < 0.05$) of past health on current preference for health but a big effect (CF=0.897, $p < 0.05$) was found for current health.

The findings of the **labour supply** category point to the 'interconnectedness' of decisions within the household regarding the leisure-labour trade off or the share of income. The former was evident via the differential effects of own wage, and spousal wage elasticities of demand for leisure and the supply of labour, while the latter concerned the effect of joint expenditures on goods on the share of income in the household. The share of income available to each partner was found to be negatively influenced (marginal effect (ME) =-0.257 to -2.644; $p < 0.10$) by joint expenditures of both partners (Couprie, 2003). On the other hand, an increment in own wages resulted in forward bending labour supply curves for individuals but backward sloping labour supply curves for their spouses (Klaveren et al., 2006). The effect of wage on labour supply could however vary under differing labour market conditions (i.e. over employment or underemployment). With over-employment conditions (i.e. people willing to work fewer hours for lower salary), elasticities of labour supply were zero until the wage rate equals (or increases in non labour income) the shadow wage. Conversely, during underemployment conditions (i.e. people are not willing to reduce their working hours), elasticities of labour supply are large and close to infinity, pending the wage decreasing or non labour income increasing (Feather, 2000).

Studies in the **allocation of time** category also found increases in own and spousal wages to lead to forward and backward sloping supply curves correspondingly (Alenezi and Walden, 2004; Gronau, 1977). The responsiveness to changes in wage may however differ by gender, as a 1% change in own wages leads to a positive effect on labour supply for married women that is approximately twice that of their husbands (Gronau, 1977). Solberg and Wong (1991) however found the opposite, as the labour supply curves of married partners were backward sloping in reaction to own and spousal wage increases, reporting labour supply elasticities of -0.133 and -0.077 ($p < 0.01$) respectively.

Labour supply also responds to the presence of children with negative and positive reactions in females and males respectively (Alenezi and Walden, 2004). Yet, for recreational activities, the allocation of time for both males and females increases with the presence of children (CF=0.980, t-statistic=2.93) or the presence of adults (CF=0.274, t-statistic=2.52) (Bhat, 2004).

The effect of the presence of children on the allocation of time in the household was also observed in the **household production** category. Time expenditures on household work and leisure were found to be determined by the presence of children in the household (Arronson et al., 2001). The presence of young children (0-6 years) was negatively related to the leisure participation of males (CF=-261.11; $p < 0.05$) and female (CF=-236.99; $p < 0.05$) but positively related to housework (CF=0.247; $p < 0.05$). Similarly, Lecoq (2000) found time expenditures on household activities except meal production to increase with the number of children (within age groups: 0-7 years, and 15-24 years) though no effect was in Van den Brink and Groot (1997).

In the **physical activity behaviour** category, findings covered the correlation between physical activity participation and associated costs. Using a model that suggest that individuals weigh associated costs and perceived benefits in uptake of physical activity, Humphreys and Ruseski (2006) empirically tested the predications of this model but with emphasis on costs. The results provided support for the model with costs, related to physical activity participation (i.e. opportunity cost of time: proxied with education and employment status), found to influence both the decisions to participate or not, and the amount of time spent given participation. The effect of cost was mixed, as people with high cost were either more likely (CF= 0.054 to 0.156; $p < 0.01$) or less likely (CF=-0.008; $p < 0.05$) to participate in physical activity. Given participation, a similar effect of cost was found for time spent on participation but with higher impacts (CF=-0.178 to 31; $p < 0.01$). The mixed effect of costs was expected given the interplay of offsetting income and substitution effects (Humphreys and Ruseski, 2006). The income effect corresponds to a positive effect of opportunity cost of time. This means that since high opportunity cost of time indicates high hourly earnings, hence increases in income, the participation in physical activity given it is a normal good will be positively related with changes in the opportunity cost of time. The substitution effect however works in the opposite direction and signifies a negative effect of the opportunity cost of time. It suggests that an increase in the opportunity cost of time, indicated by high hourly earnings, makes non-labour uses of time non-profitable and hence people tend to substitute time spent on non-labour time use (including physical activity participation) for the time spent in the labour market, to increase earnings.

In the **physical activity behaviour** category, Wu and Porrel (2000) also interpreted their results in terms of perceived benefits. They showed that people who do 'blue collar' jobs that have high physical demands also tend to do more (CF=0.05, p value < 0.01) vigorous physical activity because they have higher expectation of health benefits from that type of physical activity.

Table 2.1.5[21] presents variables showed across the categories` of studies to be significant predictors of physical activity behaviour and its proxies (i.e. leisure, and health). The signs of these predictors were reported to be theoretically consistent, although majority of studies (95%) did not clearly spell out the expected signs prior to empirical estimation.

The findings suggest that physical activity participation may be potentially correlated with socio-economic, health and environmental variables. Age, education, income, health status and gender were the frequently studied predictors though, based on effect sizes, income, employment status and education appear to have the strongest influence. Among these factors, education, gender, and health status seem to have consistent positive impacts but that of income, age and employment status seem indeterminate.

[21] In the third column of this table, the number of studies reporting a variable is provided before parentheses; the number of studies reporting a signed effect is provided before brackets; and signs of effects are in brackets: positive significant effect(-), negative significant effect (-), mixed significant effect(~), and no significant effect (0).

Table 2. 1. 5 Factors determining behaviour of physical activity and its proxies (i.e. leisure, and health)

Independent variables	**Specification of independent variables**	**Dependent variables**[22]			**Range of 'effect sizes'**[23]			
					marginal effects		*coefficients*	
		Physical activity	Leisure	Health	lowest	highest	lowest	highest
Income	Total income of individuals/household	1 [1(~)]	7 [3+), 1(-), 1(~), 2(0)]	4 [3(+), 1(~)]	0.00	2.09	0.03	36.17
Employment status (employed)	Employed or not		1 [1(+)]	1 [1(~)]	0.05	0.12	0.34	
Working hours	Number of working hours per week	1 [1(-)]					0.04	
Education (high)	(a) Highest educational level attained (b) Number of years spent in education	1 [1(+)]	1[1(+)]	3 [3(+)]	0.01	0.02	0.03	102.95
Age	Age in years	2 [1(-), 1(~)]	3 [1(+), 1(-), 1(~)]	3 [2(+), 1(-)]			0.01	37.55
Gender (male)	Male or Female	2 [2(+)]	1 [1(+)]	1 [1(-)]	0.00	0.05	0.02	0.59
Children in h'hold (presence/high)	(a) Number of children in household (b) Presence of children in household or not	1 [1(0)]	6 [1(+), 4(-)1(~)]				0.00	236.99
Adults in household	Number of adults in household		1 [1(+)]				0.27	
Health status (bad)	(a) Self assessment of general health status (b) Number of illness reported in the past 2 weeks	2 [2(-)]		2 [1(+), 1(-)]	0.00	0.02	0.07	0.34
Ethnicity (non white)	Non white or White	2 [2(~)]	1 [1(-)]				0.04	2.39
Marital status (married)	Married or not	2 [2(-)]					0.01	18.01
Smoking (high)	Number of cigarettes smokers daily	1 [1(-)]		1 [1(-)]	0.00	0.002	0.04	0.09
Drinking (high)	Amount of alcohol consumption daily	1 [1(~)]					0.04	0.07
Seasonal effect (winter)	Month indicator of interview	1 [1(-)]	1 [1(-)]				0.03	0.96
Travel time to work	Total minutes spent travelling to and from work		1 [1(-)]				1.	4.70
Number of bicycles in h'hold (high)	Number of bicycles available in the household		1 [1(+)]				0.11	

[22] Statistical levels were set at p values (between 1% and 10%) or t value > 1
[23] Not all studies report marginal effects. Hence, coefficients are presented in this table. Also, to ensure clarity, qualitative effects are not presented here, as the purpose of this column is to show the magnitude of the impact of variables

Independent variables	**Specification of independent variables**	**Dependent variables**[22]			**Range of 'effect sizes'**[23]			
					marginal effects		*coefficients*	
		Physical activity	Leisure	Health	lowest	highest	lowest	highest
Driving license (Have)	Have driver's license or not		1 [1(+)]				1.40	
Stress level (high)	Stress associated with job	1 [1(~)]					0.03	0.04
Job characteristics (high)	Level of physical effort required by job	1 [1(+)]					0.05	
Region of residence	State in which respondent resides	1[(1~)]			n/a[24]			
Exercise level of spouse (high)	Amount of exercise done by spouse	1 [1(+)]					0.10	0.16

Number of studies reporting the variable is provided before parentheses
Number of studies reporting a particular signed effect is provided before brackets
Signs of effects are in brackets: positive significant effect (+), negative significant effect (-), mixed significant effect (~), and no significant effect (0)

[24] Humphreys and Ruseski (2006) reported that region of residence showed a mixed effect but they did report the 'effect size'

2.1.4 Discussion

This section has found a range of empirically tested economic theories reflecting the complexity of demand for physical activity: leisure-consumption, health behaviour, allocation of time, labour supply, household production, and physical activity. The principal purpose of the review was to reflect on the potential ability of these theories to explain the physical activity behaviour leading to the adoption of a theoretical framework for empirical analysis.

The results point to the paucity of theoretical models developed directly for physical activity behaviour within the field of economics. Only two studies were found and only one (i.e. Humphreys and Ruseski, 2006) formulated and solved a consumer choice model of physical activity behaviour. The results across the categories of studies indicate a utility framework as the underlying theory of consumer behaviour investigated to date. It is recognised that the search strategy that was steered by the potential characterisation of demand for physical activity behaviour may have excluded relevant theories. On the other hand, the inclusion of general terms such as 'model*' and 'theor*' could have still picked up any such theories. In addition, the intention was to capture range of economic theories considered likely to cover the complex demand for physical activity. The remainder of this discussion considers which type of model is the strongest, and the potential challenges emanating from the adoption of a theoretical framework alongside implications for future research. At the end, the selection of potential predictors of physical activity participation for future empirical work is discussed.

Which category of model is the strongest?

The contextual and general criteria set out (in section 2.1.2) to identify the strengths and weakness was used as the basis for answering this question. Notably, all types of models satisfied these criteria though with varying degrees of satisfaction.

The leisure-consumption models showed good strength because conceptually leisure[25] was congruent to physical activity, with the former specified as non working time (via the labour-leisure trade-off hypothesis) that covers host of activities including the latter (Kooreman and Kapetyn, 1987). In addition, most models (80%) specified the individual as the unit of analysis though a few used general population (20%). The limitation of this category was that half of the models could not demonstrate good specification and fit.

Health behaviour models however, proved stronger in terms of both contextual and general criteria, with most (67%) showing good specification while more (89%) used the individual as the representative agent in their theoretical formulation. Also, the concept of health was analogous to physical activity because its production involves the use of time and market inputs (Dustman and Windmeijer, 2000) though 40% of the studies did not follow this specification.

Based on general criteria, household production models were among the strongest as all had good specification, with most (67%) having good fit. On the other hand, these models were weak in terms of contextual criteria as each, in theory, used the household as the unit and rarely (33%) employed a general population for empirics.

Following the labour-leisure trade off hypothesis in the theoretical specification of leisure, labour supply models also agreed with the concept of physical activity. Nonetheless, they were the weakest in terms of showing good specification (33%) or using general population (33%) and individuals as representative agents (33%), but largely demonstrated good fit (67%).

Models in the allocation of time category had empirical support but the precision of those findings could be challenged in a few studies (i.e. Gronau, 1977; Alenezi and Walden, 2004) because the econometric techniques are debatable. Gronau (1977) ran separate regression models by employment status but failed to account for selectivity bias, though he recognised the problem. Thus his estimates could be biased because sample censoring may lead to selectivity bias

[25] Notably, leisure was selected as the proxy in all the models except health behaviour and physical activity

when the observed data is not randomly selected (Heckman, 1979). Alenezi and Walden (2004) argued that selection bias could be ignored on the basis that the unobserved sample was small (i.e. 3%). However this may not be appropriate as, by addressing selection bias, can ensure that the unobserved sample is not systematically different from the observed (Jones, 2007). Also, the operationalisation of leisure in this category may differ from physical activity because it sometimes (n=2) appeared to indicate sedentariness. In such cases, leisure was specified in practice to include activities such as watching TV, and 'non physical care of children' (Bhat, 2005; Solberg and Wong, 1991). Nevertheless, more than half of the models in this category showed good specification and fit

The physical activity category was the strongest in terms of general criteria because each model in that category showed good fit and specification. It also had the closest match to context of this current research, with 100% specification of physical activity as the dependent variable and individuals as basis for both theoretical formulation and empirical analysis though half used general population for the latter. Yet, an anomaly was observed in relation to the specification of types of physical activities (i.e. vigorous activity or light activity). In Wu and Porrel (2000), vigorous physical activity included activities such as aerobics, running, and swimming. Such a specification may not be valid as vigorous activity is dependent not only on type of activity but intensity of participation as well (Craig and Mindell, 2008).

Questions could be raised concerning the extent to which all categories of models satisfied the criteria. First, the instrumental variables used by the studies to account for the problem of identification were only listed devoid of clear justification of their selection. Ideally, justification should be provided in order for readers to assess the suitability of those instruments in terms of their correlation with other predictors or the error term. Not only does the absence of such a justification hamper readers' assessment of the methodological rigour of the studies but also the applicability of the instruments to different settings.

Second, evidence on the theoretical consistency of the models was not clearly spelt out as the majority (95%) did not describe or provide justification of a priori expectations about findings. This practice makes it difficult to assess the validity of the findings especially for non-economic variables. For example, how does one examine the finding on the impact of the region of residence on physical activity behaviour, without a priori and justified expectations indicated?

The conclusion that physical activity category is the best category suggests that the theoretical basis of this thesis will lean heavily on that category, but with useful inputs from the other categories. The adapted theoretical model therefore follows the approaches of Wu and Porrel (2000) and Humphreys and Ruseski (2006).

How should the theoretical model for physical activity be characterised?

The adapted theoretical model is described as follows (mathematical formulation is forthcoming in chapter 3).

It is posited that a rational individual seeks to maximise his utility reflecting his preference for physical activity, subject to both time and budget constraints. The maximisation process of this utility function involves the individuals' comparison of costs and the perceived benefits of physical activity participation. In other words, the decision[26] to participate in physical activity is influenced by the consideration of associated costs and perceived benefits. These costs may include time costs and costs of market inputs, since similar to the health behaviour and the household production categories, the assumption is that arguments of the utility function require both time and market inputs.

This conceptual framework suggests that people tend to consume more physical activity if the perceived benefit outweighs the costs. Increasing the perceived benefits or decreasing costs (holding each other and other things constant) would encourage physical activity behaviour (Finkelstein et al., 2008, Humphreys and

[26] It is must be noted that the decision to participate in physical activity may be consists of two separate but sequential decisions: (a) decision to participate or not (b) the level of participation, given participation (Humphreys and Ruseski, 2006). To simplify the model however the decision is assumed to a single decision though subsequent empirical analysis in the thesis may present variants specification of physical activity behaviour.

Ruseski, 2006) or preventative (Cohen, 1984). Hence, a fully explicable model of demand for physical activity ought to account for both costs and perceived benefits. To estimate such a model however presents challenges:

(a) What constitutes perceived benefits related to physical activity?

Conceptually, perceived benefits may be expressed in the form of utility gain (Cohen, 1984). However, not much insight was given about what the constituents of the utility gain are, in this review. Studies in the physical activity behaviour category tended to treat perceived benefit as an unobservable factor in their model formulation due to data limitations. A plausible explanation for the minimal guidance on perceived benefits could be attributed to the fact that the models tended to focus on explaining *how* (i.e. comparison of costs and perceived benefits) people make decisions rather than *why* (i.e. what the perceived benefits are?) they make those decisions. In the context of this research however, the *why* question about economic behaviour is equally deemed important[27] as the *how* question. Even so, inability to account for perceived benefits represents a partial view of the latter.

To fully understand and influence physical activity behaviour, we ought to know what these perceived benefits are; to afford their inclusion in strategies to promote uptake. Perceived benefits related to physical activity participation may just not be health related but non health as well. Notably, studies (n=2) in the health behaviour category tended to provide some insights about the perceived benefits of health investment. These included healthy improvement and economic benefits in the form of higher earning as better health affords the strength to undertake more market work (Dustmann and Windmeijer, 2000; Havemann et al., 1994). Notwithstanding, our question on what constitutes perceived benefits of physical activity participation still begs.

A review of non-economic theories related to physical activity behaviour may potentially contribute to a deeper understanding of these perceived benefits leading to a more fully explicable model of demand for physical activity. Such a

[27] This is because what motivates people in terms of physical activity could explain the level to which they do participate.

review is intended as complement rather alternative; with the aim of fully understanding what constitutes perceived benefits and their relationship to participation in physical activity (section 3 of this chapter undertakes such a review).

(b) How are costs related to physical activity participation operationalised?

Costs of physical activity participation were specified as time or/and money costs. Though more detail was given about the constituents of cost compared with perceived benefits, how these costs are operationalised was missing. In terms of money costs, none of the studies shed any knowledge on how to measure them in practice. Time costs, conceptualised as opportunity cost of time, were in practice measured by proxies (i.e. education and employment), owing to lack of data. To afford exploration of the impact of costs on participation, information is needed on types of costs related to physical activity participation and how they are measured in practice. Measuring these costs, may however be hindered by data inadequacy as scarce datasets on costs appeared to be the most author-stated limitation.

To what extent does this review inform the selection of potential predictors of physical activity participation?

A set of variables covering socio economic[28], health[29] and environmental[30] factors have been identified as possible explanators of physical activity participation. Evidence on these variables will guide the selection and measurement of covariates as well as formulation of their expected signs in empirical analysis. However, a number of issues concerning this evidence are worth noting.

First, whilst the validity of these variables may not be critiqued given the different context of the studies, it seems reasonable to assess their completeness in relation to explaining physical activity participation. Are any potential variables missing? This is important to know because the thrust of econometric

[28] These include income, employment status, gender, working hours, education, age, job characteristics, children in household, adults in household, ethnicity, marital status, number of bicycles, driving license, travel to work, exercise level of spouse.

[29] They are health status, smoking status, drinking status, stress level.

[30] They cover seasonal effect, and region of residence.

analysis is to control for predictors likely to have a correlation with the regressand for avoidance of biased inferences (Maddala, 2001). Future empirical research in this thesis is inclined to this view. It is therefore of concern that body mass index (BMI) was not used as a covariate particularly in the physical activity category, given that it has been found to be an important predictor (CF=-0.59 to -0.70; p >0.01) of physical activity behaviour (Schmidt et al., 1997; Lazarus et al., 1989). High BMI is a deterrent to participation in physical activity due to physiological and psychological reasons (Weiss et al., 2007). For example, overweight people may not only be prevented from doing physical activity due to bad health but also discrimination encountered in social settings. Hence, failure to account for this potential confounding effect may lead to inaccurate inferences.

Second, the future measurement of predictors ought to be clarified to fashion specifications suitable for this research context. This pertains to variables that reported alternative specifications of ‘same’ variable: education and health status, ‘presence of children in household’. In terms of education, if the intention is to access the influence of level of education, then it may be best specified as ‘highest educational level attained’ rather than the ‘number of years spent in education’. This is because the latter may not necessarily be indicative of the level of education particularly when period spent schooling is interspersed with breaks. For health status, the appropriate specification is the ‘self assessment of general health status’ and not the ‘number of illnesses reported in the past two weeks’. Due to the possibility of self care, the latter may not be a good indicator of person’s health state. In the case of ‘children in the household’, the ‘number of children in household’ is preferred to ‘presence of children in household’ as using the latter may mask potential detailed effect. For example, the effect of having two children may be different from five children. These justified specifications will be used as the basis for selection if alternative specifications arise in future empirical research.

Section 2 Review on costs related to physical activity behaviour

2.2.1 Introduction

Section 1 demonstrated limited evidence on the cost of participation in physical activity, and how they are measured. Therefore, section 2 aims to contribute to the conceptualisation of these costs and other factors related to physical activity participation. The objectives are to identify: (a) costs that have been found to accrue from participation in physical activity; (b) how these costs are measured in practice; (c) potential datasets on these costs (d) a set of possible significant predictors of physical activity behaviour; and (e) gaps in current research on these costs. To achieve these, a review of empirical literature on costs related to physical activity behaviour is conducted in section 2. The methods used in this study, and the results as well as discussion are presented as follows.

2.2.2 Methods

This section describes the search strategy used, and how the studies were selected and reviewed.

Search strategy

A literature search was conducted using two electronic databases (SCOPUS and SPORTS-DISCUSS) in December 2007[31]. SCOPUS is the largest[32] bibliographic database and indexes over 14,000 titles from science, technology, medicine (provides 100% coverage of Medline) and the social sciences, and it is updated daily. SPORTS DISCUSS covers sports research, from 1949 to date, and also provides full text for over 400 journals. References of selected papers were screened for relevant papers, and recommendations from authors of relevant papers were also sought. The free text search terms (see Appendix 2.2.1) used for the electronic databases were developed with inputs from the NICE review[33] and the earlier review conducted in section 1. These search terms were

[31] Literature since then were monitored via the activation of search alerts on the databases used.
[32]Brunel University (2007).Databases: http://www.brunel.ac.uk/life/study/library/databases#s[Accessed in December 2007].
[33] NICE (2006).Rapid review of cost effectiveness of physical activity interventions.

complemented by keywords obtained from an extemporized literature search with a similar objective, which preceded this review.

Selection criteria

A study was selected only if it satisfied all the following requirements:

1. Investigated costs related to physical activity participation
2. Written in English language as there were no resources for translation
3. Published between 1997 and 2007. Given that the purpose was to obtain information on the operationalisation of costs, capturing current methods was considered reasonable because it is likely to reflect developments in the area.

Review questions

Appendix 2.2.2 provides details of the full set of review questions that were devised to give information on basic (e.g. aim, author and year) and methodological features, as well as empirical findings of selected papers.

Regarding methodological features, the questions mainly covered nature of data/ analysis, specification of cost, measurement of physical activity, and the challenges that faced the research (i.e. author stated). These were intended to discover the costs of participation in physical activity and how they are specified in practice, in addition to potential datasets to inform future empirical work. Also, they were to offer a basis for evaluating the rigour of the methods used by the papers. Questions on empirical findings were to assess the evidence base on factors influencing physical activity behaviour (mainly costs) and inform the a priori expectations of future empirical analysis. In addition, these questions were expected to gather information on how other factors affecting physical activity participation are specified in practice; to inform the selection of potential covariates for this empirical analysis.

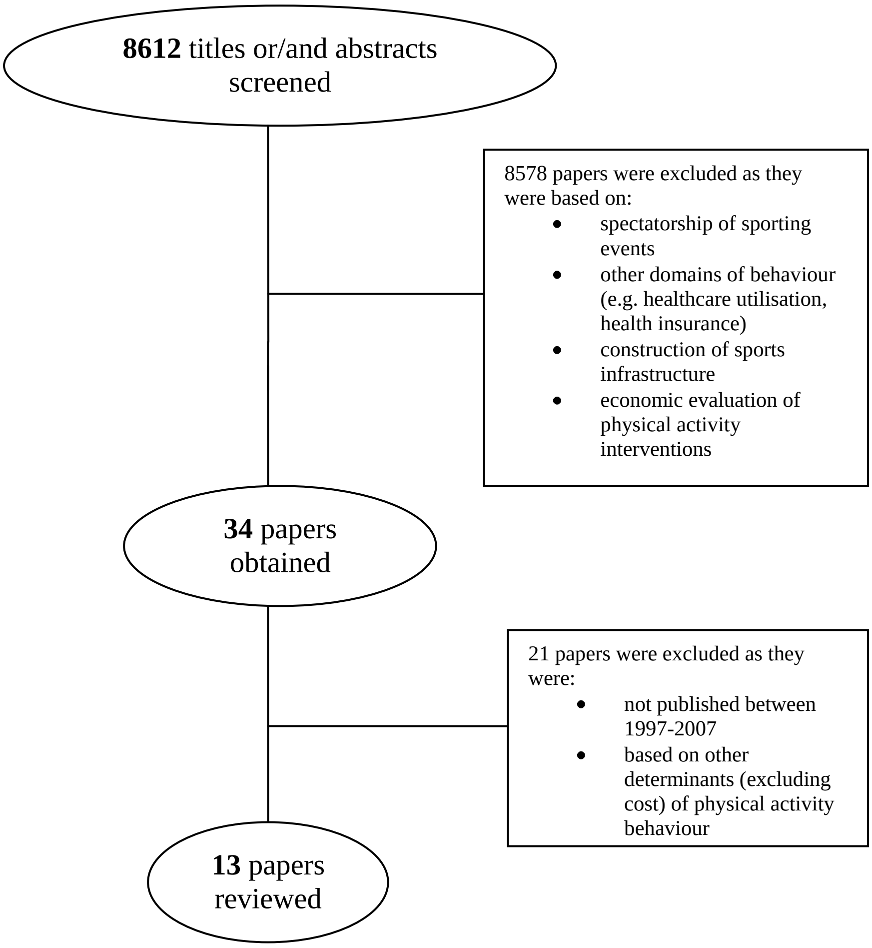
2.2.3 Results

The results cover the basic and methodological features of reviewed studies, with a summary of their empirical findings.

2.2.3.1 Basic features

The initial search yielded 8612 articles. After screening the titles or/and abstracts, 34 articles were identified and obtained but 13 met all the inclusion criteria (see Figure 2.2.1). Appendix 2.2.3 lists the papers selected for the review.

Figure 2. 2. 1 Selection of papers



The papers selected for review were drawn from 6 different countries. Five studies were from England; 2 each from US, Spain and Belgium while 1 each originated from Canada and Scotland. About 85% (n=11) of the papers reviewed were published between 2000 and 2007, with the remaining published in 1999. The literature principally centred on either attempting a general multivariate analysis of socio-economic factors[34] affecting physical activity participation

[34] With inference to cost related to physical activity participation.

(n=1); and general predications of the hypothesis emanating from theoretical and empirical economics literature (n=4). Other papers aimed at examining determinants/sources of sports-related expenditure (n=5); investigating how cost affects a prescribed exercise programme (n=1) or an exploration of the treatment of costs related to sports participation by consumers (n=2). A summary description of the papers is provided in Appendix 2.2.4.

2.2.3.2 Methodological features

Nature of data / analysis

The majority of papers either used solely primary data (n=6) or secondary data (n=5) for empirical analysis, with the remaining studies using both (n=2). Primary data collection was based on questionnaires and administered either by telephone or face to face interviews, or as self-completed questionnaires sent by post or on the web. Secondary data was accessed via records of local leisure/clubs health club centres or national datasets. Of the studies that collected primary data, a few (n=2) reported on the properties (e.g. reliability or validity) of the survey instruments used. Three of the 7 studies that applied secondary data, used UK based datasets, which are described below.

Table 2. 2. 1 Description of secondary datasets

Dataset	Description	Content of data
Health Survey for England (1997)	An annual cross sectional survey used to monitor trends in health of randomly selected general adult population (16 years plus) residing in England	Indicators of physical fitness and exercise, general health, nutrition health services and medical care
General Household Survey (1996; 2002)	An annual survey cross sectional survey used to collect data on a core topics affecting randomly selected samples from the general population of Great Britain	Indicators of physical fitness and exercise, general health, nutrition, health services and medical care, social indicators and quality of life
Family Expenditure Survey[35] (currently Expenditure and Food Survey)	A continuous cross sectional survey that collected data on the expenditure patterns of randomly selected households in the United Kingdom	Expenditure on participant sports; income, property and investment; social indicators; consumer behaviour

The studies described their samples differently but all bar one (n=12) used an adult sample (i.e. aged 16 years above). In that single case (Brown et al 2006), it

[35] This survey was cited by Davies (2002) as been a major source of data for expenditure data in UK.

was difficult to decipher the sample used as insufficient information was provided on the ages.

Most studies (n=10) reported using randomly selected samples, with 8 stating the method of sampling used. For the studies using primary data, few (n=2) provided information on the statistical justification for the sample sizes used. Five studies used samples from English population, with 3 using samples representative of the whole England, and the remaining using samples from specific regions of England.

Quantitative methods to analyse data involved either the use of regression models (n=10) or purely descriptive statistics (Brown et al., 2006; Coalter, 2004; Taks and Kessenne, 2000). While all those studies using the former provided justification for the statistical models used, only a few (n=4) reported information on the model diagnostics (Downward, 2007; Humphreys and Ruseski, 2007; Lera-Lopez and Rapun-Garate, 2005, 2007).

Specification of costs related to physical activity participation

Costs related to physical activity participation were principally operationalised as time and money costs. However, of the ten studies explicitly measuring costs, most (n=7) focussed on the latter with two considering both time and moneys costs, and one, only time costs (Humphreys and Ruseski, 2007). Data on costs was mainly collected as primary data (n=7) with only a few studies (n=3) using secondary data (Humphreys and Ruseski, 2007; Della Vigna and Malmendier, 2006; Davies, 2002).

The primary data offered a broader range of costs[36] compared with the secondary data though in both cases there was rare coverage of unit costs (Davies 2002). It is also worth noting that only a few studies (Taks et al., 1999; Taks and Kessenne, 2000; Lera-Lopez and Rapun-Garate, 2005, 2007) provided justification on the cost components that they sought to measure. In both studies,

[36] It captured all costs items on Table 2.2.2.

the justification was to capture relevant costs based on evidence from the literature.

A wide range of components of money costs was measured, with the studies showing weak agreement regarding the exact components of the composite money cost. However, patterns were observed with respect to specific money cost components across studies. Table 2.2.2 shows an overview of the money cost components measured by the studies and also provides an indication with respect to the common[37] cost components measured. The demarcation of those costs into direct and indirect cost[38] follows an approach described by Taks and Kessenne (2000).

Table 2. 2. 2 A summary of costs items measured

Types of cost	Components
Direct costs	membership fees (n=7); entrance charges (n=6); purchase of equipment (n=5); purchase of clothing (n=4); classes/instruction fees (n=4); training camps/sports holidays (n=3); rental/hiring of equipment (n=3); licenses (n=2); once only grants (n=2); registration fees for tournaments (n=1); rental/hiring of clothing (n=1); joining fees (n=1)
Indirect costs	travel cost[39] (n=5) refreshment cost (n=4); cost on club activities (n=2); medical care cost (n=2); body care cost (n=2); maintenance of equipment (n=2); cost of special nutrition (n=2); insurance charges (n=1); baby-sitting cost (n=1); other cost (n=1); cost of dormant sports equipment and apparel (n=1); purchase of videos books& sports magazines (n=1); subscriptions to sports magazines (n=1)

As shown in Table 2.2.2, the most frequently measured cost component was membership fees (n=7), followed by entrance charges (n=6). Of all the studies, Taks and Kessene (2000) provided the most comprehensive list of cost components as they captured all cost items (on Table 2.2.2) except 'subscriptions to sports magazines'.

[37] In terms of number of studies that measured that cost component.
[38] Direct costs are types of costs specifically identifiable with the participation of physical activity whilst indirect costs are those not specifically attributable to participation.
[39] Generally, all studies that measured travel cost took a global perspective (i.e. measuring just travel cost), however, a few studies (n=2) measured travel cost in terms of parking cost, and public transportation cost.

For time costs, in the three cases that it was measured, either distance travelled (n=2) or proxies were used (i.e. employment status, and educational attainment) due to data constraints. These two proxies were expected to indicate high opportunity cost of time as the labour market compensates for the costs of education and that high educational attainment is likely to reflect high wage earnings whereas being employed indicate the receipt of wage earnings (Humphreys and Ruseski, 2007).

All studies (n=9) that explicitly measured costs defined a reference period, with the majority specifying it as ‘last year’ (n=5) while the rest used either ‘last month’ (n=1), last ’10 weeks’ (n=1) or ‘day’ (n=2).

Measurement of physical activity

Physical activity behaviour was measured using self reports (n=11) and attendance records of either exercise referral scheme (n=1) or health clubs (n=1). All studies defined a reference period for the measurement of physical activity. The reference period was specified as ‘last four week/last year’ for self-reports and health clubs or for the duration of exercise referral schemes. Physical activity behaviour was operationalised as: level (i.e. frequency or duration) of participation (n=8); participation or not (n=3); choice of location of participation (n=1); and one study used a ‘dual-decision process’ involving two separate but sequential decisions: the participation decision (i.e. participate or not), and the level of participation (i.e. time duration) given participation. Only one study specified the intensity of participation in physical activity and did so by specifying ‘moderate intensity’ exercise (Tai et al., 1999).

Challenges that faced research

Less than half of the studies (n=4) indicated the limitations that challenged their research. The most stated limitation (2 out of 4) was the lack of data on cost related to physical activity participation. Owing to the lack of a measure of time cost (i.e. opportunity cost of time), Humphreys and Ruseski (2007) had to use proxies (e.g. employment status, educational status). In the case of Coalter (2004), inadequate data on fixed costs (e.g. equipment cost, cost of sports clothing and shoes) tended to under-value the total costs borne by respondents.

Other author-stated limitations were associated with the lack of rigour of statistical analyses due to the inability to control for potential confounders and the lack of generalisability of findings (Brown et al., 2006) as well as the potential over representation of the sample used with respect to the target population (Davies, 2002).

2.2.3.3 Empirical findings

A summary of main findings of the studies is provided in two parts: cost related to physical activity participation and; other factors affecting physical activity participation.

Cost related to physical activity participation

The findings indicated that money expenditure on physical activity participation was higher among frequent sports practitioners than non-frequent sports practitioners. This pattern was consistent across countries. The average spending on sports participation in the latter group was £84.59 per year (1997) compared with £686.65 per year (1997) among the former group, in Sheffield, England (Davies, 2002). Similarly, in Navarra, Spain, sports practitioners spent about €658 / £447[40] per year (in 2004) on sports participation, while less (€485 / £330 per year-2004) is spent by both non sports practitioners and sports practitioners (Lera-Lopez and Rapun-Garate, 2005).

Regarding the relative contribution of individual cost components to total expenditure, membership fees accounted for the largest percentage (27%) of sports expenditure for those who did sports at least once in the month or year prior to the survey date (Davies, 2002). Admission and hire of facilities accounted for a larger percentage of the sports expenditure by those engaged frequently in sports (i.e. 2-4 times in the last four weeks) in Sheffield (Davies, 2002). Among sports practitioners in Scotland, entrance charges emerged as the highest cost component (54%) followed by travel cost (34%) and refreshment cost (8%) (Coalter, 2004). However, the results from Taks and Kessene (2000) were slightly different as travel cost accounted for the largest amount of

[40] All currency conversions in this chapter was sourced from International Currency Converter (2009). Historical rates: http://www.iccfx.com/history.php (Accessed 10th May 2009).

expenditure (30%), followed by equipment purchase (25%), among a Belgian sample.

Across individual sports activities, golf emerged as the sport on which most was spent with an average expenditure on last occasion of participation as £10.56 (in 1997) among residents of Sheffield (Davies, 2002). This amount was approximately double the amount spent on each of the sports considered in that study. Cycling was the sport on which least was spent (£0.83 in 1997) (Davies, 2002). This finding was similar to that of Taks et al. (1999) who found active, adult Flemish males to spend most on golf (€4050 per year[41]) but least on swimming (€ 413 per year). In contrast, families in Belgium spent US$192.8 / £116 per year (1998) on skiing followed by cycling (US$152.46 / £92 per year-1998) with gymnastics having the lowest expenditure (US$10.55 /£6 per year - 1998) (Taks and Kessene, 2000).

A few studies (n=2) explicitly investigated the effect of unit cost on physical activity participation. Using a sample of 275,455 randomly selected US adults, Humphreys and Ruseski (2007) explored the impact of time cost (i.e. opportunity cost of time) on decisions to participate or not in physical activity and given participation, the total amount of time spent on physical activity. The results showed a significant positive relationship between opportunity cost of time and physical activity behaviour across individual sports activities. Opportunity cost of time was positively correlated with the decision to participate in outdoor recreation (CF =0.009; $p < 0.01$), group sports (CF=0.008; $p < 0.01$), walking (CF=0.072; $p < 0.01$) and individual sports (CF=0.084; $p < 0.01$). However, given participation, higher opportunity cost of time only increases the amount of time spent on outdoor recreation (CF=255; $p < 0.01$) and group sports (CF=25; $p < 0.05$). Also, Tai et al. (1999) investigated the impact of cost on attendance of a prescribed exercise scheme using data from 152 adult patients (16 – 75 years) in South Islington (London). The attendance of this exercise scheme was not significantly influenced by a reduction in entrance fees, and particularly so for people who cited 'lack of money' as a deterrent to their participation in physical

[41] Year of currency calculation not known.

activity. This was despite the fact that, those people were 4 times more likely ($p < 0.05$) to drop out of the exercise scheme[42].

Findings from Coalter (2004) could also be surmised as giving an indication of the effect of cost on physical activity participation. Aimed at exploring the attitudes of users of sports facilities to current entrance charges, a sample of 1344 users of six sports facilities in Scotland was interviewed. The findings revealed that 27% of individuals who opposed potential increases in entrance charges would stop doing sports if the entrance charges were increased. Eleven percent of those individuals indicated that whether the price increment would affect their sports participation would depend on the magnitude of price increment. However, 21% of the individuals who opposed the increases in entrance fees stated that it would not affect their participation in sports.

Other indirect inferences on the effect of cost on physical activity could be accessed from a number of studies. For example, Downward (2007) using data from an adult UK sample, predicated an income-leisure trade-off for a normal good (i.e. physical activity), as income was positively related (CF=0.234; $p < 0.05$) to participation in sport while working hours (paid, and unpaid) showed a negative relationship (CF=-0.008, -0.036; $p <0.05$ respectively). High income earners were expected to dedicate more time to sports participation because they can still maintain appreciable income levels which also facilitate their high consumption of sports, but at the same time they may have high opportunity costs of time due to higher earnings and hence the incentive to work more hours. Little support was found, however, for the predication of the income-leisure trade off in Downward (2004) as the positive effect of income (ME =0.002 to 0.003; $p <0.05$) and the negative effect (ME=-1.08; $p <0.05$) of working hours, were found only in 'male oriented' activities (i.e. keep fit, running, swimming, weight training). Furthermore, using an adult English sample, Farrell and Shields (2002) reported that the positive effect of income on physical activity participation suggested that high income or low prices augments access to sports facilities. They found that the probability of participation in sport increases from 0.004

[42] Potential evidence of existence of cofounders within the relationship between cost and physical activity participation.

(ME) to 0.171 (ME) at 5% significance level, as income increases from 'below £10400' to 'greater than £52000'.

A number of studies (n=3) explored the determinants of costs related to physical activity participation. Taks et al. (1999), and Lera-Lopez and Rapun-Garate (2005) found these costs to be positively influenced by income (CF =0.000 to 0.879; $p < 0.05$) while Lera-Lopez and Rapun-Garate (2007) also found a positive effect for educated people (ME=0.073; $p < 0.01$), and occupational categories[43] such as entrepreneur (ME=0.358; $p > 0.10$), self-employed (ME=0.327; $p < 0.10$), and manager (ME=0.688; $p < 0.01$). Participation in physical activity was also found to be a significant positive predictor of costs (ME=106; $p < 0.01$) (Lera-Lopez and Rapun-Garate, 2007). Still, gender (female) was found to be negatively related (CF=-134.1; $p < 0.01$) to costs (Lera-Lopez and Rapun-Garate, 2005).

Some findings related to the 'treatment' of cost of physical activity participation by individuals, specifically golfers and gym users. Evidence of the Allan-Alchian theorem[44] was established as golf course patrons, particularly the visiting ones in Ohio, US, were found to treat travel cost as a 'bundled' rather than 'sunk cost' (Brown et al., 2006). In other words, as fixed cost (i.e. travel cost) is added to prices of playing golf (e.g. green fees) the price of expensive golf courses becomes cheaper for visiting golfers. As such, the visiting golfers are able to play relatively high quality and 'expensive' rounds of golf compared with low quality and 'less expensive' rounds of golf than the local golfers. Therefore the positive correlation between other costs related to golf participation and the travel cost was higher among visiting golfers (rho=0.983; $p < 0.10$) than all golfers (rho=0.549; $p < 0.10$).

DellaVigna and Malmendier (2006) tested whether consumers based their contractual choices regarding sports consumption on expectations about future behaviour. The results indicated that consumers 'pay not to go to the gym' as

[43] The omitted category was non workers (i.e. retired or housewife).
[44] The theorem states that the addition of fixed cost to the prices of two goods renders the more expensive good to become relatively cheaper.

80% of members of three US health clubs tended to pay over 70% more than they would have paid if they had based their contractual choices on actual attendance. Also, members with monthly contracts were found to be 17% more likely to sustain their membership to the health clubs though they incurred higher fees to enjoy the option of abrogating their membership at the end of each month. To explore these findings, the authors undertook a further survey of 48 users of randomly selected health clubs to draw out the expectations of health club users about their attendance. Results showed that the respondents had unrealistic expectations about attendance, as their forecasted attendance was 9.5 visits per month but actual attendance was 4.17 visits per month.

Other factors affecting physical activity participation

The relationship between physical activity behaviour and a variety of other variables was examined by a number of the studies (n=7[45]). Table 2.2.3 presents the findings on the relationship between those variables and physical activity participation.

Among these variables, a positive influence on physical activity participation was mostly shown for: gender (male); education (high); education(high); ‘drinkers’(yes); urban residents; having access to vehicle; spending more hours on arts and other volunteering; and participation in other leisure activities. Conversely, smoking status (smokers); employment status (employed); general health status (unfavourable); ethnicity (non whites); and presence of adults in household (high) were generally reported as having a negative effect on physical activity participation. Mixed effects were however reported for: age (increased); marital status (married); presence of children (yes); and government expenditure on recreation and parks (high).

Viewing the ‘effect sizes’, it appears that gender, education, and region of residence have the strongest influence on physical activity participation and working hours, urbanisation, government parks and recreation spending the weakest.

[45] It must be noted that not all 7 studies accounted for all the variables.

Table 2. 2. 3 Predictors of physical activity participation (PA)

Variable	Variable description	Reported sign[46] with PA	Range of effect sizes’[47] *marginal effect*		*coefficient*	
			lowest	highest	lowest	highest
Gender (male)	Male or Female	6[4(+), 2(~)]	0.22	3.68	0.01	0.48
Age	Age in years	7[4(-), 2(+),1(~)]	0.01	0.08	0.00	0.09
Income	Total income of individuals/household	6[4(+), 2(0)]	0.04	3.34	0.00	0.23
Education (high)	Highest level of education attained	5[3(+), 2(0)]	0.08	0.26	0.32	0.62
Marital status(married)	Married or not	4[2(~), 1(+),1(-)]	0.06	1.71	0.00	0.16
Employment status (employed / skilled occupational types)	(a) Employed or not (b) Types of occupation	4[3(-), 1(~)]	0.08		0.19	0.65
Working hours	Weekly working hours	2[2(-)]	0.01		0.01	0.03
Ethnicity (non white)	Non white or White	4[2(-), 1(~), 1(0)]	0.061	1.21	0.01	0.33
Health status (bad)	(a) Self-reported general health status (b) Self-reported mental health status	4[4(-)]	0.01	0.13	0.00	0.23
Children in household (presence/ high)	(a) Number of children (ages:5-15; 2-15) / infants (ages:0-4; 0-2) in household (b) Presence of children / infants in household or not	4[3(~), 1(+)]	0.00	0.50	0.00	0.38
Adults in household	Number of adults in household	2[1(-), 1(~)]	0.10	0.28	0.18	0.19
Drinking status (drinkers)	Drinks alcohol or not	3[3(+)]	0.14	0.56	0.14	
Smoking status (smokers)	Smokes cigarettes or not	3[2(-), 1(0)]	0.10		0.44	0.76
Participation in other leisure activities (high)	Number of arts and leisure activities (i.e. watching TV, listening to radio, reading, painting and the arts) undertaken in the past month	1[1(+)]			0.30	
Participation in voluntary activities (high)	Hours spent on arts and other volunteering	1[1(+)]			0.12	
Urbanisation (urban)	Rural or urban resident	1[1(~)]			0.011	0.014
Access to vehicle (Yes)	Own or use a motor vehicle	1[1(+)]			0.33	
Region of residence (all regions with London as the omitted category)	Northern England and Yorkshire; East &West Midlands and East Anglia; South West and South East England; Wales; Scotland; London	2[1(+), 1(0)]			0.39	0.56

[46] The statistical significance levels were set at p value(between 1% and 10%) or t value > 1.
[47] Not all studies reported marginal effects; hence coefficients are presented in this table. The qualitative effects are not presented here for clarity, as the purpose of that column is to portray the magnitude of the quantitative effects.

Variable	Variable description	Reported sign[46] with PA	Range of effect sizes'[47] *marginal effect* lowest	highest	*coefficient* lowest	highest
Government parks and recreation spending	State and local government expenditure on parks and recreation	1[1(+)]			0.002	

Number of studies reporting the variable is provided before parentheses
Number of studies reporting a particular signed effect is provided before brackets
Signs of effects are in brackets: positive (-), negative significant effect (-), mixed significant effect (~), no significant effect (0)

2.2.4 Discussion

Current literature on costs and physical activity participation was reviewed and revealed a dearth of research (Downward, 2007, 2004; Humphrey and Ruseski, 2006; Farrell and Shields, 2002; Gratton and Taylor, 2000). Findings from this review also show a plethora of costs considered within the few studies available, and that they could influence physical activity behaviour. The impact of costs though seems unclear given the conflicting findings and the methodological rigour of the few studies. The discussion considers how well costs were measured, the inputs of this review in terms potential datasets and identifies a set of potential covariates for future work, as well as the gaps identified in the literature with respect to the context of this thesis.

How well were costs related to participation in physical activity measured?

This review has shown that physical activity participation may lead to direct and indirect costs to the individual, and that these costs are principally measured via questionnaires. Yet, the evidence is clouded by the fact that 70% of the studies did not justify the choice of cost items measured, which makes it unclear whether the full range of costs was captured. This problem is compounded given the weak agreement across the studies concerning the selection of these costs. Some confidence could still be drawn from the evidence given that the few studies (30%), which justified the choice of costs, tended to cover all the costs items identified. Furthermore, the costs were compared with the content of an established national survey that collects data on costs of participation in physical activity (i.e. Physical Activity Monitor 1995 in Canada). Given that there are no such surveys in the UK, it was necessary to look elsewhere. This is not a gold standard but the best available evidence because of the following reasons. First, the design of the content of this survey, which is ran by the Canadian Fitness and

Lifestyle Research, was considered rigorous as it involves extensive consultations with Sport Canada, Public Health Agency of Canada, and provincial and territorial government departments focused on sports, fitness, and active living (Cameron et al., 2006). Second, it was the only accessible national survey that measures costs of physical activity.

Comparing the costs identified in section 2 to the costs captured in these surveys showed the former to be comprehensive as it includes all items in the latter (ie. membership fees, cost of equipment, cost of sports clothing, transportation costs, and other). It is recognised though that our comparator may not be sufficiently comprehensive hence future research on capturing full range of costs intends to further test the comprehensiveness of the costs using other avenues (e.g. expert evaluation).

Whilst the existing evidence may be strong in terms of money costs, it is weak for time costs because the latter was only measured as ‘opportunity cost of time’, and ‘distance travelled’- thereby ignoring components such as travel time (Ching, 1995; Gertler, 1987; Acton, 1975). The importance of capturing the latter is due to the fact that the former may not fully reflect the impact of time cost as it tends to be insensitive to mitigating factors such as time of travel and mode of transport. For example, time cost in terms of physical distance may be the same for two people travelling from Uxbridge to Ickenham for physical activity irrespective of model of travel, but travel time may vary.

It is also notable that insufficient evidence was gathered on operationalisation of unit cost as the studies mainly captured total costs (n=12). Although this specification was in concordance with the aims of the studies, its applicability to the context of this thesis is limited because unit costs and not total is required to study the impact of cost (Gratton and Taylor, 2000) because the essence is to examine how participation in physical activity changes with variation in costs at a given period. Given the dearth of evidence, it is imperative that the operationalisation of unit costs in future empirical work is further explored.

The majority of studies (n=11) did not provide information on the reliability and validity of questionnaires thus making it impossible to ascertain their ability to capture the ‘true data’ (Collins, 2003). This does not only make it difficult to assess the appropriateness of the questionnaires in their context but also for future replication.

Potential datasets for future empirical work

One objective of this review is to highlight potential datasets on costs related to physical activity participation since the findings from section 1 hinted data constraints as likely to challenge future empirical work. Three England-specific datasets were identified. Overall, there seems to be clear advantages associated with these datasets. First, they provide comprehensive data on indicators of physical activity participation. Second, they sourced data from representative general adult population. However, the extent to which these datasets may adequately inform future work particular for costs appears limited. The reason is that only one of them (i.e. Expenditure and Food Survey) provides data on costs but even in that case, the costs data may not prove useful due to the following reasons. First, the dataset has no data on indicators of physical activity participation. Second, the cost data is captured only as total cost. Does it mean that these datasets may not provide any inputs for future work? There is a reason to argue on the contrary given that a potential idea as captured in sections 1 and 2, is to use proxies to capture costs. The paucity of data on costs hinted in section 1 and affirmed here emphasises a need to explore the use of primary data. Wanless (2004) reflected similar concerns, when he lamented ‘poor data’ on physical activity in England, and hence recommended an improvement in data collection. Still, a more expansive search for datasets on costs may have to be conducted to further address the issue of data unavailability.

Which potential covariates were identified for future empirical work?

A number of variables (n=19) arose from this review to inform the selection of covariates for empirical analysis. These variables mainly cover socio-demographic (gender, age income, education, marital status, children in household, adults in household, employment status, working hours, ethnicity, access to vehicle); health (health status, drinking status, smoking status);

environmental factors (urbanisation, region of residence); and other (participation in other leisure activities, participation in voluntary activities, government parks and recreation spending). The alternative specifications of 'same' variables (i.e. employment status, health status, and children in household) raises a question regarding how best those variables may be specified in future work. For employment status, 'types of occupation' appears to be a better specification than 'employed or not' because it provides richness of information, as it could presents insights not only on the effect of being employed but also detailed effect of different types of employment. In the case of health status, it may be best specified as 'self reported general health status' because 'self reported mental health status' offers a relatively restricted specification to health status.

Are there any gaps in the literature?

It is worth noting the gaps in the reviewed literature given the context of this current research. First, the existing literature tends to ignore an important aspect of understanding physical activity behaviour, which is the decision to become physically active (i.e. meeting the recommended level of participation[48]). Physical activity behaviour was operationalised in the literature as: level (i.e. frequency or duration) of participation (n=8), participation or not (n=3), choice of location of participation (n=1), or in a two stage format - participate or not; and, time spent participating given uptake (n=1). Current government policies are mainly geared towards encouraging people to becoming physically active (i.e. meeting the recommended participation levels) and to help them attain the health benefits accruable from participation (DH, 2005; DCMS, 2002). Thus, for policy relevance, research should aim at assessing the determinants of 'being physically active' as a key challenge is "how to encourage more people to become more active" (DH, 2005).

Second, no study was found to have investigated the relationship between both time and money costs, and physical activity behaviour. This situation may be

[48] The minimum recommendation for adults is 20 minutes per session of vigorous intensity physical activity on three or more days per week or 30 minutes per session of moderate intensity physical activity on five or more days per week (WHO, 2009).

attributed to the lack of available published datasets on these costs, particularly in the UK (Gratton and Taylor, 2000).

A few studies (Tai et al., 1999; Humphreys and Ruseski, 2007) however sought to investigate the impact of either time or money cost on physical activity participation. However, these studies had a number of limitations given the context of the current research. Considering the case of Tai et al. (1999), the study was limited to a referred patient population in inner London (i.e. South Islington), England. The behaviour of such a sample may not reflect that of the general population. Tai et al. (1999) also placed a restricted perspective on cost as only admission/entrance charges were considered. Interestingly, no effect for reduced admission/entrance charges was observed on the attendance of the exercise scheme even among those respondents who cited ‘lack of money’ as a barrier to their participation in physical activity. A plausible explanation may be the lack of a comprehensive coverage of money cost components and the possibility that other cost components may be ‘price’ sensitive with respect to physical activity behaviour. Furthermore, participation in exercise prescribed programmes (i.e. the specification of physical activity behaviour in Tai et al. (1999) may not often be a sufficiently sensitive indicator of the physical activity behaviour of participants (Chinn et al., 2006) or of the impact of changes in cost of the activity.

While Humphrey and Ruseski (2007) assessed the effects of time cost (captured as opportunity cost of time) on physical activity behaviour in an adult US sample and found a positive impact, they not only ignored money cost but used proxy data for time cost (i.e. education and employment). The use of few proxies could lead to unreliable findings as they may not be sufficient to detect the differential levels of the concept they are intended to measure; hence the recommended approach is to include more proxies to account for the potential measurement errors (Kolenikov and Angelis, 2004).

These reasons to an extent explain the inconsistent findings on the impact of costs and also emphasise why it is unlikely to gauge the effect of cost on physical activity behaviour using the existing evidence base. In light of this, future research should seek to explore the effect of cost (i.e. time cost or/ and money cost) on physical activity behaviour.

Section 3 Review of psychological models of physical activity behaviour

2.3.1 Introduction

The review of theoretical economic models to explain the demand for physical activity conducted in section 1 of this chapter, recommended that a further review of theoretical non-economic models may be capable of offering a relevant alternative model of the demand for physical activity. This is because the theoretical economics model tended to focus on explaining *how* (i.e. comparison of costs and perceived benefits) people make decisions rather than *why* (i.e. what the perceived benefits are?) they make those decisions. This section intends to assess the role of psychological models to contribute to the development of economics models. To achieve this, a review of psychological models of physical activity participation was undertaken. The decision to consider models from psychology is because studies of motivation may tend to offer explanation of the *why* questions about economic behaviour (Lea et al., 1987). Furthermore, the efficacy of theoretical psychology models to explain physical activity behaviour has been established; they have been used to effectively explain physical activity behaviour over the last two decades (Spencer et al., 2006). This section therefore reviews literature on empirically tested psychology models with the following objectives: (a) to detect the constituents of perceived benefits related to participation in physical activity; and (b) to discover potential determinants of physical activity behaviour.

The remaining part of this section first describes the methods used to identify and review the literature, followed by the results and the discussion respectively.

2.3.2 Methods

Due to the breadth of the literature and time available, secondary sources were used. In particular, the frame for this research was a recent comprehensive and relevant ‘review of reviews’ commissioned by National Institute for Clinical Excellence (NICE, 2006(b)). The selection of papers included all review papers identified by NICE (2006(b)), from which individual papers were selected according to criteria (details provided in the next section). The decision to use NICE (2006(b)) was for methodological reasons. First, the general aim of NICE (2006(b)) was compatible with section 3 and the methodology was considered rigorous in terms of the adequacy of the search strategy and the quality of selected review papers, which had been assessed using the quality criteria set out by NICE Public Health Guidance Manual. Second, NICE (2006(b)) was likely to capture the current state of the literature since it was a recent study (i.e. June 2006), 3 months before the commencement of this review. A description of the NICE (2006(b)) review is given in Box 2.3.1.

Box 2. 3. 1 Summary of NICE (2006(b)) review

Authors: Taylor, D; Bury, M; Campling, N; Carter, S; Garfield, S; Newbould, J; Rennie, T

Aim: To study and predict health related behaviour change (including physical activity participation) by examining the use and effectiveness of commonly applied models of health behaviour change: Health Belief Model[49], Theory of Reasoned Action, Theory of Planned Behaviour, and Transtheoretical Models.

Methods: The review was conducted using methods set out by the NICE Public Health Guidance Methods Manual (2006) and the Centre for Public Health Excellence (CPHE) technical team at NICE.

- Search strategy: This was developed by information specialists at NICE and the Centre for Reviews and Dissemination (CRD), University of York, in collaboration with the London School of Pharmacy, with the searches carried out by CRD and NICE. Thirteen databases were searched: *MEDLINE, EMBASE, PsychInfo, CINAHL, BNI, the King’s Fund Database, ASSIA, Sociological Abstracts, Social Policy and Practice, ERIC, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (CRD administrative system), DH-Data.* Additionally, a citation search was conducted on the names of the propounders of the different psychology models in the ISI Sciences and Social Sciences Citation Indexes. The grey literature was also searched. Two reviewers independently screened titles and abstracts against the inclusion criteria, which was based on the scoping document by NICE (2005). As part of the inclusion criteria, papers were only selected if they met the quality criteria set out by NICE Public Health Guidance Manual.

[49] Health Belief Model was reported to be employed in other health related behaviour change such as: immunization uptake; and medical treatment but not in physical activity behaviour (NICE, 2006(b)).

Selection criteria

Papers were selected for this review if they met all the following criteria:

1. Focus on explaining physical activity behaviour.
2. Have been published over the last ten years (i.e. 1996-2006), a time frame considered adequate to capture the current state of the literature. The decision to review the current application of psychological models is to get a sense of the current evolution of existing models because research in psychology and various disciplines are influenced by recent socio-economic conditions and that models may be modified and improved overtime. For example, the Theory of Reasoned Action (TRA) introduced in 1967 was later modified to generate the Theory of Planned Behaviour (TPB) in 1988.
3. Written in English, as there were no resources for translation.

Review questions

Seventeen questions that extracted information under description of studies, underlying theories, methods used, and empirical findings were used to review the selected papers (see Appendix 2.3.1 for full set of questions).

For 'description of studies', questions were asked about the basic characteristics of the studies. Information obtained on underlying theories was intended to reveal the constructs influencing behaviour and how they are measured in practice. This would provide a basis for comparison of models, leading to information on how perceived benefits are conceptualised across different models. To evaluate the rigour of the findings, questions related to methods focused on areas such as: sample used, sampling strategy, measurement of physical activity, design of study, and type of data analysis (including model diagnostics). Evidence on empirical findings of the papers would be used to assess the utility of the psychological models and inform the selection of potential covariates for empirical research of this thesis.

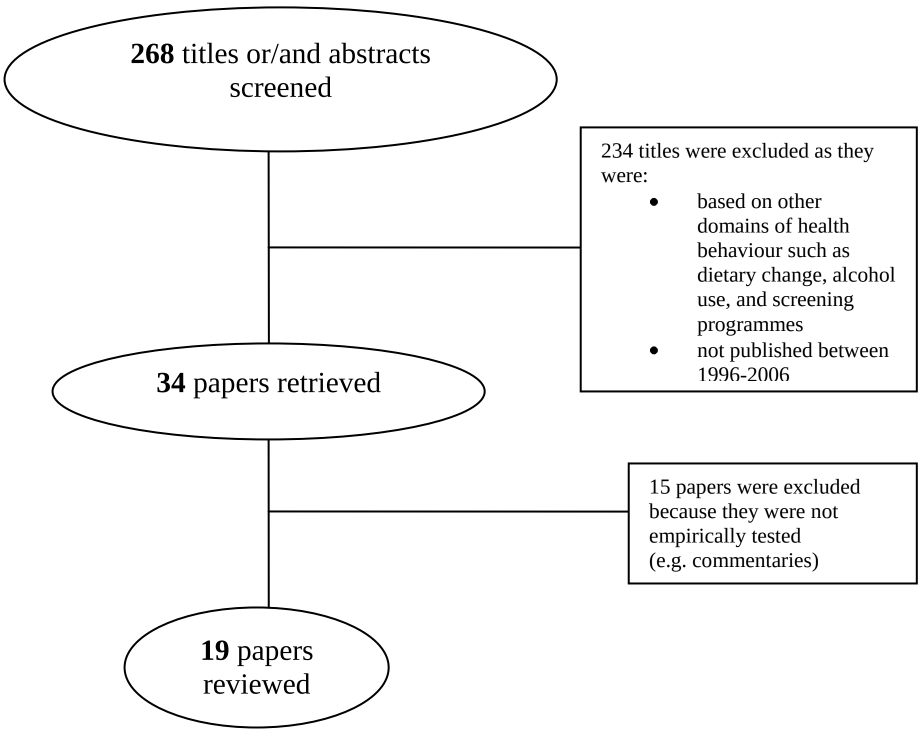
2.3.3 Results

This section presents the description of studies, underlying theories, methods used and the empirical findings.

2.3.3.1 Description of studies

A total of 34 papers were initially obtained from 268 items produced by the search (Figure 2.3.1). Of these 34 papers, 19 were finally selected for full review after further examination (see the list and summary of papers in Appendices 2.3.2 and 2.3.3 respectively).

Figure 2. 3. 1 Selection of papers



Of the 19 studies reviewed, 9 were from the US, 7 from the UK, and 1 each from Finland, Canada and Australia. All bar one of the studies were published between 1996 and 2002. All studies applied either the Transtheoretical model (TTM) (n=11), or Theory of Reasoned Action (TRA)/Theory of Planned Behaviour (TPB) (n=8). The aim of the studies was to examine the utility of these theories to explain or improve physical activity behaviour. The application of the theories was either singly or in combination with other theories (i.e. Social Cognitive

Theory (SCT), Elaboration Likelihood Model (ELM)). A distribution of the mode of application of theories by studies is provided in Table 2.3.1.

Table 2. 3. 1 Distribution of mode of application of theories by studies

Mode of application of theories	**Types of theories**	
Single (n=16)	Transtheoretical model (n=8)	Theory of Planned Behaviour (n=8)
Combination (n=3)	Elaboration Likelihood Model, Transtheoretical model (n=1)	Transtheoretical model, Social Cognitive Theory (n=2)

2.3.3.2 Methods used

Sample description & data analysis

All papers used primary data accessed using a questionnaire that was administered either face to face or by telephone, and to either a patient sample or general sample. Patient populations included disease specific samples or people using health centres. The majority (11/19) of studies used a general sample that mainly (9/11) consisted of adults (i.e. 16 years plus) or children (i.e. below 16 years). All studies (8/19) that used a patient sample considered only adults. Only 3/19 studies reported using random sampling techniques and in each case, this was a stratified sampling technique. The samples were predominately white (90% on the average) and female (60% on the average) when reported (n=17).

Most papers (n=18) used quantitative techniques to analyse data, with only one (Martilla and Nupponen, 2000) conducting qualitative analysis. The former mostly involved multivariate regression models (n=15) though almost half (7 out of 15) did not report model diagnostics. Where reported (n=8), the model diagnostics did not cover specification tests of models but only goodness of fit measures using indicators such as Tucker Lewis index, standardised root mean square of residuals, and r squared.

Measurement of physical activity

Physical activity behaviour was measured through self reports of the frequency and/or duration of physical activity from the participants. Only two studies used both subjective (i.e. self reports) and objective methods of measurement (i.e. treadmill, accelerometer and heart rate at specified submaximal stage). In both cases, the changes in physical activity participation assessed from either objective or subjective measurements were found to be consistent though the degree of comparison between them was not reported.

Design

All studies that applied TTM either solely or in combination with other theories (n=11), were controlled trials except two (Rosen, 2000; Sarkin et al., 2001). However, only three studies reported the mechanism used for randomisation (Bock et al., 2001; Green et al., 2002; Norris et al., 2000). The intervention tool mainly adopted by the studies was behavioural counselling, which was intended to trigger changes in physical activity participation. The counselling was delivered by telephone, manual or face to face, and administered by behavioural professionals.

The follow up period adopted for outcome measurement (i.e. physical activity) can be classified as short term (less than 6 months) or long term (more than 6 months) as described by Adams and White (2003). In total, four studies used a short term, five studies used long term, and two studies used both for outcome measurement**.**

2.3.3.3 Underlying theories

The following section compares and contrasts the theoretical models identified in the literature (and summarised individually in Appendix 2.3.4). The similarities across these models are first described followed by the differences.

Perceived benefits

The construct of perceived benefits is common to all theoretical models used. All models show that the decision to adopt a new behaviour involves a thought process which considers the outcome expectations of the intended behaviour.

The formation of the expected outcomes involves a comparison of the perceived benefits and perceived costs. Perceptions of individuals regarding the benefits they expect from the uptake of behaviour are however, labelled as different constructs across theories, that is, *decisional balance* in TTM, *attitudes* in the context of TRA/TPB, *expectations* in SCT, and *attitudes* in the ELM. The *decisional balance* construct in the Transtheoretical model postulates that the individual considers pros and cons related to specific behaviour before uptake. Both the TRA/TPB and ELM employs the *attitudinal* construct that shows how people evaluate an intended behaviour by comparing its benefits and costs, and that the degree to which the benefits outweigh the costs positively influence the intention or behaviour related to that action. Also, the SCT captures perceived benefits in an *expectations* construct by indicating that individual's uptake of a specific behaviour is influenced by their anticipation of the outcomes of that behaviour.

The tendency to adopt a particular behaviour becomes likely when the perceived benefits outweigh the perceived costs. In physical activity the perceived benefits may include: *'to stay fit and in shape'; 'to improve skills'; 'to enhance physical appearance'; 'to enhance health'; 'to lose weight'; 'to have fun' 'pleasurable positive experiences of nature and fresh air'; 'to improve skills'; 'psychological stimulation'; 'positive outlook on life'* (Sarkin et al., 2001; Martilla and Nupponen, 2000; Hagger et al., 2000; Mummery et al., 1999; Norman et al., 2000). It is notable however that among the 5 studies that explicitly operationalised perceived benefits, only a few (n=2) used samples from England (Hagger et al., 2000; Norman et al., 2000).

Perceived benefits were mainly assessed by asking participants to indicate their perceptions (via Likert type scales from say 'not important' to 'extremely important') about a list of benefits related to physical activity participation or through responses indicating a perceived benefit or perceived barrier to the participation of physical activity. For example responses to statements such as*: 'I think that for me, participation in regular physical activity during the next month would be….'* with the responses indicating variety of perceived benefits and perceived barriers: *'fun-boring' 'enjoyable-not enjoyable'; 'good-bad' 'exciting-*

boring, and pleasant-unpleasant' (Mummery et al., 1999; Norman et al., 2000). One study (Martilla and Nupponen, 2000) however used open questions to assess perceived benefits by asking respondents what benefits they would expect from physical activity participation.

'Perceived behavioural control'

Perceived behavioural control was also found to be a common construct. The TPB, TTM and SCT all consider the perceived behavioural control (though labelled differently), which is the ability of the individual to sustain his intended behaviour despite barriers, as a determinant of behaviour. The *perceived behavioural control* (for TPB) and *self efficacy* (for TTM and SCT), both specify the confidence in the ability to resist relapse as a key determinant of acquisition and maintenance of a new behaviour.

'Influence of significant others'

The TPB, TTM and SCT also recognised the importance of accounting for the role of 'significant others' in the decision making of the individual. *Subjective norms* (for TPB), *helping relationship* (for TTM) and *reciprocal determinism* (for SCT) specify the tendency of individuals who are embarking on a behavourial change to consider the thoughts of people who are close to them.

Despite the similarities across the theoretical models, they do differ with regard to their overall approach in describing behaviour change. Two main approaches to explaining behaviour change were identified. The first approach appears to involve adopting a dimension that attempts to explain behaviour change not only by considering the determinants of behaviour change but also accounting for the stages behaviour change undertaken. The second approach concentrates only on the former aspect explaining behaviour change. The approach of TTM was found to be similar to the first approach whilst the other models adopted the second approach. In that sense, the other models dealt mainly with 'what constructs determine behaviour change' while the TTM deals with 'what constructs determine stages of behaviour change, and what mediates the movement through these stages'.

2.3.3.4 Empirical findings

Although several theoretical models emerged in this review, the emphasis of the studies was primarily to examine the efficacy of two theoretical models (i.e. Theory of Reasoned Action/Theory of Planned behaviour (TRA/TPB), and Transtheoretical model (TTM)). Thus the findings from the studies are reported as follows under these models.

TRA/TPB related findings

All the studies that applied the theory of planned behaviour to explain physical activity behaviour found the theory to be predictive of the intentions and behaviour of physical activity. The effectiveness of the TRA/TPB were mainly (7/8) assessed by using hierarchical regression models[50] to investigate the relationship between the constructs of TRA/TPB and physical activity behaviour. All constructs were generally found to be predictors of intention or/and behaviour related to physical activity.

Attitudes (positive) were found to be the strongest predictor irrespective of population (both adults and children). The majority of the studies (6/8) reported a statistically significant moderate relationship between attitudes (CF= 0.29 to 0.57; $p < 0.05$) and the intention to do physical activity. Investigation into the differing relationship of diverse positive attitudes (via perceived benefits) and physical activity participation revealed interesting results. Martilla and Nupponen (2000) found that non-participants and participants of outdoor exercise activity tend to expect different types of benefits from physical activity participation. The participants of outdoors exercise activity expected psychological benefits (e.g. *'pleasurable positive experiences of nature and fresh air'; 'psychological stimulation'*) from physical activity participation while the non participants expected health benefits (e.g. *'to enhance health'*). Also, Hagger et al. (2001) found that expecting physical activity participation to *'give fun'* compared with *'to stay fit and in shape'* or *'to improve skills'* given the cons of participation, dominates (37.2%) the formation of attitudes that promote physical activity participation.

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[50] The regression models were usually ran by entering the individual constructs in turn into the regression model, to asses their explanatory power via their respective contributions to the variance of the intention or behaviour related to physical activity. Models showed good fit.

In a few cases (n=2) however, perceived behavioural control not attitudes (positive) was found to be the strongest predictor of intention or/and behaviour related to physical activity participation. Perceived behavourial control was measured by respondents' self-assessed ability to do physical activity, and was elicited from differential scale responses (i.e. -3 to +3) to statements such as '*For me to take regular physical activity over the next 6 months is difficult/easy'* (Norman et al., 2000). Mummery et al. (2000) found perceived behavioural control to be the strongest predictor (CF=0.34, p <0.05) of intention to do physical activity, followed by attitudes (CF=0.32; p <0.05) and subjective norms[51] (CF=0.23, p value <0.05) respectively. Norman et al. (2000) also found none of the constructs of TPB except perceived behavioural control to be a significant predictor of intention to do physical activity, reporting an effect of (CF=0.70, p value <0.001).

The introduction of additional constructs other than the standard constructs (i.e. subjective norms, perceived behavourial control, and attitudes) to explain the intention or/and behaviour related to physical activity was also addressed by three studies, and found to be successful. These additional constructs were: past behaviour, self efficacy, and self schema. Past behaviour of doing physical activity (measured as frequency of participation during say the previous 6 months) was found to be positively related to present intention to do physical activity, with coefficients ranging between 0.20 and 0.62 (p <0.001) (Hagger et al., 2001; Norman et al., 2000; Hagger et al., 2001(b); Sheeran and Orbeil, 2000). Self-efficacy, specified in practice as perceived confidence to maintain uptake[52], was also found to a significant predictor (CF= 0.28, p <0.001; CF=0.58, p <0.01) of the intention to do physical activity (Payne et al., 2002; Hagger et al., 2001). Sheeran and Orbeil (2000) aimed at exploring the effect of self schema[53] (defined

[51] Subjective norms were measured by the respondents self-assessment of the perceptions of 'significant others' regarding his uptake. In practice a typical specification was: 'On the whole, people who are important to me think that I should exercise' with likely responses – strongly agree=1 to strongly disagree=5.
[52] Data on self-efficacy was elicited from responses to statements such as: 'I am confident that if I choose to exercise I can stick to it'. The responses usually ranged from 1=not at all confident to 7=very confident (Payne et al., 2002).
[53] To measure self schema, respondents were asked to rate a 11-point scale indicating how: (a) the following phrases: 'physically active', and 'keeps in shape' describe themselves, and (b) the importance of these phrases are to their image. Thus, schematics were classified as those who scored at least 2 of the phrases as both highly (i.e. score 8-11) descriptive and important. Conversely, non schematics were those who scored at least two of the phrases as highly important but non descriptive (i.e. score 1-4).

as cognitive generalisations about one's self based on past experiences which are used to process information) on the physical activity behaviour. They found that schematics (i.e. people who recognise traits related to a domain as highly valuable to self image and descriptive of one's self) compared with non schematics (i.e. people who recognise traits related to a domain as highly valuable to self image but not descriptive of one's self) are likely (CF=0.37, p <0.01) to do physical activity given the intention.

Other findings showed gender differences regarding the intention to do physical activity as girls were found to have significantly ($p < 0.01$[54]) higher intentions to do physical activity (Mummery et al., 2001). Age was also found to be negatively correlated (CF=-0.24, $p < 0.001$) with the intention to physical activity (Payne et al., 2002)

TTM related findings

The TTM was found to be useful in promoting physical activity behaviour. In the literature, the context of using the TTM either singly or in combination with other theoretical models was mainly to gauge its utility in promoting physical activity behaviour. This was normally done by designing interventions based on the stages of behaviour construct of TTM, and then using the main intervention tool; say behavioural counselling, to promote physical activity behaviour. In other words, the intervention tool was administered based on the stages of behaviour of the individual. The utility of TTM was then examined by observing the proportion of increase in physical activity participation achieved by people in the intervention group compared with the control group.

The findings of the majority of studies (n=9) point to the efficacy of TTM in promoting physical activity behaviour as the intervention groups increased their physical activity participation significantly ($p < 0.05$) higher than the control group. Only a number of these studies (n=6) however demonstrated the impact of the intervention on the specific stages of behaviour change though the intervention tool was administered to reflect participants' stage of behaviour

[54] No effect sizes are given here because the study did not provide it as the statistical analyses only involved a significance tests. The above explanation applies to forthcoming incidence of 'only p values' in this section.

(Hasler et al., 2001; Steptoe et al., 2001; Pinto et al., 2001; Rosen, 2000; Sarkin et al., 2001; Bock et al., 2001). The findings when reported showed that participants in the action and maintenance stages of behaviour reported significantly ($p < 0.05$) more physical activity sessions than those in the other stages (i.e. preparation, precontemplation, and contemplation).

In assessing the utility of TTM, the studies rarely addressed all the constructs of the TTM framework, tending to concentrate on individual constructs. A total of 9 studies did not consider the *processes of change* construct in their analyses at all. Out of those, 5 studies considered only the *stages of change* construct while the remaining 4 studies applied only the *stages of chang*e construct and *mediators* but not the *processes of change*.

Only two studies (Bock et al., 2001; Pinto et al., 2001) therefore comprehensively assessed all the constructs of the TTM framework. Both studies examined the utility of TTM by observing the *stages of behaviour* construct as well as all the mediators of the transition through the stages of behaviour (i.e. self efficacy, decisional balance, and processes of change) in their analyses. All the constructs were found to be effective in both studies. The intervention group reported increased physical activity behaviour ($p <0.01$), were more likely to have higher *self efficacy* (Odds ratio (OR) =4.92, $p <0.01$), and used more of the *processes of change* (OR=4.06, $p <0.05$), as well as reported fewer *perceived barriers* to physical activity behaviour ($p <0.001$) or more *perceived benefits* ($p < 0.05$).

It is important to note however that in cases (n=4) that the relationship of *perceived benefits* (via decisional balance construct) and physical activity behaviour was investigated, a strong positive relationship (e.g. OR=4.61, p value <0.001) was reported.

With regard to the use of mixed theoretical models to investigate physical activity behaviour, the findings show that the application of TTM and other theoretical models (i.e. TPB, ELM) offer a thorough understanding in physical activity behaviour (Rosen, 2000). This study aimed at investigating how the attitudes (TPB element) or the stage of behaviour change (TTM element) affects the processing of information (ELM element) related to physical activity. He found that sedentary participants with positive attitudes about exercise portrayed thorough elaboration of messages related to physical activity compared with those with negative attitudes. Nevertheless, no such difference in the elaboration of messages related to physical activity was found between individuals in the precontemplation stage and those in the contemplation or preparation stage.

2.3.4 Discussion

The focus of this study was to review psychological models that explain physical activity behaviour and reflect on their relevance to contribute to the development of the adapted economics model for future empirical work. A limitation of this study is using the NICE (2006(b)) as the basis for selection of papers because it tended to restrict the review to a few psychological models. On the other hand, the purpose was to capture the dominant models, and not a broad sweep of theories. The following discussion considers the efficacy of these models to explain physical activity behaviour, and how they relate to economics models and improve our understanding of perceived benefits. It also discusses the selection of components of demand for empirical analysis.

Are the models sufficient predictors of physical activity behaviour?

The focus of the studies was to demonstrate and establish the efficacy of two theoretical models (i.e. TRA/TPB and TTM) though various models emerged in this review. Empirical support exists for all models regarding ability to explain physical activity. For TTM, using it as the basis to design physical activity promotion interventions was successful in increasing uptake. A similar conclusion was reached by previous review studies (NICE, 2006(b); Spencer et al., 2006; Hausenblas et al., 1997).

The methodological rigour of the papers however raises questions about how well established these theories are. First, the efficacy of TTM was mainly only examined partially, as the majority of studies (n=9) did not address all the constructs but tended to concentrate on the *stages of behaviour change* construct.

The application of the latter is also questionable because a number of these studies (5/9) showed the intervention effect on physical activity of the whole sample but not groups in individual stages. Hence it was not clear, for example, which proportion of people had moved from *preparation* stage to *action* stage due to the intervention. Second, the representativeness of the samples used by most (n=16) of the papers was questionable as they did not use report random sampling techniques. The description of sample, where reported, suggested white females dominated samples. This limits the generalisability of findings to a white female general population. Concerns about the validity of these findings for other populations are warranted by evidence from the economics literature reviewed in sections 1 and 2 of this chapter, which show that gender and ethnicity are themselves predictors of physical activity, with females negatively associated with physical activity (Wu and Porrel, 2000; Farrel and Shields, 2000; Lera-Lopez and Rapun-Garate, 2005, 2007; Humphreys and Ruseski, 2006; Downward, 2007) though mixed effects were found for whites (Farrel and Shields, 2000; Wu and Porrel, 2000; Humphreys and Ruseski, 2006; Downward, 2007).

The inadequate evidence provided for how well the regression models were specified also renders the empirical support for the psychological models debatable. This practice makes it difficult to examine the validity of predictions of the models - which is important because these predictions could be biased if the models were not well specified. As argued by Greene (2008), models need good specification for avoidance of placing incorrect restrictions on estimations (via the omission of relevant variables) that leads to unbiased estimates.

A useful consideration is which of the models is superior in explaining physical activity behaviour. There is not enough evidence to address this issue, as no study sought to compare the predictive power of the different models. Furthermore, there was heterogeneity in the methods used by the studies with regards to specification of outcomes and study participants, making comparison complicated. Nonetheless two attempts were made to give an indication as to which of these models is superior. The first involved the comparison of the variance in physical activity behaviour observed by the two models. This however did not give clear evidence given that the studies using TTM did not provide such evidence though the TPB models was showed to explain between 21% and 53 % of observed variance in physical activity. A second route covered the general criteria[55] (via model diagnostics) used in section 1(see 2.1.2 for details). On that basis, the TPB appeared the better model because about 88% of its empirical testing showed good fit as compared with less than 20% for TTM. This is not however conclusive of the superiority of TPB over TTM because the papers (particular for the latter) did not provide enough information to test that hypothesis.

Possibly, an 'integrationist' approach that combines different theoretical approaches can explain a greater variation in physical behaviour. Rosen (2000) found that the use of combined models provide a more thorough understanding of physical activity behaviour. However, that may not be entirely true because predictions of two out of the three combined theories were only verifiable. Moreover, the use of a student sample hampers the generalisability of findings of that study.

Comparing and contrasting economic and psychological models

This part of the discussion highlights how section 3 could provide inputs for adapting economic models either by supporting or challenging the tenets of the latter.

First, the psychological models recognises the decision making of the individual as weighing perceived benefits and perceived costs which bears similarity to the economic models.

Second, the economic models provided a flavour of the potential influence of others on decision-making by the individual using arguments such as general characteristics[56] of the individual in their theoretical formulation. This arguably arises in the psychological models, though quite differently through subjective norms and therefore as a more indirect influence. The subjective norms construct

[55] The contextual criteria were not used because the object of this review unlike in section 1 is not to adapt any of these models for future empirical research.
[56] This was specified in practice as children or spouses of the individual.

describes how individual behaviour is influenced by perceptions of 'significant others' regarding that behaviour. For instance, people are likely to participate in physical activity if their 'significant others' are in support. The point of departure, however, borders on the characterisation of how individuals consider the interest of 'significant others'. Whereas the economic models opine that individuals consider the interest of 'significant others' because it gives them utility, psychological models see it as norms that are regarded irrespective of its benefits to the individual. The construct of the latter however, seems to have a practical appeal given that individual behaviour tends to be 'ruled' by societal norms. For example, there is a craze among young men to have 'six pack' tummies because that's what society seems to suggest as ideal. Hence, it is reasonable to suggest that an important part of understanding individual behaviour may be accounting for the effect of societal norms. However, this presents a challenge: does accounting for societal norms in an economics framework constitute a defiance of methodological individualism[57] because of the seeming emphasis on social preferences? The answer is 'no', since these norms constitute predilections of individuals, and thus recognizing them as 'motivational mechanism is not to violate methodological individualism' (Elster, 1989, p.102).

Third, the psychological models, particularly TTM, contradict the adapted economic model in relation to disparity in the characterisation of decision making. Whilst the economic model assumes a 'single stage' approach to explain physical activity participation, the TTM uses a 'multiple stage' framework. According to the latter, behaviour change occurs overtime, and hence the decision to participate in physical activity ought to be characterised by a temporal dimension that involves six main stages (see details in Appendix 2.3.4). Notably, the comparison of the pros (i.e. perceived benefits) and cons (i.e. perceived costs) is facilitated by the six main stages. For example in the initial stages, pros outweigh cons but the opposite occur in the final stages. An advantage of this framework is that it facilitates a detailed approach to understanding behaviour as it highlights principles of behaviour at each stage of

[57] It is a feature of mainstream economics theories and it advocates explaining behaviour in terms of individual behaviour rather than social preferences.

behaviour change and informs design of interventions for targeted populations (Guillot et al., 2004).

The potential adaptation of the ‘multiple stage’ framework to the current research is however not considered useful because despite its empirical application, it suffers from conceptual limitations and tends to oversimplify human behaviour (Bandura, 1997). According to Bandura (1997), the TTM contravenes the key axioms of an appropriate stage theory: qualitatively diverse, non-reversible, and unchanging sequence. First, the stages described by TTM are not qualitatively different because the preliminary stages merely diverge in the extent of intention, while the latter stages only signify varying lengths of behavourial continuance. Second, the TTM posits that behavourial change do not start at the same stage and that the stages do prance, indicating a changing sequence. Third, the stages in TTM are reversible as the progression in behaviour change is assumed to be ‘recyclable’. Povey et al. (1999) also argues that a problem with the application of this framework is that the fixed time frames used to define the stages tend to ignore the plodding process of behaviour change thereby hampering its practicality.

What are the covariates identified for future empirical work?

An implication of the findings for future empirical work is the identification of potential components of demand. A range of predictors covering psychological variables (i.e. subjective norms, perceived behavourial control, past behaviour, self schema, perceived barriers and self efficacy), and demographics (i.e. age and gender) have been found to be explain statistically significant variation in participation of physical activity. However, accounting for these variables may present data challenges, as a consideration of the methods of data collection indicates that all these variables were sourced from primary data. It is therefore suspected that the measurement of these variables in future work using existing datasets may be difficult.

How does the review improve our understanding of perceived benefits?

All the psychological models account for perceived benefits as a construct of behaviour change, with studies demonstrating the constituents of these benefits and how they are measured, unknown from section 1. The constituents of perceived benefits as shown indicate that individuals expect not only health benefits from physical activity participation (i.e. *'to stay fit and in shape' 'to enhance health'; 'to lose weight'*) but non health benefits (i.e. '*to have fun' 'pleasurable positive experiences of nature and fresh air' 'to improve skills'; 'psychological stimulation' 'to enhance physical appearance'; 'positive outlook on life'*) as well. Nonetheless, a question remains regarding the extent to which these perceived benefits relate to the context of this thesis. Concerns exist about the applicability of these perceived benefits to general English population because relatively few studies (n=2) measured perceived benefits using English population, and the samples used were either high school pupils or patients attending health promotion clinics. Ultimately, the findings from future empirical research should for example inform policies about which types of benefits people should be made aware of, to increase uptake in England. Such an endeavour would be hampered if relevant perceived benefits are not accounted for in empirical analysis. That is not to say that the perceived benefits identified here are not informative, but given the inter-country variation in perceived benefits associated with participation in physical activity (Zunft et al., 1999), there is the need to inform the choice of perceived benefits for future empirical research with 'England-specific' evidence.

Section 4 Review on perceived benefits related to physical activity behaviour

2.4.1 Introduction

Section 4 informs the operationalisation of perceived benefits relevant to physical activity participation in England because the extent to which the perceived benefits found in section 3 relate to the context of this current research was limited. The objectives are to: (a) identify the types of perceived benefits associated with physical activity participation in England; (b) determine how these benefits are measured in practice; (c) detect other factors that are associated with physical activity behaviour; and (d) observe the gaps in current research on these perceived benefits. The remaining part of section 4 describes methods, results and discussion in that order.

2.4.2 Methods

Search strategy

Two electronic databases (SCOPUS and SPORTS-DISCUSS[58]) were searched in July 2007[59] for literature. In addition, references of selected papers were searched for relevant papers while recommendations from authors of relevant papers were taken. Free text search terms used for the electronic databases were developed with inputs from the NICE review, NICE (2006), and earlier reviews conducted as part of this thesis. These search terms were complemented by keywords taken from an earlier extemporized literature search with a similar objective. See Appendix 2.4.1 for details of search terms used.

Selection criteria

A paper was selected only if it met all the following requirements:

1. Examine perceived benefits related to physical activity behaviour
2. Published between 1997 and 2007. Focusing on current literature was intended to capture recent evolution of perceived benefits as they may change overtime (Prochaska, 1994).

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[58] Refer to section 2.2.2 for details of these databases.
[59] Literature since then were monitored via the activation of search alerts on the databases used.

3. Used a sample of England/UK population since the scope of this section is to discover information relevant to that setting.
4. Written in English language as there were no resources for translation

Review questions

The review questions, which are provided in Appendix 2.4.2, comprised the following areas: background information (i.e. aim, author and year of publication), identified perceived benefits, description of techniques, and correlates of physical activity behaviour.

'Identified perceived benefits' covered questions on types of benefits found by selected papers to relate to physical activity, and how they were measured. The description of techniques category aimed to gather information to help assess the general validity of the methods used by the studies, and hence consisted of questions on data collection, empirical analysis, as well as limitations (i.e. author-stated). Regarding 'correlates of physical activity behaviour', the questions extracted data on the main empirical results and were mainly intended to inform the choice of predictors for future work.

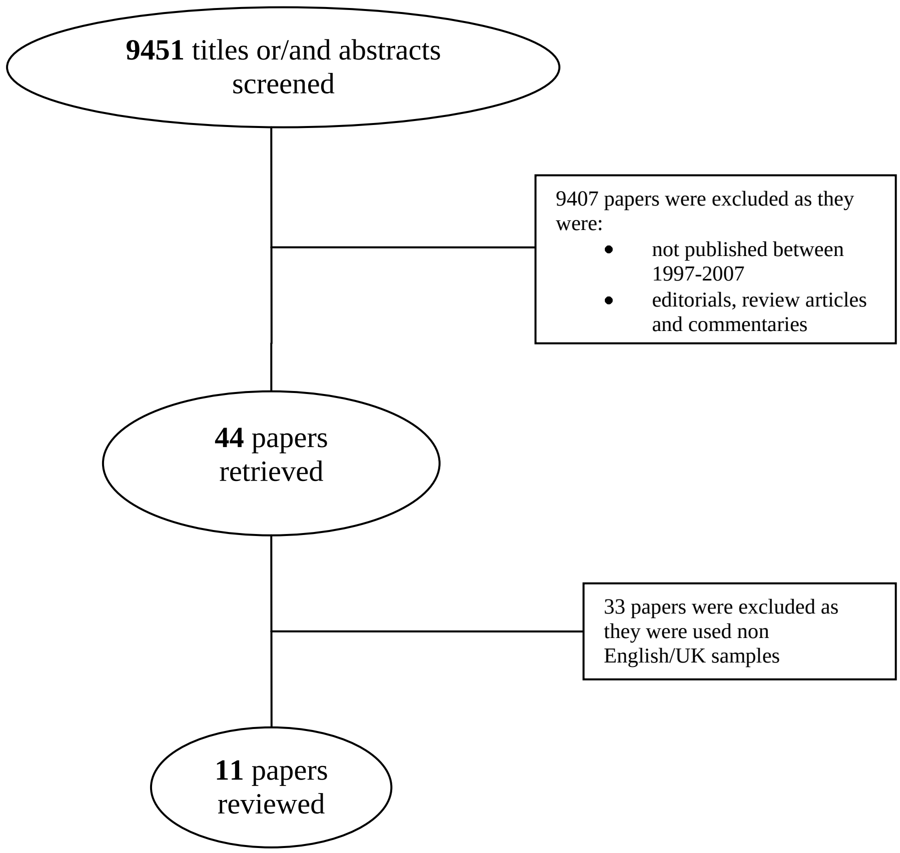
2.4.3 Results

The results section presents the background information of reviewed papers, identified perceived benefits, description of techniques, and correlates of physical activity behaviour correspondingly.

2.4.3.1 Background information

Figure 2.4.1 shows that 44 papers were initially retrieved after the titles or/and abstracts of 9451 studies had been screened. Thirty-three papers were subsequently excluded for not meeting the selection criteria, leading to a final selection of 11 papers (see list of papers in Appendix 2.4.3).

Figure 2. 4. 1 Selection of papers



Most (n=7) papers were published between 2001 and 2006. The papers focussed on either attempting a general multivariate analysis of the determinants (including perceived benefits) of physical activity participation (n=4); a comparison of the degree (i.e. modest or high) of expectations about exercise schemes between 'completers' and 'non completers' of those exercise schemes (n=2); and an exploration of the perceptions or experiences about physical activity participation (n=5). A summary of the reviewed studies is provided in Appendix 2.4.4.

2.4.3.2 Description of techniques

Data

The majority of studies (n=8) solely used primary data for empirical analysis, and one study (Chinn et al., 2006) used both primary and secondary data. Another one (Mullineaux et al., 2001) solely used secondary data, sourced from the Allied Dunbar National Fitness Survey (1990), which is a one-time cross-sectional survey that collected data on physical activity participation using a random sample of 4316 residents of England aged 16 years and over.

The method of primary data collection used by the studies involved focus groups, physiological measurements, and questionnaires that were administered either using face to face interviews or by post. Few studies (n=4) provided information on the validity and reliability of survey instruments used for primary data collection.

Most of the studies (n=7) used an adult sample (i.e. 16 years or above) and 3 studies used a sample of children (i.e. below 16 years). One study (Zunft et al., 1999) used a sample aged 15 years plus[60], and hence does not fit either category. The majority of studies (n=8) used samples comprising both males and females, with the remaining using solely females (Jones et al., 1998; Flintoff et al., 2001) or males (Robertson, 2003). Few studies (n=4) stated the method of sampling used and of those that did, 3 studies used randomly selected samples (Zunft et al., 1999; Mullineaux et al., 2001; Robertson, 2003). A number of studies (Zunft et al., 1999; Mullineaux et al., 2001) used samples representative of the whole England or UK, with the rest using samples from specific regions of England. Samples sizes used were mostly (n=7) above 100 observations, but few studies (Zunft et al., 1999; Mullineaux et al., 2001) reported the justification for the sample size used.

Data analysis conducted by the studies spanned quantitative analysis (n=7) and qualitative analysis (n=4). Quantitative analysis involved techniques such as principal component analysis, univariate analysis (e.g. chi square tests) and multivariate regression analysis. For qualitative analysis, the studies used either thematic or narrative analysis.

[60] No information was provided on mean age.

Measurement of physical activity

Physical activity behaviour was measured either through self reports (n=7) or records on the adherence to an exercise referral scheme (n=3). Only Jones et al. (2005) used both measurements. The majority of studies (n=7) defined a reference period for the measurement of physical activity, specifying ‘one week’ for the self -reports or for the duration exercise referral schemes. Only 2 studies (Gillison et al., 2006; Mullineuax et al., 2001) specified the intensity of physical activity participation by specifying both moderate and vigorous intensities. This was to afford extensive coverage of types of physical activity for analysis.

Challenges (authors stated)

Seven studies indicated the limitations that challenged their research, which mostly (n=4) covered the insufficiency and ‘unrepresentativeness’ of samples. Another limitation (n=3) was the inadequacy of the survey measurements used to collect data. For example, the use of self-reports to measure physical activity behaviour was reported as fraught with potential over-estimation. Using BMI to measure body fatness in children was also indicated as inaccurate because it does not account for maturation (Gillison et al., 2006). Other limitations were associated with the rigour of statistical analyses as a few authors (n=2) stated that the inadequate coverage of cofounding variables in their analyses may affect the robustness of findings.

2.4.3.3 Identified perceived benefits

Table 2.4.1 provides details on the types of perceived benefits related to physical activity. A range of benefits, both ‘health related’ and ‘non health related’, were expected from physical activity participation, with ‘maintain good health’ the most frequently reported (n=10) while ‘have fun’ and ‘weight control’ were also measured in more than half the studies.

Table 2. 4. 1 Types of perceived benefits identified

Perceived benefits	Count	Population focus	
		Whole of England	Specific regions of England
Maintain good health	**10**	✓	✓
Weight control	**7**	✓	✓
Have fun / enjoyment	**6**	✓	✓
Fitness	**4**	✓	✓
Meet people / socialise	**4**	✓	✓
Look good / attractiveness	**4**		✓
Relax and forget about cares / release tension / stress relief	**4**	✓	✓
Independence	**2**		✓
Sense of achievement	**2**		✓
Get outdoors	**2**	✓	✓
Improved feeling of well being	**1**		✓
Self-confidence	**1**		✓
Good shape physically	**1**		✓
Learn new things	**1**		✓
Improved sleep	**1**		✓
Improved body tone	**1**		✓

Given that most studies (n=9) used samples from specific regions of England, it is important to indicate which of the perceived benefits were sourced from a general England population. These perceived benefits are: 'maintain good health'; 'release tension'; and ' get fit'; ' get outdoors'; 'socialize'; 'to control weight'; 'have fun' (Table 2.4.1). The question remains as to whether the studies that used samples specific to regions of England reported similar perceived benefits. As shown by the last column of Table 2.4.1, these benefits were reported by those studies as well.

Within specific regions of England, gender specific perceptions of benefits from physical activity participation were found. Gillison et al. (2006) showed that girls were more likely to expect benefits such as 'improved body tone' (27%), and 'improve attractiveness' (26%) while boys were more likely to expect physical activity participation to provide improved fitness (36%). Also, though both sexes expected physical activity to improve health, the level of perception was higher for boys (33%) compared with girls (26%). Flintoff et al. (2001) also found that 'young women'(15 year olds) tend to expect 'short term benefits' (i.e. 'to meet friends'; 'to learn new skills' and 'to lose weight') from physical activity participation. Robertson (2003) however, found men (aged between 27 and 43 years) to be more likely to expect physical activity to provide non-physical health benefits (i.e. 'enjoyment'; 'having a laugh').

All types of perceived benefits were primarily assessed via questionnaires (n=6) or in-depth interviews and/or focus group discussions (n=5). Questionnaires covered closed questions that asked respondents to score a list of benefits on a Likert type scale[61] indicating their perceptions. For in-depth interviews or focus groups, the approach was exploratory, with focus group discussions or in-depth interviews structured on topic guides which had been developed earlier. Qualitative analysis of the collected data were then undertaken to obtain the benefits respondents perceive about physical activity participation. In one study (Mulvihill et al., 2000), data on perceived benefits was not only obtained from focus group discussions of the main study participants but also from 'other people' related to them (i.e. parents).

2.4.3.4 Correlates of physical activity behaviour

Perceived benefits

A number of studies (n=5) explicitly investigated the impact of perceived benefits on physical activity behaviour, with only a few (n=2)[62] using multivariate analysis. Findings show that a high level of perception about benefits related to physical activity participation generally leads to the uptake and adherence to physical activity.

Mullineaux et al. (2001) found that participants with *very high* perception (OR=5.2, $p < 0.05$); *high* perception (OR=4.7, $p<0.05$); *moderately high* perception (OR=4.4, $p<0.05$) and; *moderately low* perception (OR=3.6, $p<0.05$), compared with those having *very low* perception about benefits of physical activity were more likely to do more physical activity. Chinn et al. (2006) also found that participants and non -participants in randomised controlled trial of physical activity varied in their perception about these benefits, with the latter more likely ($p<0.05$[63]) to expect these benefits.

[61] In the case of Zunft et al. 1999), the type of measurement scale was used was insufficiently described.
[62] These were: Gillison et al. (2006) and Mullineaux et al. (2001).
[63] No effect sizes were provided as the statistical analysis was a significance test.

Different types of perceived benefits may have varying influence on physical activity behaviour. For example, individuals who expected physical activity participation to lead to the attainment of ‘extrinsic’ benefits (i.e. ‘weight control’, ‘body tone’, ‘to be more attractive’) tend to do less physical activity compared with those expecting ‘intrinsic’ benefits (i.e. ‘improve fitness’, ‘improve health’) (Gillison et al. 2006). The negative effect of ‘extrinsic’ benefits was reported as: CF=-0.11 (90% CI[64] =-0.16 to -0.18); p <0.05), while the effect of ‘intrinsic’ benefits was greater and positive (CF= 0.24, 90% CI=0.19 to 0.30; p <0.05).

A few studies (n=2) however, showed that the degree of expectations about the benefits of exercise referral schemes may impact negatively on adherence. Jones et al. (2005) found that the non-completers of an exercise referral scheme compared with completers had significantly (p < 0.05) greater expectations with respect to benefits like feeling independent or self-confident. No statistical difference was found however between the two groups regarding ‘health and fitness’ (p = 0.18). Also, Jones (1998) established that participants of a GP referral 10-week exercise scheme who had high expectations about the benefits were more likely not to complete the scheme compared with those who had modest expectations.

Extra predictors

Findings on other variables that were found to correlate with physical activity participation are summarised here (see Table 2.4.2). A positive correlation was found between physical activity behaviour and the following variables: gender (male); education (high); children in household (yes); ‘role of other people (positive)’; ‘perceived activeness’; ‘adequate exercise; health problems (yes); and psychological well being (good). On the other hand, age; smoking status (smokers); deprivation of area of residence (high); adult carer (yes); and barriers (yes) were generally reported as having a negative correlation with physical activity behaviour. When ‘effect sizes’ were reported (n=1), age and ‘perceived activeness’ appeared to be the most important predictors.

[64] Confidence interval.

Table 2. 4. 2 Correlates of physical activity participation (PA)

Variable	Variable description	Reported sign[65] with PA	'Range of effect sizes'[66] (Odds ratio) Lowest	Highest
Gender (male)	Male or Female	3[2(+), 1(0)]	N/A[67]	
Age	Age in years	3[2(-), 1(+)]	2.2	14.8
Education (high)	Highest level of education attained	3[3(+)]	1.8	
Role of other people (yes)	Support from family, friends, or exercise instructors encouraging respondents' uptake of physical activity	3[2(+), 1(0)]	N/A	
Barriers (yes)	Self report of things that impede participation in physical activity such as: feeling embarrassed; cost; lack of time; fatigue; illness; bad weather; never good at sports; too fat; too old; do not enjoy; poor health.	3[3(-)]	N/A	
Lifestyle problems (none)	Self report of health problems that affect lifestyle	1[1(+)]	1.6	
Deprivation of area of residence (high)	Deprivation score based on home ownership, overcrowding, and unemployment in area of residence	1[1(-)]	N/A	
'Perceived activeness' (yes)	Self report on own level of fitness	1[1(+)]	11.6	
Children in household (yes)	Presence of children (>16years) in household or not	1[1(+)]	N/A	
Psychological well being (good)	Self report on psychological condition using scores from general health questionnaire (GHQ)	1[1(+)]	N/A	
Adult carer(yes)	Caring for an adult in the household or not	1[1(-)]	N/A	
Smoking status (smokers)	Smokers or non smokers	1[1(-)]	N/A	
Adequate exercise (yes)	Self rating on whether level of participation in physical activity is sufficient or not	1[1(+)]	2.9	

Number of studies reporting the variable is provided before parentheses
Number of studies reporting a particular signed effect is provided before brackets
Signs of effects are in brackets: positive (-), negative significant effect (-), mixed significant effect (~), no significant effect (0)

[65] The statistical significance levels were set at 5%.
[66] The qualitative effects are not presented here for clarity, as the purpose of that column is to portray the magnitude of the quantitative effects.
[67] No effect sizes were provided as the statistical analysis involved only significance tests (applies to all such notations on this table).

It is notable that the effect of BMI was investigated indirectly in a pathway analysis, which sought to ascertain how the effect of BMI on ‘perceived pressure to lose weight’ impacts the formation of perceived benefits that in turn affects physical activity (Gillison et al., 2006).The path was found to be statistically significant ($p<0.01$) for males but not females.

2.4.4 Discussion

This discussion considers the extent to which the review informs the selection of perceived benefits and other variables for empirical analysis. The discussion ends by considering potential gaps in the current literature.

Any new perceived benefits identified?

It has been demonstrated that people expect a variety of benefits from physical activity participation in England, and that the degree of expectation about these benefits tends to affect physical activity behaviour. An important consideration is the extent to which these perceived benefits relate to those in section 3, given that the purpose of this review was to fill an information gap in that section. Whilst there is equivalence across the perceived benefits identified from both, a few items (i.e. ‘to meet people’; ‘to get outdoors’) were missing in section 3, which emphasises the importance of section 4 in contributing guiding the selection of perceived benefits for empirical analysis. Yet, inadequate evidence was found on perceived benefits sourced from a general England population because only one paper (i.e. Zunft et al., 1999) collected such data. The remaining papers tended to elicit perceived benefits from populations in specific regions of England (e.g. south west England, Midlands, London). Nonetheless, the perceived benefits observed in the latter were similar to that of the former study.

The evidence on perceived benefits still have a number of limitations. First, the majority (n=9) of studies provided no justification, either statistical or theoretical, with regard to the sample sizes used. Therefore, it is difficult to assess whether the response rates were sufficient to provide answers to the research questions.

Second, there was limited information on the method of sampling applied in a number of studies (n=4). Most studies (n=9) used samples that are not representative of England as they were from specific regions of England, a narrow age range (e.g. 63-79 years), or gender specific. Third, only a few studies (n=4) provided information on the reliability and validity of the survey instruments used for data collection, making it difficult to ascertain how reliable those data are. Nevertheless, confidence could be drawn from the findings because the studies particularly drawn upon[68], addressed these anomalies.

Potential predictors for empirical analysis

A number of correlates of physical activity behaviour were discovered, and would be considered for empirical analysis. These variables spanned psychological, health and socio economic factors. Notably, there seems to be congruence between these factors and those observed across the previous reviews but with a few exceptions. The new variables were: adequate exercise, perceived activeness, deprivation of are of residence, and adult carer. Although these variables were rarely studied (n=1), their moderate 'effect sizes' show them to be potentially important predictors. It is also interesting to note that the effect of BMI[69], which was 'surprisingly' missing in all the earlier reviews, was studied here. Yet, the nature of that analysis makes it difficult to decipher evidence on the direct effect of BMI for empirical work. Nonetheless, the effect of BMI may need to be explored in empirical analysis to account for its potential confounding effect.

Gaps in the current literature

Although the current literature has demonstrated that people expect a variety of benefits from physical activity participation, the relative importance place on these perceived benefits was not clearly demonstrated. The latter ought to be accounted for in research on perceived benefits because it moderates the relationship between these benefits and physical activity (Williams et al., 2005). An increase in current levels of physical activity participation can only be attained 'if people are *aware* of, understand and *want* the benefits of being

[68] These were studies that used samples from general England population
[69] See section 1(specifically 2.1.4) for the argument on BMI

active' (DH, 2005, p. 6) (my italics) or when people '*see* and *want* the benefits' related to physical activity participation (DH, 2004, p. iv) (my italics). A key to understanding individual behaviour is to investigate what they place importance on because that tailors the choices people make (Divine and Lepisto, 2005; Erdem et al., 1999). This becomes useful in the case of physically inactive people who are aware of the benefits of physical activity but still not exercising. A probable clue to understanding their physical activity behaviour is to know the importance they place on those benefits.

There is notably limited research on the relationship between perceived benefits and physical activity participation (Wilcox et al., 2006; Williams et al., 2005). Most of the studies (n=6) explored general perceptions or perceived benefits but not necessarily to investigate the impact of these benefits on physical activity behaviour. When the effect of perceived benefits has been studied (n=5), univariate analysis are largely used (n=3) thereby questioning the robustness of the findings. Failing to adjust for potential cofounding variables may lead to inaccurate inferences as the observed effect may be caused by an unobserved variable (Maddala, 2001).

Furthermore, most studies (n=9) did not account for intensity of participation in the measurement of physical activity. To inform public health policies, the intensity, frequency and duration ought to be accounted for. Although this may not be necessary if the objective is to explain participation or not, it becomes useful when the intention is to determine active or inactive behaviour because of difficulties of interpretation. For example, in Zunft et al. (1999), participants reported inactive behaviour though they were doing at least an hour of physical activity per week. The puzzle is how one interprets the 'activeness' of their physical activity behaviour because to know whether they are active or not, there should be information on the frequency, duration and intensity of their physical activity per a reference period. Such information is missing in current research.

CHAPTER 3 Framework for empirical analysis

3.1 Introduction

Chapter 3 aims to set out and justify a theoretical framework as well as consider what evidence could be used to test the model empirically using English or UK specific data. The emphasis is on English/UK data because the purpose of this thesis as set out in chapter 1 is to understand demand for physical activity in England. The subsequent sections of this chapter cover description of the theoretical model, followed by methods and results of the search for data, and the discussion focuses on their implications for work in forthcoming chapters

3.2 Theoretical framework

Chapter 2 (specifically section 1) identified a theoretical economic framework, which accounts for both costs and perceived benefits, as the most suitable for explaining the demand for physical activity. This theoretical framework was selected because it was found to be the strongest model based on the general and contextual selection criteria used to evaluate the strengths and weakness of the different categories of models (see details in chapter 2). The concept of this framework indicates that the rational consumer maximises his utility that reflects his preference for physical activity, subject to both time and budget constraints. The maximisation process involves the consumers' comparison of costs and perceived benefits of physical activity participation. Thus, physical activity behaviour, which could take various specifications (such as to participate or not; time spent; number of days, meet the recommended level of participation or not), is determined by, inter alia, costs and perceived benefits related to consumption of physical activity, all things being equal. The theoretical model is mathematically derived as follows:

A rational individual is assumed as having a utility function:

$$U = u(p, d) \qquad (1)$$

where p = physical activity

d = other goods (composite good)

s.t.

$$I = mp + vp + cd \qquad (2)$$

(money budget constraint)

where I= total income available

m = direct cost related physical activity

(e.g. entrance charges)

v = indirect cost related to physical activity

(e.g. travel money costs)

c = costs incurred on composite good

and s.t.

$$T^{70} = tp + бd \qquad (3)$$

(time budget constraint)

where T= total time available

t = time cost related to physical activity (e.g. travel time)

б = time cost related to composite good

Hence the costs (C) associated with physical activity participation represent both time and money costs as expressed in terms of equations 2 and 3:

$$C = mp + vp + tp \qquad (4)$$

Maximisation of the utility function is attained, as the individual attempts to maximise equation (1) subject to the constraints of equations (2) and (3). This constrained maximisation is solved using the Lagrangian multiplier:

$$\text{Max } u (p, d) + \lambda_1 [I - mp- vp - cd] + \lambda_2 [T- tp - бd] \qquad (5)$$

The first order conditions are derived by partially differentiating equation (5) with respect to the arguments of the utility function and the Lagrangian multipliers:

$$\partial u (p, d) /\partial p - \lambda_1 (m–v) – \lambda_2 = 0 \qquad (6)$$

$$\partial u (p, d) /\partial d – \lambda_1 c – \lambda_2 б = 0 \qquad (7)$$

$$\partial u / \partial \lambda_1 [I–mp-vp-cd] = 0 \qquad (8)$$

[70] If time is assumed to measured in similar units, then ‘T’ can be defined a residue of time spent in the labour market.

$$\partial u / \partial \lambda_2 [T - tp - бd] = 0 \quad (9)$$

Equations (6); (7); (8) and (9) are rewritten as:

$$\partial u / \partial p = \lambda_1 (m + v) + \lambda_2 t \quad (10)$$

$$\partial u / \partial d = \lambda_1 c + \lambda_2 б \quad (11)$$

$$\partial u / \partial \lambda_1 \equiv I = mp + vp + cd \quad (12)$$

$$\partial u / \partial \lambda_2 \equiv T = tp + бd \quad (13)$$

From here the equimarginal principle which indicates the optimal condition is obtained. At this point the individual allocates his time and money resources among the arguments of the utility function to attain an optimum point where his utility is maximised. This optimum point is achieved by setting equation (10) to equation (11):

$$MUp / \lambda_1 (m + v) + \lambda_2 t = Mud / \lambda_1 c \; + \; \lambda_2 б \quad (14)$$

Equation (14) can be rewritten to indicate the 'point of tangency' which is a sufficient condition[71] for optimal choice.

$$MUp / MUd = \lambda_1 (m + v) + \lambda_2 t / \lambda_1 c + \lambda_2 б \quad (15)$$

Utility is maximised at this point, with the marginal rate of substitution (i.e. the ratio of marginal utilities or marginal benefits between physical activity and composite good) equalling the ratio of costs related to physical activity and composite good. At this point, the indifference curve is tangent to the budget line. To reach this optimum condition, the individual allocates available resources (i.e. time and money) to consume arguments of the utility function such that the marginal benefit of each argument is equal to the marginal cost. So, when the benefit of consuming say one extra unit of physical activity is greater than the cost of that extra unit, the individual will consume more of physical activity and vice versa.

This framework indicates that individuals tend to consider costs and perceived benefits in decision making to do physical activity, holding other things constant.

[71] Although it does not hold for all cases (e.g. when the consumption of one good is zero).

Thus, to test this model empirically and understand physical activity behaviour, the empirical research of this thesis is steered by the exploration of the impact of costs and perceived benefits on the uptake of physical activity, controlling for other factors (socio-demographic, health, psychological and others - information forthcoming in section 3.4 on their selection).

3.3 Data search

Given that the theoretical model postulates costs and perceived benefits as the main predictors of physical activity behaviour, the data search for empirical analysis aims at identifying datasets that have information on these factors, alongside indicators of uptake.

3.3.1 Methods

3.3.1.1 Search Strategy

The search for datasets was conducted in April 2007[72] using four main approaches:

1. A search was conducted in the UK Data Archive[73] (UKDA). Set up in 1967, the UKDA is a custodian of the biggest collection of digital data in social sciences and humanities in the UK. It is also in charge of the management of the Economic and Social Data Service (ESDS) as a lead collaborator. The strategy in UKDA was to browse by subject using ‘physical activity and fitness’. Regular monthly updates were undertaken till September 2008.
2. Datasets identified from literature reviews conducted in chapter 2.
3. Recommendations of 10 researchers (see Appendix 3.1) in the field of physical activity both in England and abroad were sought. The researchers were specifically asked whether they were aware of any datasets with data costs or/and perceived benefits of physical activity participation as well as indicators of participation in England. These researchers were mainly identified via the literature reviews conducted in chapter 2, and contacted because their analytic experience of physical

[72] Regular monthly updates were however undertaken afterwards.
[73] Set up in 1967, the UKDA is a custodian of the biggest collection of digital data in social sciences and humanities in the UK. It is also in charge of the management of the Economic and Social Data Service (ESDS) as a lead collaborator. The strategy in UKDA was to browse by subject using ‘physical activity and fitness’.

activity behaviour was expected to increase the likelihood of awareness of relevant datasets.

4. Recommendations of survey research organisations in England such as Sports England, National Centre for Social Research (NATCEN), and British Market Research Bureau (BMRB). These organisations were approached because they are in charge of running national surveys on physical activity in England (see Appendix 3.1 for details for the surveys they organise). In addition, recommendation from personnel of UKDA were taken as being data custodians, they may have been approached on similar issue and hence would have important ideas to offer.

3.3.1.2 Selection criteria

A dataset was selected for review if it was based on the English/UK general adult (16 years and above) population and had data on indicators of physical activity behaviour.

Selected datasets were then examined to check whether they had data on cost or/and perceived benefits related to participation in physical activity. The data on costs and perceived benefits could cover any of the components of these factors identified in chapter 2 (sections 2-4). For the former, these include both time and money costs (direct and indirect costs) while the latter cover health and non-health benefits.

A number of criteria were also used should multiple possibilities arise. First, the comprehensiveness of indicators of physical activity covered by datasets was assessed. This is important because datasets with more coverage of the indicators of physical activity affords various specifications of physical activity behaviour to advance knowledge, given that current research as indicated in chapter 2 (section 2) ignore certain specifications (e.g. meeting recommended level of participation).

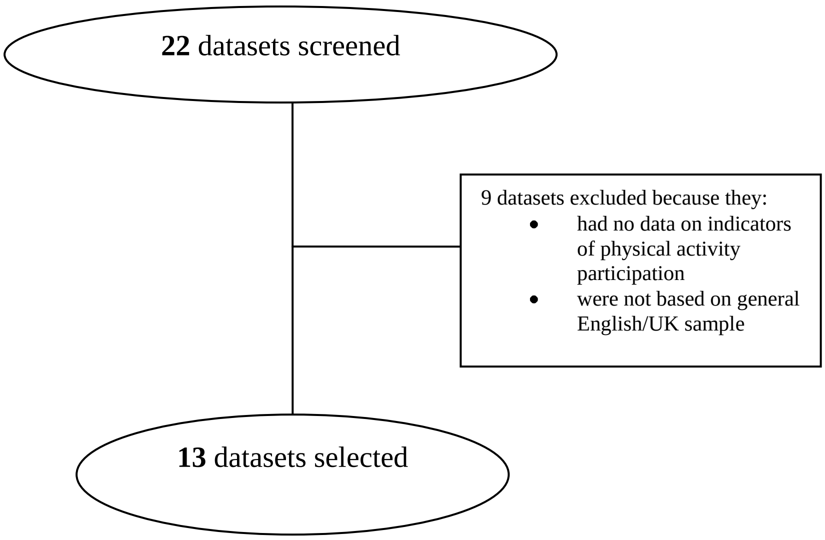
Second, information on the year of data collection was examined because the most current dataset is more likely to provide a picture of current uptake levels.

Third, whether the dataset (or survey) is repeated (and still running) or a one time study was also considered because the former was useful for alternative routes of future data collection (forthcoming in section 4), which could be relevant if there were a lack of data. A lack of data was suspected because chapter 2 (sections 1&2) found that inadequate data on costs was the most stated challenge facing research on physical activity behaviour (and its proxies).

3.3.2 Results

Figure 3.1 shows that 22 datasets were yielded by initial search. After screening these datasets, 13 met the selection criteria. Table 3.1 describes the selected datasets and the research objectives they can potentially address.

Figure 3. 1 Selection of datasets



None of the 13 remaining datasets had data on either time or money costs related to physical activity participation. Only one dataset (Health Education Authority National Survey of Activity & Health (1991)) had data on perceived benefits related to physical activity participation, though these benefits were tied specifically to vigorous exercise[74]. A notable exception regarding data on costs is

[74] Vigorous exercise specified as an activity that makes you out of breath or sweaty.

the Expenditure and Food Survey (1994-2005)[75] which has data on money cost (i.e. weekly expenditure on participant sports) but no data on indicators of physical activity participation.

Six datasets including HEANSAH, Health Survey for England, Taking Part Survey, Health Education Monitoring Survey, Active Life Survey; and OPCS/ONS Omnibus Survey had the most comprehensive data on indicators of participation in physical activity with data covering frequency, intensity, and duration of physical activity. All datasets had data on socio demographic variables including education, employment, age and others.

Forty-six percent (n=6) of the datasets were collected after 2000. Out of those, the Health Survey for England was the most recent, with data collected between January 2006 and May 2007. Only three datasets (Health Survey for England, Taking Part Survey, and General Household Survey) were repeated studies that are still running.

[75] Not presented on Table 3.1 because it does satisfy the selection criteria (i.e. no data on indicators of physical activity behaviour).

Table 3. 1 Selected datasets

Datasets	Data on costs	Data on perceived benefits	Coverage of Indicators of PA behaviour	Dates of data collection	Time dimension
Health Education Authority National Survey of Activity & Health (1991)	X	✓	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	March 1991-July 1991	One time study
Health Survey for England (1991/2; 1993; 1994;1997; 2000; 2002; 2003; 2004; 2006)	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	January 2006- May 2007	Repeated study (running)
Taking Part Survey 2005/6	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	July 2005-October 2006	Repeated study (running)
General Household Survey (1990/1; 1993/4; 1996/7; 2002/3)	X	X	(a) Frequency of participation	April 2002-March 2003	Repeated study (running)
Trent Lifestyle Survey Adults and Young People (1992, 1994)	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	February 1994-April 1994	Repeated study (1992&1994)
Health Education Monitoring Survey [1995, 1996, 1997(follow up), 1998]	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	May 1998-July 1998	Repeated study (up till 2000)
British Household Panel Survey (1991-2004)	X	X	(a) Frequency of participation	September 1991-May 2004	One time study (longitudinal)
UK Time Use Survey (2000)	X	X	(a) Frequency of participation	June 2000-September 2001	One time study
Active People Survey (2005-2006)	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	October 2005-October 2006	One time study
OPCS/ONS Omnibus Survey (1992, 1996,1997,1998,1999)	X	X	(a)Intensity of participation (b)Frequency of participation (c)Duration of participation	March 1999-April 1999	Repeated study (up till 1999)
Population Based Computer Assisted Telephone Interviewing survey of lifestyles and Health in 3 British Cities (1990-1991)	X	X	(a)Intensity of participation (b)Frequency of participation	September 1990-September 1991	Repeated study (up till 1991)
Health and Lifestyle Survey (1991-1992)	X	X	(a)Frequency of participation (b)Duration of participation	September 1991-october 1992	One time study (longitudinal)
Slimming (1967)	X	X	(a) Frequency of participation	April 1967	One time study

Source: (UKDA, 2007; 2008)

3.4 Implications for empirical research

The results show that no dataset had data on costs (time and money) and only one had data on perceived benefits. Given that the theoretical framework for empirical analysis suggests that both costs and perceived benefits are accounted for, three potential routes could be envisaged to steer future empirical research: (1) use of single datasets (2) merging of individual datasets (3) collection of primary data.

3.4.1 Are there any individual datasets that could be used?

Although the ideal situation to empirically test the hypothesis set out in the theoretical framework would be to establish the impact of costs and perceived benefits controlling for other factors using a single dataset, a series of analyses aimed at exploring the impact of these factors (among control factors) separately using available datasets could still provide useful insights.

For the analysis on perceived benefits, data could be sourced from HEANSAH (1991) and the focus will be to explore the role of these benefits among control factors in explaining participation in physical activity.

The choice of a dataset for the analysis on time and money costs is, however, complicated considering that no dataset had data on costs. Nonetheless, as indicated by the reviewed literature in chapter 2 (specifically sections 1 and 2), when data on time and money costs is not available, proxies (i.e. education and employment status) could be used to at least capture the impact of time costs (indicated as opportunity cost of time) on physical activity. Hence, a similar approach could be followed here to explore the role of time costs (among control factors). All datasets had data on these proxies and hence were eligible for selection. However, based on the selection criteria, the HSE (2006)[76] is the obvious choice since it provides the most current data and comprehensive data on indicators of physical activity participation.

These analyses will advance knowledge in a number of, albeit limited, ways. First, it will demonstrate the influence of time cost and perceived benefits on physical activity behaviour in England, effects hitherto lacking in the literature. Second, insight will be given on the determinants (via the control factors) of the

[76] At the time of conducting the analysis, HSE (2006) was the latest but ever since then HSE (2007) has been released.

choice of individuals' to meet the recommended level of participation in physical activity, which is important to know given the paucity of evidence on such factors despite that decision being a thrust of current policies in England (DCMS, 2008; DH, 2005; DCMS, 2002). These advances in knowledge and others (forthcoming in the empirical chapters) could help specify policy options to encourage uptake of physical activity in England.

Such analyses, however, have limitations as neither offers a full empirical testing of the theoretical framework and the estimated effects of either costs or perceived benefits are likely to be confounded by either. The analyses will not provide information on money costs. In addition, given that the perceived benefits in HEANSAH (1991) are limited to vigorous exercise, hence results may not be transferable to other indicators of physical activity behaviour. The effect of perceived benefits on the other indicators of physical activity is important to know because explanators of physical activity participation could differ depending on the type of physical activity in question (Sallis and Hovell, 1990).

Control variables

Control variables refer to factors that are likely to have a correlation with physical activity and thus have to be accounted for in each of the analyses in order to provide robust estimates for the empirical testing of the theoretical model (Maddala, 2001). The selection of these factors, which include socio-economic, health, and psychological variables was based on the literature reviews undertaken in chapter 2. A variable was selected if it: (a) had at least a statistically significant[77] association with physical activity (or its proxies) in a study, and (b) has been specified exactly in the dataset or (b) could be proxied. Table 3.2 presents an overview of how these variables were specified both in the literature and in either dataset to be used for the analyses.

[77] But not necessarily by all the studies that investigated the variable's relationship with physical activity.

Table 3. 2 Specification of control variables

Control variable	Specification of variable in the literature	Specification of variable in HEANSAH (1991)	Specification of variable in HSE (2006)
Socio-economic			
Age	Age in years	Age in years	Age in years
Income	Total income of individuals/household		Total income of household
Gender	Male or Female	Male or Female	Male or Female
Education	(a) Highest educational level attained (b) Number of years spent in education	a) Educated or not b) Type of educational qualification	Type of educational qualification
Ethnicity	Non white or White	Non white or White	White, non white (i.e. mixed race; Asian; Black; Chinese)
Marital status	Married or not	Married, single, divorced/separated/widowed	Married(living), single, other
Employment status	(a) Employed or not (b) Types of occupation	Full time or part time or unemployed	Employed or not
Working hours	Weekly working hours	NA	Weekly working hours (full time/part time)
Health			
Health status	(a) Self -report on general health condition (b) Number of illnesses reported in the past 2 weeks (c) Self-reported mental health condition	Self -report on general health condition	Self -report on general health condition
Smoking	Smoker (no. of cigarettes smoked daily) or non smoker	Smoker (no. of cigarettes smoked daily), ex smoker, non smoker	Smoker or non smoker
Drinking status	(a) Amount of alcohol consumption daily (b) Consume alcohol or not	Consume alcohol or not	Consume alcohol or not
Psychological			
Subjective norms	Advice/support from family, friends, or exercise instructors encouraging respondents' uptake of physical activity	Are you encouraged by family or friends to do exercise?	NA
Perceived activeness	Self report on own level of fitness	Self appraisal of level of physical activity participation compared to peers	NA
Adequate exercise	Self-rating on whether level of participation in physical activity is sufficient or not	Do you get enough exercise to keep you fit?	NA
Others			
Children in h'hold	Presence/number of children (i.e. under 16 or 18 years) in household	NA	Number of children (i.e. under 16 years) in household
Adults in h'hold	Number of adults (i.e. above 16 or 18 years) in household	NA	Number of adults (i.e. above 16 years) in household
Seasonal effect	Seasons of year: summer, spring, autumn, winter (captured via month of interview variable)	Seasons of year: summer, spring[78] (captured via month of interview variable)	Seasons of year: summer, spring, autumn, winter (captured via month of interview variable)
Region of residence	(a) State in which respondent resides (US) (b)Region of residence in UK/England	NA	Region of residence in England: North east, North west, Yorkshire, East Midlands, West Midlands, East, London, South West
Participation in	Hours spent on arts and other	NA	Participation in voluntary

[78] The data collection covered March 1991 to July 1991 and hence the specification included only summer and spring.

Control variable	Specification of variable in the literature	Specification of variable in HEANSAH (1991)	Specification of variable in HSE (2006)
voluntary activities	volunteering		activities or not
Urbanisation	Rural or urban resident	NA	Rural or urban resident
Access to vehicle	Own or use a motor vehicle	Access to motorcycle, van or car	Access to vehicle in household or not
Barriers	Things that stop people from engaging in physical activity:	Things that stop people from engaging in physical activity	NA
Lifestyle problems	Self report of health problems that affect lifestyle	Whether your present state of health is causing problems with your participation in exercise	NA
Adult carer	Have care responsibilities over adult(s)	Caring for disabled adult	NA
Driving license	Have a driver's license or not	Have a driver's license or not	NA

NA: Not available

A priori expectations for control variables

A priori expectations about these variables were developed in light of the findings in the literature (see Table 3.3). In developing the expected effects, consideration was given to the methodology (e.g. the specification of the dependent variable and the control variable; the origin and characteristics of the sample) used by the papers reporting those findings. These a priori expectations are similar for both analyses because either the dataset sourced information from the same population (i.e. England) or the specification of control variables does not vary.

A positive relationship is expected between physical activity behaviour and the following variables: gender (male), income, education (yes/high), subjective norms (yes), drinking status (drinkers). These expectations are described and justified as follows in order of likelihood[79].

Gender (male) is expected to be positively related to physical activity because most of the findings in the literature suggest so (Wu and Porrel, 2000; Lera-Lopez and Rapun-Garate, 2005, 2007; Humphreys and Ruseski, 2006; Gillison, 2006; Downward, 2007; Farrell and Shields, 2000; Mulvihill et al., 2000; Bhat, 2005) and also those studies used methods comparable to this research in terms of specification of dependent variable and characteristics of sample. The strength

[79] Same order of presentation applies to the variables with expected negative effect.

of the positive influence was found to be relatively moderate, with ME=0.21 (t stat=4.48) in Farral and Shields (2000) and the rest reporting coefficients ranging from 0.01 to 0.59 (p value (p) < 0.01). A few studies though reported negative (Proper, 2000; Mummery et al., 2000), mixed (Downward, 2004; Humphreys and Ruseski, 2006) or no relationship (Jones 2005), using dissimilar methods. For example, Propper (2000) had a different specification for dependent variable (i.e. health) while Mummery et al. (2000) and Humphreys and Ruseski (2006) used Canadian and US samples respectively.

Table 3. 3 A priori expectations about variables

Variables	**Reported signs with PA (and its proxies)**	**Reported 'effect sizes' with PA (and its proxies)**						**Expected signs**
		Marg. effect (ME)		Coefficient (CF)		Odds ratio (OR)		
		lowest	highest	lowest	highest	lowest	highest	
Gender (male)	14 [2(-), 9(+), 2(~), 1(0)]	0.00	3.68	0.01	0. 59			+
Income	18 [1(-), 10(+), 3(~), 4(0)]	0.00	3.34	000	36.17			+
Education (yes/high)	13 [11(+), 2(0)]	0.01	0.26	0.03	102.95	1.8		+
Subjective norms (yes)	10[4(+), 6(0)]			0.23				+
Drinking status (drinkers/high)	4[3(+), 1(~)]	0.14	0.56	0.04	0.14			+
Health status (unfavourable)	8[7(-), 1(+)]	0.00	0.13	0.00	0.34			-
Age	19 [10(-), 6(+), 3(~)]	0.01	0.08	0.00	37.55	2.2	14.8	-
Seasonal effect (winter)	2 [2(-)]			0.03	0.96			-
Smoking status (smokers/high)	6[5(-), 1(0)]	0.00	0.10	0.04	0.76			-
Working hours	3[3(-)]	0.01		0.01	0.04			-
Barriers (yes)	4[4(-)]	N/A						-
Employment status (employed/skilled occupational types)	6[3(-), 1(+), 2(~)]	0.05	0.12	0.19	0.65			?

Variables	Reported signs with PA (and its proxies)	Reported 'effect sizes' with PA (and its proxies)						Expected signs
		Marg. effect (ME)		Coefficient (CF)		Odds ratio (OR)		
		lowest	highest	lowest	highest	lowest	highest	
Ethnicity (non white)	7 [3(-), 3(~), 1(0)]	0.06	1.21	0.01	2.39			?
Children in h'hold (yes/high)	12 [4(-), 3(+), 4(~), 1(0)]	0.00	0.50	0.00	236.99			?
Adults in h'hold (yes/high)	3 [1(-), 1(+), 1(~)]	0.10	0.28	0.18	0.27			?
Region of residence (London)[80]	3 [1(-), 1(~), 1(0)]			0.34	0.56			?
Marital status (married)	6[3(-), 1(+), 2(~)]	0.06	1.71	0.00	18.1			?
Participation in voluntary activities (high)	1[1(+)]			0.12				?
Driving license (yes)	1[1(+)]			1.40				?
Access to vehicle (yes)	1[1(+)]			0.33				?
Urbanisation (urban)	1[1(~)]			0.011	0.014			?
Adult carer (yes)	1[1(-)]	N/A						?
Lifestyle problems (none)	1[1(+)]					1.6		?
Adequate exercise (yes)	1[1(+)]					2.9		?
Perceived activeness (yes)	1[1(+)]					11.6		?

Number of studies reporting the variable is provided before parentheses
Number of studies reporting a particular signed effect is provided before brackets
Signs of effects are in brackets: positive (-), negative significant effect (-), mixed significant effect (~), no significant effect (0)

The effect of **income** on physical activity (or its proxies) was mostly found to be positive (Farrell and Shields, 2002; Downward, 2007, 2004; Humphreys and Ruseski, 2007; Cameron et al., 1988; Owen, 1971; Barnett, 1979; Atriostic, 1982; Rosenzweig and Schulz, 1983; Propper, 2000) and with a strong influence.

[80] This refers to the omitted category for the reported negative effect as the studies reporting the other finding did not provide details of the omitted category.

For example Downward (2004) found increases in income to reflect highly positively (ME vary from 2.78 to 3.34, $p < 0.05$) on physical activity. A few articles however reported a negative (Darrough, 1997), mixed (Humphreys and Ruseski, 2007; Alenezi and Walden, 2004; Dustmann and Windmeijer, 2000) or no effect (Lera-Lopez and Rapun-Garate, 2005, 2007; Solberg and Wong, 1991; Aronsson et al., 2001). Nonetheless, a positive effect is expected as high income is indicative of the ability to afford money cost of physical activity participation given that physical activity is a normal good (Gratton and Taylor, 2000). In addition, the studies that showed the positive effect mostly used a British/UK adult sample, specified physical activity as the dependent variable and specified income as household income. Conversely, the study that found the negative effect used a Japanese sample and specified leisure as the dependent variable.

The evidence in the literature consistently suggested a positive effect of **education** (yes/high) on physical activity (or its proxies) (Wu and Porrel, 2000; Propper, 2000; Havemann, 1994; Arronson et al., 2001; Mullineaux et al., 2000; Zunft et al., 1999; Bentzen et al., 1989; Chinn et al., 2006; Downward 2004, 2007; Farrel and Shields, 2002). The strength of the effect was found to be high, with coefficients ranging between 0.25 and 102.95 ($p < 0.10$). Two studies (Lera-Lopez and Rapun-Garate, 2005, 2007), however, found no effect. Despite the consistency in findings, it is still not straightforward to formulate the expected sign because high education could reflect a high opportunity cost of time as the well-educated tend to have high wage earnings (Humphreys and Ruseski, 2007, 2006) and therefore a high shadow price of leisure (i.e. foregone earnings in the labour market). The direction of the effect of opportunity cost of time is, however, complicated because it depends on offsetting income and substitution effects (Ekelund and Ritenour, 1999).

The income effect corresponds to a positive effect of opportunity cost of time because if physical activity is a normal good, then high opportunity cost of time which shows high income will reflect positively on participation. The substitution effect however signifies a negative effect as high opportunity cost of time means non-labour uses of time are non-profitable, increasing the tendency for the latter to be substituted for labour time. Still, it can be argued that educated people are more likely to do physical activity because they may have developed permanent preferences via years of sports participation in school and also be more aware of the benefits of physical activity (Farrell and Shields 2002). Also, considering the similar methods (i.e. specification of dependent variables; sample characteristics) shared between this current research and most of the literature (Wu and Porrel, 2000; Mullineaux et al., 2000; Zunft et al., 1999; Chinn et al., 2006; Downward 2004, 2007; Farrel and Shields, 2002) it is likely that the effect of education would be positive.

Subjective norms (positive) are also expected to have a positive influence on physical activity behaviour because, given the intention to engage in behaviour (e.g. physical activity), support from close relations is likely to promote uptake (Ajzen and Fishbein, 1980). This is supported by findings in the literature as subjective norms (positive) reflected directly on physical activity (Stathi et al., 2004; Ussher et al., 2007; Mummery et al., 2000; Hagger et al. 2001(b)) though a number of studies (Mulvihill et al., 2000; Hagger et al., 2001; Payne et al., 2002; Downs and Hausenblas, 2003; Sheeran and Orbeil., 2000; Norman et al., 2000) found no effect. The 'effect sizes' though are unknown given that none of the studies reported quantitative effects; they largely used significance tests of association to assess the relationship between physical activity and subjective norms.

Drinking status (yes/high) was principally showed to have a direct relationship (ME=0.14 to 0.56; $p < 0.05$, t stat >2) with physical activity (Farral and Shields, 2002; Downwards, 2004, 2007). A mixed effect was however found in Wu and Porrel (2000), who used an adult US sample and found a negative (CF=-0.04, $p < 0.01$) and a positive effect (CF=0.04 to 0.07, $p<0.10$) for heavy and moderate drinking respectively. A positive effect will be argued for drinking status (drinkers) as the former used general adult English/UK samples, and also drinkers are likely to engage in physical activity considering the 'social environment' it provides (Farrell and Shields, 2002).

A negative sign is expected for: health status (unfavourable), age, seasonal effect (winter), smoking status (smoker), working hours, barriers (yes).

The effect of **health status** (unfavourable) on physical activity has been consistently negative in the literature. Using a representative English/British sample, Farrel & Shields (2002); Propper (2000) and Downward (2004, 2007) found that people with unfavourable health status are less likely (ME vary from -0.00 to -013; $p < 0.05$, t stat > -2) to engage in physical activity (or its proxies). Similarly, Wu and Porrel (2000) and Humphreys and Ruseski (2006, 2007) found a negative effect (CF range from -0.00 to -0.34; $p<0.10$) for unfavourable health using US samples. Cameron (1998) however found health (unfavourable) to be directly related (CF vary from 0.01 to 0.26; t stat >1) with utilisation of health care among single, adult Australians. A positive effect of health (unfavourable) in the latter context is unsurprising since the dependent variable was specified as 'health care utilisation'. Considering that the dependent variable and samples used in the former were mainly physical activity and English/British correspondingly; a positive effect is expected.

An increase in **age** mostly reflected inversely (ME vary from -0.01 to -0.08, $p < 0.10$) on physical activity (or its proxies) (Mullineaux et al., 2000; Wu and Porrel, 2000; Kooreman and Kapetyn, 1987; Zunft et al., 1999; Payne et al., 2002; Bentzen et al., 1989; Tai et al.,1999; Farrell and Shields, 2000; Downward, 2004; 2007). This may be due to the health limitations associated with increasing age (Grossman, 1972), which may deter uptake. However, a mixed effect was found in Arronson et al., (2001), Humphreys and Ruseski (2006, 2007) and a few others (Wrick et al., 1966; Jones et al., 2005; Dustman and Windmeijer, 2000; Gronau, 1977; Lera-Lopez and Rapun-Garate, 2005, 2007) reported a positive effect (CF range from 0.00 to 11.8; $p<0.05$, t stat > 2). The former rather than the latter is expected due to the following reasons. First, Jones et al. (2005) used a relatively 'old' sample aged from 35 to 55 years and specified physical activity behaviour as attendance in an exercise referral programme. Although the attendance of such programmes could indicate the intention to engage in physical activity, its adequacy as an indicator for actual behaviour is questionable (Chinn et al., 2006). Second, the remaining studies used non-English samples, and all except Lera-Lopez and Rapun-Garate (2005, 2007), Humphreys and Ruseski (2006, 2007) used leisure or health as dependent variable.

A negative effect is expected for **seasonal effect** (winter) as findings point to a consistent negative effect with Humphreys and Ruseski (2006), and Bhat (2005), reporting low (CF vary from -0.028 to -0.116 $p < 0.10$) and high influences (CF range from -0.513 to -0.956 t stat >-1) respectively. Moreover, it is reasonable to expect unfriendly weather conditions during winter to deter people from participation in physical activity though few activities such as skiing may enjoy a rise in participation (Cooke, 1994).

Likewise, findings on **smoking status** (smokers/high) were consistent, with Wu and Porrel (2000); Propper (2000); Chinn et al. (2006); Farrell and Shields (2000); Downward (2007) proving a negative but not strong effect (ME vary from - 0.00 to -0.10, CF range from 0.04 to 0.76; $p < 0.10$) though Downward (2004) found no effect. Given that smoking status is an indicator of lifestyle choices, it can be argued that smokers may have lower discount rates for health (Farrell and Shields, 2000) and hence are unlikely to do physical activity. In addition, the studies mainly used methods similar to HEANSAH (1991) and HSE (2006) in terms of dependent variable and sample characteristics.

A negative influence is expected for **working hours** (full time) considering that findings are consistently negative low and the congruence in methods across those studies and this research. Both Downward 2007 and 2004 used a general adult UK sample, and found respondents working more hours to be less likely (CF vary from -0.04, $p<0.05$; ME=-0.01, $p< 0.05$ respectively) to participate in physical activity. Also, Wu and Porrel (2000) found a negative effect (CF=-0.04, $p<0.10$) though they used a US sample.

Physical activity was often found to be negatively related (between 1% and 10% significance levels) with **barriers** associated with uptake (Bock et al., 2001; Mulvihill et al., 2000; Chinn et al., 2006; Ussher et al., 2007). Given the consistency in findings and the fact that studies mainly used physical activity as the dependent variable and UK samples, a negative effect is expected.

The expected effects of employment status (employed/skilled), ethnicity (non whites), children in household (yes/high), adults in household (yes/high), region of residence (London), marital status (married), adult carer (yes), participation in voluntary activities (high), access to vehicle (yes), urbanisation (urban), lifestyle problems (none), adequate exercise (yes), perceived activeness (yes) and driving license (yes) are treated as indeterminate and therefore future analysis will be hypothesis generating rather than hypothesis testing.

For **employment status**, the expected effect is not self-evident as past research yielded mixed findings. Farrell and Shields (2000), Lera-Lopez and Rapun-Garate (2005, 2007) found a negative effect (ME=-0.08, t stat=-2.61; CF range from -0.20 to -0.65, $p < 0.10$, in that order) for employed people. In contrast, Bhat (2005) found that employed people were more likely to have increased leisure time (CF vary from 0.34, t stat=1.33)**,** while Downward (2007) and Propper (2000) reported mixed effects. It is further complicated to decipher the effect of employment status because all studies except (Bhat, 2005) used comparable methods (i.e. either a general adult UK sample or specified physical activity as the dependent variable). Yet, a positive effect can be argued given that employed people may 'invest' in their health as a form of health insurance (Hjortsberg, 2003) by engaging in physical activity. On the other hand, employed people may have a high opportunity cost of time which makes them less likely to do physical activity (Humphreys and Ruseski, 2007). Even so, the offsetting income and substitution effects make it difficult to be definite on the effect of employment status.

Evidence in the literature does not provide a clear indication of the direction of the influence of **ethnicity** (non whites) on physical activity. A negative effect was found by Downward (2007), Bhat (2005) and Farrell and Shields (2000) though the strength of influence was not high, with the latter for example reporting marginal effect of 0.06 (t stat=-1.97). A few others (Wu and Porrel, 2000; Humphreys and Ruseski, 2006, 2007) however found mixed effects while Downward (2005) demonstrated no effect. Formulating the expected effect of ethnicity (non whites) is ambiguous given that the methods used by studies showing either set of finding were similar. All studies except Downward (2005,

2007) and Farrel and Shields (2000) used US samples. Still, both studies that used UK samples reported incongruent findings.

The effect of **'children in household'** (yes/high) on physical activity participation is inconsistent in the literature. Downward (2004), Chinn et al. (2006) and Bhat (2005) found the 'presence/number of children' in the household as having a positive influence (ME range from 0.16 to 0.50, $p < 0.05$) on participation in physical activity or leisure. Conversely, four studies (Arronson, 2001; Kooreman and Kapetyn, 1987; Gronau, 1977; Van Den Brink et al., 1997) reported a negative effect (CF vary from 0.00 to 236.99; t stat > -1, $p<0.10$). Others (Farrell and Shields, 2000; Klaveren et al., 2000; Downward, 2007; Humphreys and Ruseski, 2007) found mixed effects, with one (Wu and Porrel, 2000) showing no effect. If the presence of children in the household decreases the time allocated to the caring of children at the expense of other activities (Craig and Bittman, 2005), a negative effect for uptake can be expected. However, drawing such a conclusion may not be feasible considering the dissimilarity between the methods used by the studies reporting a negative effect and that of this thesis. All those studies used different specification of the dependent variable (i.e. leisure), and non English samples. Whereas the studies (Downward, 2004, 2007; Farrel and Shields, 2000) using methods similar to this research (in terms of sample characteristics and specification of dependent variable) tended to differ in reported findings.

Mixed findings were reported by the few studies (Downward, 2004, 2007; Bhat, 2005) that investigated the effect of **'adults in the household'** on the physical activity. Downward (2004) found that respondents with higher number of adults in their household were less likely (ME range from -0.10 to -0.28, $p<0.05$) to engage in any sports activity. Others yielded different results with Bhat (2005) showing a positive effect (CF=0.28, t stat=2.5), and Downward (2007) a mixed effect. Both Downward (2004, 2007) used general adult UK sample and specified physical activity as the dependent variable while Bhat (2005) used US sample and a different specification of dependent variable (i.e. leisure). Given the varied nature of the evidence coupled with congruent findings reported by studies with comparable methods, the expected effect is uncertain.

‘Region of residence’ is treated as indeterminate because of inconsistent findings in the literature. Only three studies (Downward, 2007; Farrell and Shields, 2002; Humphreys and Ruseski 2006) studied the effect how ‘region of residence’ influences physical activity participation. All except Humphreys and Ruseski (2006) used English/UK sample but different specifications of ‘region of residence’. Downward (2007) though like this research, specified ‘region of residence’ in terms of government office region; his specification was wider as it included Scotland and Wales. He found positive effects for Scotland (CF=0.56, $p < 0.10$), Wales (CF=0.35, $p < 0.10$), South England (CF=0.51, $p < 0.10$), Midlands (CF=0.34, $p < 0.10$) North England (CF=0.40, $p < 0.10$), with London being the omitted category. Farrell and Shields (2002), found no effect using a similar specification but excluding non-English regions. Humphreys and Ruseski (2006) on the other hand, found mixed effects for ‘states of residence’ in the US.

Evidence on the relationship between **marital status** (married) and physical activity behaviour was conflicting. Farrel and Shields (2002) found a negative effect (ME=-0.06; t stat=2.68) using a general adult English sample. Also, Wu and Porrel (2000), and Humphreys and Ruseski (2006) found married people to be less likely (CF vary from -0.01 to -18.01; $p < 0.10$) to do physical activity in a general adult US sample. Nonetheless, Downward (2007) using an adult UK sample found a positive effect (CF=0.16; $p < 0.05$) with few studies finding a mixed effect (Humphreys and Ruseski, 2007; Downward, 2004). A negative effect is plausible as family commitments may lead to higher time restrictions hence limiting time for physical activity (Andajani-Sutjahjo et al., 2004). However, in light of the inconsistent findings and given that the studies used similar methods to this current research, one cannot be certain about the effect of marital status.

Expected effects for ‘participation in voluntary activities’; ‘driving license’; ‘access to vehicle’; ‘urbanisation’ ‘adult carer’; ‘lifestyle problems’; ‘adequate exercise’; ‘perceived activeness’ on physical activity were considered indeterminate as they were rarely studied (n=1). Moreover, the methods of those studies particularly in terms of specification of these variables and the dependent variables were generally not analogous to HEANSAH (1991) and HSE (2006).

3.4.2 Could different datasets be combined?

This involves linking datasets with cost (i.e. Expenditure and Food Survey (EFS)) and perceived benefits data (i.e. Health Education Authority National Survey of Activity & Health (HEANSAH)) by transferring a money cost variable from the former to the latter via 'out of sample prediction[81]'. The 'out of sample prediction' is based on the estimation of a regression model using the cost variable as the dependent variable in the EFS. This regression model should include independent variables that potentially explain variation in costs and are available in both the EFS and HEANSAH datasets. Next, the dependent variable (i.e. costs) is predicted for in the HEANSAH based on the estimates of the regression model ran in the EFS. Therefore, in the end, the HEANSAH will have data on both costs (via the out of sample prediction) and perceived costs (already available).

The advantage of this approach is that it offers a complete empirical testing of the theoretical model as both costs and perceived benefits are accounted for in a single analysis. However, this approach has the following limitations. First, it is likely to result in wide margins of error given the uncertainty associated with out of sample prediction (Ao, 2008). Second, the cost variable from EFS is defined in terms of total cost (i.e. weekly expenditure on participant sports) and not unit cost[82], which is required to estimate the effect of cost because the essence is to examine how uptake varies with cost per occasion of participation (Gratton and Taylor, 2000). Given these reasons, the merging datasets is considered not workable.

[81] The out of sample prediction is based on the estimation of a regression model using the cost variable as the dependent variable in the EFS. Next, an out of sample prediction for the cost variable using the estimates of the regression model in EFS is undertaken in HEANSAH. It must be noted that the regression model includes variables that are common to both datasets.

[82] A unit cost could not be derived from the total costs either because the EFS had no data on indicators of physical activity.

3.4.3 What options exist for primary data collection?

Another potential approach is to create new data. The advantage of this is that it could offer a complete empirical testing of theoretical models using the same sample, which neither of the previous options offers. Ideally, a new dataset should have data on costs, perceived benefits, control factors and indicators of physical activity participation. In addition, the data would be collected from a randomly selected nationally representative general adult population of England. To obtain such data, a formal request was made to the Department of Health and NatCen to add in questions to the HSE 2008. Unfortunately, the request was not successful because questions on 'vegetable consumption' were given higher priority by the government.

Therefore, the remaining options to create a new dataset were: (a) a follow-up survey to an existing national survey that has already collected data on indicators of physical activity participation - the main purpose here would be to collect data on costs and perceived benefits; (b) a new independent, randomly selected national representative survey that would collect data on costs and perceived benefits alongside indicators of physical activity participation; and (c) a survey that collects data on costs, perceived benefits and indicators of physical activity participation using a convenience sample. The first option only suffices for datasets that are repeated and currently running because that provides the option for a follow-up. Thus, the available alternatives were the Health Survey for England (HSE), the Taking Part Survey (TPS) and the General Household Survey (GHS). The GHS was rejected because it only offers limited coverage of indicators of physical activity (NHS 2009), restricted to only frequency of participation, which will hinder the specification of physical activity behaviour particularly in terms of meeting the recommended level (focus of current policies). The advantages and disadvantages of the alternative approaches to data collection are presented in Table 3.2.

Table 3. 4 Follow up survey vs. new independent survey vs. 'convenience sample survey'

	Advantages	Disadvantages
Follow-up survey	• Direct link to all HSE / TPS data, including objective measurements of physical activity (i.e. in the case of HSE) • No need to repeat questions asked previously unless affected by time. • Possibility to add in questions about continuity of exercise over time • Able to account for probabilities of sample selection, with data on non-responders • All may have given permission to be contacted and therefore response rate likely to be high. • Previous contact may increase the likelihood that people answer cost questions.	• The follow-up survey may potentially be a more motivated group and, given the objective measurement tests particularly in the case of HSE (2008), more likely to want to do physical activity. This may affect the validity of estimations of future demand as we need both to understand the demand of physical activity and potential for increasing demand.
New independent survey	• Could plan to use some of the HSE 2008 / TPS 2008 questions to allow for some linkage • Could access a more representative sample	• No link to objective physical measures • Unlikely to have data on non-responders • Non-responders may also have lower rates of physical activity • Need to ask all physical activity questions, leaving less space for other questions • Likely to have a low response rate and high rates of non-response for cost questions
Convenience sample survey	• Less resource intensive	• Likely to be limited sample • Non-representative and non random sample • No link to objective physical measures • Unlikely to have data on non-responders • Non-responders may also have lower rates of physical activity • Need to ask all physical activity questions, leaving less space for other questions • Likely to have a low response rate and high rates of non-response for cost questions

Based on the comparison provided in Table 3.4, the follow-up survey was the preferred option for future data collection.

Follow–up survey

The decision on which of the alternative approaches (HSE 2008 vs. TPS 2008) is appropriate, was based on the methodology (including the content of the questionnaire) used in both surveys. A summary of their questionnaires is provided in Appendices 3.2-3.

Taking Part Survey (TPS) vs. Health Survey for England (HSE)

The TPS started in July 2005 and ran continuously for three years, with an annual sample size of around 27,000. The achieved sample size was 28117[83] (including a boost sample of ethnic minorities) in 2005-06 and 24174 in 2006-2007. It has a sports element that gathers information on participation in active sport, levers and barriers to participation, and other data around volunteering, and spectatorship of sport.

The HSE is a series of annual surveys about the health of people in England. The Health Survey was first proposed in 1990 to improve information on morbidity by the Department of Health. This information is used to underpin and improve targeting of nationwide health policies. Each year the Health Survey for England focuses on a different demographic group and looks at health indicators such as cardio-vascular disease, physical activity, eating habits, oral health, accidents, and asthma. The sample sizes for the HSE since its inception average about 10, 000 individuals.

Although the methods used by both TPS and HSE appear similar (see Table 3.1), each offered different benefits. These benefits which relates to the coverage of measures of physical activity behaviour are important because they offer a more robust empirically testing the theoretical model through the usage of variant indicators of physical activity behaviour. Using the HSE presented the following advantages: First, a wider coverage of the domains of physical activity participation by gathering data on occupational activity, domestic activity and sedentary time in addition to sports and exercise activities. Second, reporting of fitness tests for respondents and the detailed coverage of the use of sedentary time are likely to help obtain an objective measurement of activity level of the sample. On the other hand, TPS proffered a wider coverage of question areas on sports and exercise activities (including reasons for participation; sports club membership; barriers and levers to participation) and a larger sample size.

[83] Response rate of 55.2%.

On balance, a follow-up survey to the HSE 2008 was considered more satisfactory for future data collection because it has a comparative advantage of providing direct link to objective monitoring of physical activity thereby offering access to richer and accurate information on physical activity. The use of objective measures is important as it reduces measurement biases associated with using solely self reports as indicators of physical activity behaviour (Gillison et al., 2006).

3.5 Conclusion

This chapter has identified a gap in data sources pertaining to costs of participation in physical activity that may be attributable to the paucity of empirical research in demand for physical activity (Gratton and Taylor, 2000). Given the current evidence, the empirical research of this thesis, which is based on a theoretical model that accounts for both costs and perceived benefits among control factors, will employ the approaches justified and described in section 3.4. The emphasis though would be on the use of individual datasets to conduct series of analyses and the collection of primary data because the merging of datasets as already indicated is not feasible.

Chapters 4 and 5 examine the role of perceived benefits, and costs (using proxies) on physical activity behaviour. Owing to the fact that each of these chapters will only afford a partial empirical testing of the theoretical model, a limited understanding of physical activity behaviour, chapter 6 tackles the issue of data inadequacy by developing and pretesting a questionnaire to collect data on both costs and perceived benefits. Chapter 7 fully explores the impact of both time and money costs as well as perceived benefits on physical activity behaviour using data collected via the questionnaire developed in chapter 6. Due to resource constraints, the focus is not a randomly selected representative English sample. Instead, a convenience sample is used to provide some limited quantitative data to illustrate the impact costs and perceived benefits as well as test the questionnaire itself in order to provide recommendations for future data collection.

CHAPTER 4 Perceived benefits and physical activity behaviour

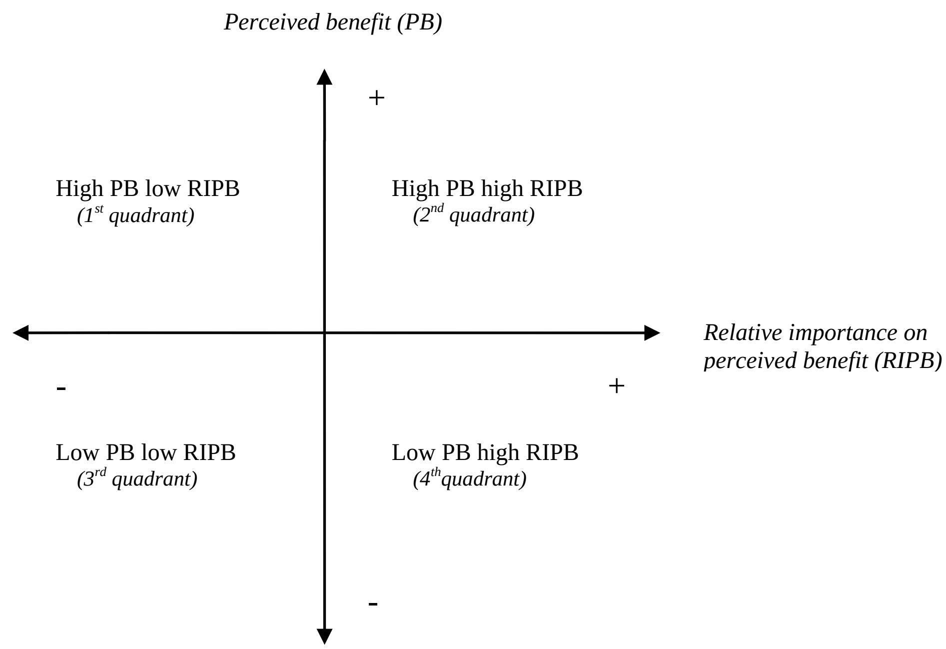
4.1 Introduction

The aim of this chapter is to determine the role of perceived benefits among other factors in understanding physical activity behaviour. Research on perceived benefits and physical activity has not been widely pursued (Wilcox et al., 2006; Williams et al., 2005). Eleven papers were found when such literature was reviewed (see section 4 of chapter 2). These papers included: a general multivariate analysis of the determinants (including perceived benefits) of physical activity participation; a comparison of the degree (i.e. modest or high) of expectations about exercise schemes between 'completers' and 'non completers'; and an exploration of the perceptions or experiences about physical activity participation. The main findings from that review indicated that people expect a variety of benefits from physical activity participation, and that the degree of expectations about these benefits determine uptake.

What is not clear from the literature is the relative importance placed on perceived benefits, which is important to know because it moderates the relationship between these benefits and physical activity (see detailed discussion in section 4 of chapter 2). Investigating the different dimensions of perceived benefits and the importance (see Fig. 4.1) may also provide an understanding of preferences and inform policies intended to encourage physical activity participation by making people aware of the benefits of physical activity.

Thus the underlying objectives of this chapter are to: (a) find out the benefits people expect from physical activity participation; (b) determine whether the expectations and importance of these benefits differ by level of physical activity participation; and (c) investigate the relationship between these benefits (among other factors) and physical activity, and discover the characteristics of target groups at which interventions to increase awareness of benefits could be targeted.

Figure 4. 1 Potential interactions between perceived benefits and relative importance on perceived benefits



The subsequent section of this chapter describes the data and methods used for analysis. Results and discussion are presented in succeeding sections**.**

4.2 Methods

4.2.1 Data

The data used for the analysis was the Health Education Authority National Survey of Activity and Health (HEANSAH) 1991 (see chapter 3 for how this dataset was selected). This survey was undertaken to provide comprehensive data on the levels of physical activity and how it relates to general health. The HEANSAH is a one-time cross sectional face-to-face survey that drew a nationally representative sample of persons aged 16 years and over residing in private accommodation in England. 4200 addresses within 112 parliamentary constituencies in England were targeted for the survey, from which 2837 responses were obtained, indicating a response rate of 70%. One individual was selected from each address by the interviewer who collected data on general health, nutrition, physical activity, diet, drug abuse, alcohol and smoking. The range of questions on physical activity covered time and number of days spent on activities such as sport and exercise, cycling, home activities (i.e. gardening, building work, and housework), walking and occupation as well as attitudes (including perceived benefits) to physical activity. Two versions of questionnaire were administered in the survey. The main and longer version of questionnaire was directed to respondents aged 16-69 years and a shorter questionnaire was administered to respondents aged over 70 years. As the shorter questionnaire had no questions on attitudes to physical activity, this chapter is limited to 16-69 year group (n=2453).

4.2.2 Dependent variable

Physical activity is specified in this study as vigorous exercise. The decision to specify physical activity as vigorous exercise, which has been the focus of other studies (Hall et al., 2002; Hillsdon et al., 2004), was intended to provide consistency in the analysis since the perceived benefits (an independent variable) were tied specifically to vigorous exercise. In HEANSAH, respondents were asked: *'Do you do this kind*[84] *of vigorous exercise three times a week or more for at least 20 minutes per occasion?'* The possible responses were 'yes' or 'no'.

The dependent variable is binary[85] and takes the value of one if the person does vigorous exercise 3 times a week or more for at least 20 minutes per session (i.e. vigorously active sample) and zero otherwise (i.e. not vigorously active sample). This specification is in line with the updated physical activity recommendations from the 'American College of Sport Medicine (ACSM) and the American Heart Association (AHA)', which states that adults should participate in vigorous-intensity aerobic activity for a minimum of 20 minutes on three days each week to be active and reap the benefits of exercise (Haskell et al., 2007; WHO, 2009).

4.2.3 Independent variables

Independent variables are grouped under 2 headings: main variables and control variables. The former are variables whose potential relationship with physical activity is the primary focus of this chapter, and include perceived benefits (and

[84] The kind of vigorous exercise meant 'something which makes you out of breath or sweaty'.
[85] No other variable specification was possible since the data was originally created as a binary.

relative importance placed on perceived benefits). The control variables comprise socio-demographic, health, and others (refer to chapter 3 for details on the selection, specification and a priori expectations of these variables).

Perceived benefits

To date, perceived benefits of physical activity have mainly been assessed via questionnaire asking study participants to score a list of expected benefits from physical activity participation on a Likert type scale (Jones et al., 2005; Gillison et al., 2006; Chinn et al., 2006). The specification of perceived benefits in this survey is in line with the approach used in the literature. In HEANSAH (1991), respondents were asked to score each of the 13 benefits from 1 to 5 (1=not at all; 5=great deal) with 6 as 'don't know'. The scores were to reflect how much the person thinks vigorous exercise could help him/her achieve the 13 items respectively. The question was: ….*'tell me how much you would say vigorous exercise could help you in the following things:*

1. *To relax and forget about your cares*
2. *To get together and meet other people*
3. *To have fun*
4. *To get out of doors*
5. *To feel a sense of achievement*
6. *To feel independent*
7. *To feel mentally alert*
8. *To feel in good shape physically*
9. *To learn new things*
10. *To look good*
11. *To control or lose weight*
12. *To seek adventure and excitement*
13. *To improve or maintain your health*

This list of benefits[86] was chosen based on a behavioural model developed in Canada. The wordings of the benefits were however modified to suit the setting of England.

Relative importance placed on perceived benefits

The relative importance of perceived benefits from vigorous exercise was defined by the question: "… *tell me how important are the following things to you by giving me a number from '1' which means it is not at all important, through 2, 3, 4 to '5' which means it is very important'.* Each of the same 13 benefits scored under the perceived benefits' question were thus scored by the respondents to reflect their own views of importance.

Control variables

Socio-demographic variables

A range of socio-demographic variables were also considered. The variables included; gender, age, ownership of accommodation or not (i.e. proxy for income)[87], education (educated or not; type of educational qualification), employment status, marital status, ethnicity, subjective norms, barriers to physical activity, adult caring responsibilities (i.e. whether they care for a disabled adult or not), access to vehicle, and driving license. Subjective norms regarding physical activity is assessed from the question: *'Do your close family or friends encourage or discourage you to do physical activity?'* with possible responses of: *encourage a lot; encourage a little; neither; discourage a little; discourage a lot; no close family/friends*. Barriers to physical activity were specified by whether respondents thought each item on a list of 18 items stopped them or not from engaging in more exercise.

Health variables

A variety of variables were used as health indicators: health status; smoking status; drinking status; health problems affecting physical activity participation;

[86] These benefits are comparable to those identified in section 4 of Chapter 2 (see Table 2.4.1).

[87] In the absence of data on income, 'ownership (or not) of accommodation' was used as a proxy indicator for income. An alternative was 'ownership of telephone', which has been used to proxy income in developing countries (Stewart and Simelane, 2005), but given the context of this current research, it was considered inadequate. In a study to examine the validity of commonly used indicators of income in Britain, Davies et al. (1997) confirmed 'ownership of accommodation' as a valid indicator.

and body mass index (BMI[88]). BMI was calculated from the weight and height data collected on respondents in the survey. The information on overall health status was taken from a question asking respondents to rate their general health compared with their peers as either ‘excellent’, ‘good’, ‘fair’, or ‘poor’.

<u>Other variables</u>

These consisted of variables that indicated perceived level of exercise compared to peers, perceived assessment of adequacy of level of exercise, and seasons of participation.

4.2.4 Analysis

Analysis was conducted in three stages: (a) analysis of missing observations (b) descriptive analysis, and hypothesis testing (c) regression models to assess the relationship between perceived benefits (among other independent variables) and vigorous physical activity, and to identify the determinants of varying perceptions about these benefits given ‘not vigorously active behaviour’.

Missing observations

Descriptive statistics of missing observations for both dependent and independent variables were conducted to investigate the pattern of missingness in the data set. Statistical tests of association were used to examine the mechanisms under which the missingness occurred (i.e. missing completely at random or not) (Briggs et al., 2003). This involved the use of chi square test and Fischer’s exact test[89] to check the association between the dependent variable and dummy variables representing item non response for all independent variables. If the pattern of missingness did not occur completely at random, data was adjusted to account for potential ‘non randomness’ of the missingness and afford complete use. This involved a regression based imputation method to replace missing values of continuous variables and a dummy variable specifying item-non response added. For the categorical variables, item non-response was included in the omitted category and a dummy variable for item non-response created

[88] The effect of BMI was considered exploratory as no finding exists to that effect in the literature. Nonetheless, a negative effect is expected as high BMI may constitute a deterrent to participation (Weiss et al., 2007).

[89] Chi square test is used to test association between dummy variables (Bland , 2000) however when the expected values in the cells of either variable are below 5 observations, a Fischer exact test is required (Peacock and Kerry, 2007).

(Morris et al., 2005). The regression based imputation method involved predicting for missing values in a given variable from a regression model, which had that variable as the regressor and all other variables as regressands (Briggs et al., 2003).

Descriptive analyses and hypothesis testing

For the descriptive analyses, means (standard deviation) and proportions were calculated for continuous and categorical variables correspondingly. The chi-squared test, Kruskal-Wallis test, t test, Kendal rank correlation test, and the Mann Whitney U test were used to compare the proportions and means among sub-samples (i.e. vigorously active and not vigorously active) for independent variables, as appropriate.

The calculation of medians with inter quartile ranges (IQR) was used to analyse the type of benefits people expect from vigorous physical activity and whether they place importance on these benefits. For this analysis, the variables measuring 'perceived benefits' and the 'relative importance placed on perceived benefits' were treated as ordinal[90], excluding all 'don't know' responses (i.e. score '6'). To be regarded as being actually perceived or valued by respondents, each of the 'perceived benefits' and the 'relative importance placed on perceived benefits' variables should have a median equal to 2 or more. This is because according to HEANSAH, a score of '1' indicates that the respondent does not perceive or place importance on a benefit at all.

The Mann Whitney U test[91] was used to examine whether 'vigorously active' and 'not vigorously active' samples place importance on perceived benefits of vigorous physical activity differently or have different expectations about them. To examine how expectations about the benefits relate with importance placed on them within each of these samples; the Kendall rank correlation test[92] was used.

[90] It was for this analysis only.

[91] A non-parametric test based on ranks and can be used to compare the scores among two groups (Peacock and Kerry, 2007).

[92] The Kendall rank correlation can be used to test the degree of association between two ordinal variables (Bland, 2000).

Regression models

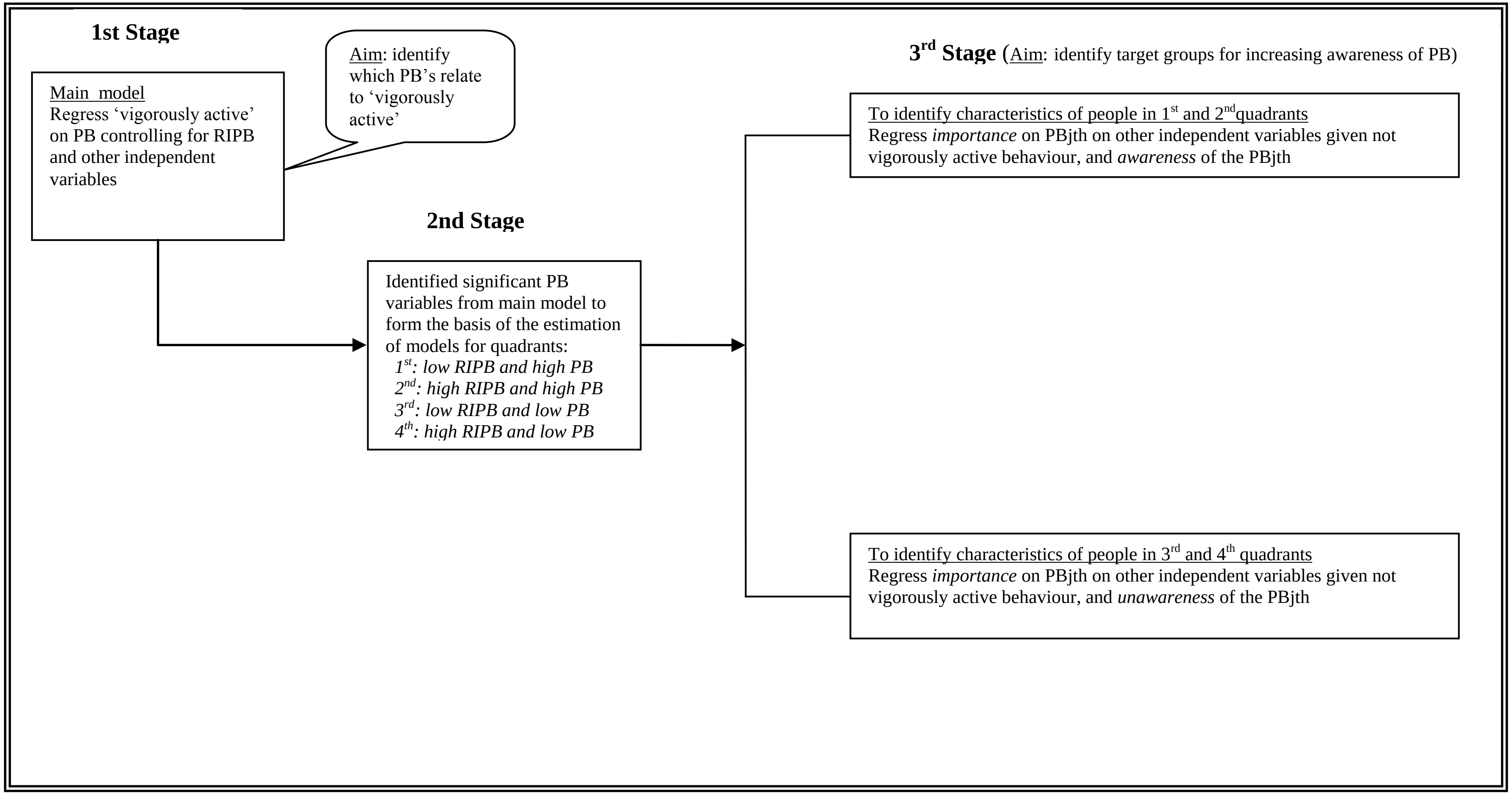
Figure 4.2 illustrates the conceptual framework underlying the estimation of regression models that were conducted in three stages. First, to investigate the relationship between vigorous physical activity and perceived benefits, the dependent variable (i.e. indicator for 'vigorously active behaviour') was regressed on perceived benefits[93] controlling for 'relative importance placed on perceived benefits' and other independent variables[94]. The second stage involved identifying the perceived benefits which were significantly related to vigorous activity in the first stage. For the third stage, the aim was to identify target groups (via quadrants described in Fig. 4.1) for increasing awareness of perceived benefits (i.e. identified PB's in stage two). For this purpose, two models were run for each of the significant PB variables from the first stage; these models involved:

- Regressing the probability of placing an importance on the perceived benefit (i.e. an indicator variable representing RIPB takes value of 1 if the score is between 2 and 5) on the other independent variables given *'not vigorously active behaviour'*, and *awareness* about perceived benefit (i.e. an indicator variable representing PB takes value one if the score is between 2 and 5). Here the emphasis is to identify the characteristics of people in 1st and 2nd quadrants in Fig. 4.1.

- Regressing the probability of placing an importance on the perceived benefit (i.e. an indicator variable representing RIPB takes value one if the score is between 2 and 5) on the other independent variables given *'not vigorously active behaviour'*, and *unawareness* about perceived benefit (i.e. an indicator variable representing PB takes value one if the score is 1). This was intended to determine the characteristics of people in 3rd and 4th quadrants in Fig. 4.1.

[93] The variables measuring PB and RIPB were treated as binary variables. For example 'to relax and forget about your cares' takes the value of one if the observed score lies between 2 and 5 but zero otherwise. This was to analyse these variables as indicators for expectations or importance of benefits of vigorous physical activity and to avoid estimation problems. This stems from the fact that the alternative specification that involves entering each score of PB and RIPB as a binary variable leads to the model failing to meet convergence given the large number of variables (i.e. over 100 variables for PB and RIPB alone).
[94] Variables such as educational qualification and ethnicity were entered in the regression model as dummy variables to ensure enough observations in the categories.

Figure 4. 2 Conceptual framework for estimation of regression models [involving perceived benefits (PB); relative importance on perceived benefits (RIPB)]



As the dependent variable in all models is binary, a logit model[95] was used. Reduced models were derived for each of the base logit models by identifying and removing independent variables that were not statistically significant via stepwise regression. Categories of significant categorical variables that were dropped by stepwise regression were added back into the model. After which, variables with the largest p value (average p value for categorical variables) were removed one by one, until the reduced model had only significant variables. The Wald test was used to test significance of variable/variables before their removal (Baum, 2006).

Specification errors and goodness of fit of regression models were examined using the linktest[96] (Cameron and Trivedi, 2009) and Hosmer Lemeshow test (Archer and Lemeshow, 2006; Hosmer and Lemeshow, 2000) respectively. To improve precision of estimates, the collinearity of independent variables was assessed to ascertain whether they lie within tolerance ranges[97] (Chatterjee et al., 2000; Gujarati, 1995).

Marginal effects, estimated at sample mean values of independent variables, were computed for each variable. The marginal effects indicate how a unit increase or a change from zero to one of an independent variable, predicts the probability of increase in the dependent variable (Greene, 2008). Statistical significant levels were set to 10% in all analyses, and all statistical analyses were undertaken using Stata version 9.

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[95] Standard binary regression models are logit and probit models. The difference between the two models relates to which distribution the error term is assumed to follow. Assuming the error term follows a normal distribution or a logistic distribution indicates a probit or logit model respectively (Jones, 2007). The choice between the two models is a matter of convenience (Gujarati, 2003; Greene, 2008). Thus in this chapter, a logit model is constructed around the binary variable that shows whether a person, say, would be vigorously active or not.

[96] The idea behind the linktest is that if a regression model is well specified, extra independent variables that are significant should only be found by chance. The linktest works by creating two variables (i.e. the variable of prediction and the variable of squared prediction), after which the model is fitted with these two variables. The null hypothesis is that there is no specification error. This is checked by looking at the statistical significance of the variable of squared prediction, which should not be a statistically significant predictor if the null hypothesis is to be accepted.

[97] This was measured by indicators of variable inflated factor (VIF) (i.e. measures the amount of inflation of the standard error that is caused by collinearity) and ‘tolerance’, which shows the amount of collinearity a regression model can tolerate. A tolerance value of 0.1 or less, and a VIF of 10 or more, shows a variable to be highly collinear and hence likely to provide imprecise estimates.

4.3 Results

The sample is described first, followed by results on missing observations; descriptive analyses and hypothesis testing; regression model of being vigorously active; and identification of target groups for increasing awareness of PB.

4.3.1 Description of sample

Table 3.1 shows that the sample was predominately White (97%) with the remaining 3% constituting Indians, Pakistanis, Chinese, Bangladeshi, Black African, Black Caribbean and Black (other), and had a mean(SD) age of 42.2 (14.9)years. Of the sample, 52.6% were female and most were married (69.2%), had an educational qualification (65.1%) and in full time employment (52.9%). The mean (SD) BMI was 28.8 (5.6) kg/m^2 indicating an overweight sample, but with most reporting good health status (55.9%). Detailed summary statistics of the whole sample and the sub-samples can be found in Appendix 4.1.

4.3.2 Missing observations

The dependent variable had 13 missing observations (0.53%). All the independent variables except smoking status; age; and gender had missing observations (see Appendix 4.2). Thus the pattern of missingness in the data was observed as multivariate or general (Briggs et al., 2003). Overall, 'type of educational qualifications' had the highest number of missing observations (n=913) while 'employment' had the lowest (n=1), and most variables had around 1% of data missing. The proportion of 'vigorously not active' sample with missing values for the independent variables was greater than that of 'vigorously active' sample for all variables except for 'employment'; 'values of perceived benefit'; and 'barriers to physical activity participation'. The difference in proportions of missing observations among the two sub samples was found to be statistically significant for 3 variables. These were: BMI, 'type of educational qualifications' and 'to feel mentally alert'. Therefore, the mechanism under which the missingness occurred may not be completely at random.

Table 4. 1 Descriptive statistics of sample*

Variables	Whole sample (n=2453)	
	Obs.	**Mean (SD) / %**
Age	2453	42.2 (14.9)
Gender		
Male	1162	47.4
Female	1291	52.6
Educated		
Yes	1597	65.1
No	850	34.7
Ethnicity		
White	2350	95.8
Black Caribbean	11	0.4
Black African	4	0.2
Black Other	3	0.1
Indian	39	1.6
Pakistani	6	0.2
Chinese	5	0.2
Employment status		
Full time	1298	52.9
Part time	334	13.6
Unemployed	820	33.4
Marital status		
Married	1698	69.2
Single	495	20.2
Divorced/widowed/separated	258	10.5
Health status		
Good	1364	55.6
Fair	672	27.4
Poor	101	4.1
Excellent	303	12.4
BMI	2453	28.5 (5.6)

*adjusted for missing observations

4.3.3 Descriptive analyses and hypothesis testing

Dependent variable

About 21% (n=519) of the sample were vigorously active and 79% (n=1921) ‘not vigorously active’. All the control variables were significantly correlated with the dependent variable, except in the cases of BMI, adult carers, smoking status, and some barriers to vigorous physical activity participation (i.e. no facilities nearby; cannot afford; no time due to work; fear of injury) (see Appendix 4.1).

Perceived benefits

The median score for all ‘perceived benefits’ was greater than 2 in both the whole sample and sub-samples respectively (see Table 4.2), indicating that the respondents expected all 13 benefits from vigorous physical activity participation. ‘To stay in good shape physically’ was the most expected (median (IQR):5(4, 5)) and ‘to seek adventure’ the least (median (IQR):3(2, 4)).

There were statistically significant differences between the sub-samples with regards to the degree of expectations about the benefits. The ‘vigorously active’ sample had higher expectations about them as they reported significantly higher scores than the ‘not vigorously active’ sample, for all 13 benefits (see fifth column of Table 4.2). Though the median scores for both sub-samples are the same for some benefits (i.e. ‘to lose or control weight’; ‘to learn new things’; ‘to look good’), there was still the tendency for the vigorously active group to report significantly higher scores[98]. 93% (n=481 out of 521) of the vigorously active group compared with 85% (n=1615 out of 1921) of ‘not vigorously active’ group scored at least 2 for ‘to control or lose weight’ though both samples had the same median (see Appendix 4.3).

[98] There could be same median scores but with statistical difference among the two groups if there is a small number of possible scores and a high number of tied scores; in such cases, the percentages for the scores could provide more information (Peacock and Kerry, 2007).

Table 4. 2 Median (inter quartile range) of PB for whole sample (n=2453); vigorously active sample (n=519); not vigorously active sample (n=1921)

Items	Whole sample	Vig. active sample	Not vig. active sample	Vig. Active vs. Not vig. Active
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Comparison of scores (p value)** [a]
To feel in good shape physically	5(4,5)	5(4,5)	4(3,5)	<0.001***
To improve or maintain your health	4(4,5)	5(4,5)	4(3,5)	<0.001***
To feel a sense of achievement	4(3,5)	5(4,5)	4(3,5)	<0.001***
To get out of doors	4(3,5)	5(4,5)	4(3,5)	<0.001***
To control or lose weight	4(3,5)	4(3,5)	4(3,5)	<0.001***
To feel mentally alert	4(3,5)	4(4,5)	4(3,5)	<0.001***
To look good	4(3,5)	4(3,5)	4(3,5)	<0.001***
To have fun	4(3,5)	4(3,5)	3(2,5)	<0.001***
To relax, forget about your cares	3(2,5)	4(3,5)	3(2,4)	<0.001***
To get together and meet other people	3(2,5)	4(3,5)	3(2,4)	<0.001***
To learn new things	3(2,4)	3(2,4)	3(2,4)	<0.001***
To feel independent	3(2,4)	4(3,5)	3(2,4)	<0.001***
To seek adventure and excitement	3(2,4)	3(2,4)	3(1,4)	<0.001***

[a]The asterisks show significance level of 1%(***); (Mann Whitney U test)

Relative importance of perceived benefits

Table 4.3 presents the median (IQR) scores on 'relative importance placed on perceived benefits' for the whole sample and both sub-samples separately. The results suggest that the whole sample and both sub-samples placed importance on the perceived benefits as median scores greater than 2 were found in all cases. For the whole sample, 5 perceived benefits (i.e. 'to feel in good shape physically'; 'to feel mentally alert'; 'to improve or maintain health'; 'to relax, forget about cares'; and 'to get out of doors') were found to be highly important (i.e. median (IQR) =5(4, 5)) while 'to seek adventure' was the least important (i.e. median (IQR) =3(2, 4)). Among them, 'to stay in good shape physically' was the most important as about 98.7% (n=2411) of the whole sample reported scores greater than 2 for this item (see Appendix 4.4).

The two sub-samples had different preferences about the most important perceived benefit, with the 'vigorously active' sample choosing 'to stay mentally alert' (100% of score were at least 2) and the 'not vigorously active' sample, 'to stay in good shape physically' (99.4% of score were at least 2) (Appendix 4.4).

Both samples also differed in terms of the level of importance placed on perceived benefits, as the 'vigorously active' sample placed statistically significant higher importance on 7 perceived benefits. These were: 'to stay in good shape physically'; 'to improve/maintain health'; to get outdoors'; 'to have fun'; 'to have a sense of achievement'; 'to learn new things'; and 'to seek adventure' (see the fifth column of Table 4.3).

Table 4. 3 Median (inter quartile range) of RIB for whole sample (n=2453); vigorously active sample (n=519); not vigorously active sample (n=1921)

Items	Whole sample	Vig. active sample	Not vig. Active sample	Vig. Active vs. Not vig. Active
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Comparison of scores (p value)** [a]
To feel in good shape physically	5(4,5)	5(4,5)	5(4,5)	<0.001***
To feel mentally alert	5(4,5)	5(4,5)	5(4,5)	0.64
To improve or maintain your health	5(4,5)	5(4,5)	5(4,5)	0.06*
To relax, forget about your cares	5(4,5)	5(4,5)	5(4,5)	0.27
To get out of doors	5(4,5)	5(4,5)	5(4,5)	0.03**
To have fun	4(4,5)	5(4,5)	5(4,5)	<0.001***
To feel a sense of achievement	4(4,5)	5(4,5)	5(4,5)	0.001***
To feel independent	4(4,5)	4(4,5)	4(4,5)	0.68
To look good	4(3,5)	4(4,5)	4(3,5)	0.55
To learn new things	4(3,5)	4(4,5)	4(3,5)	0.15
To get together and meet other people	4(3,5)	4(3,5)	4(3,5)	0.001***
To control or lose weight	4(3,5)	4(3,5)	4(3,5)	0.29
To seek adventure and excitement	3(2,4)	4(3,4)	3(2,4)	<0.001***

[a]The asterisks show significance level of 1%(***), 5%(**), 10%(*) (Mann Whitney U test)

Perceived benefits vs. relative importance placed on perceived benefits

Table 4.4 shows a statistically significant positive relationship between all 'perceived benefits' and their corresponding 'relative importance placed on perceived benefits' items, for both sub-samples respectively. This suggests that there is a tendency for the perception about the benefits to increase as the importance placed on them increases. Hence people who place high importance on these benefits are likely to expect them from physical activity participation, notwithstanding level of uptake. The relationship was however stronger in the 'vigorously active' group for all items, with the exception of 'to have fun'. In this case, the correlation coefficient was 0.28 for the 'not vigorously active' group but 0.22 for the 'vigorously active' group.

Table 4. 4 Comparison of scores for PB and RIPB within sub samples [i.e. vigorously active sample (n=519), and not vigorously active sample (n=1921)]

Items	Vigorously active sample			Not vigorously active sample		
	PB	RIPB	PB vs. RIPB	PB	RIPB	PB vs. RIPB
	Median(IQR)	**Median(IQR)**	**Comparison of scores (tau b)** [a]	**Median(IQR)**	**Median(IQR)**	**Comparison of scores (tau)** [a]
To feel in good shape physically	5(4,5)	5(4,5)	0.36***	4(3,5)	5(4,5)	0.14***
To improve or maintain your health	5(4,5)	5(4,5)	0.39***	4(3,5)	5(4,5)	0.23***
To feel a sense of achievement	5(4,5)	5(4,5)	0.26***	4(3,5)	5(4,5)	0.22***
To get out of doors	5(4,5)	5(4,5)	0.31***	4(3,5)	5(4,5)	0.16***
To control or lose weight	4(3,5)	4(3,5)	0.44***	4(3,5)	4(3,5)	0.39***
To feel mentally alert	4(4,5)	5(4,5)	0.35***	4(3,5)	5(4,5)	0.20***
To look good	4(3,5)	4(4,5)	0.49***	4(3,5)	4(3,5)	0.34***
To have fun	4(3,5)	5(4,5)	0.22***	3(2,5)	5(4,5)	0.28***
To relax, forget about your cares	4(3,5)	5(4,5)	0.23***	3(2,4)	5(4,5)	0.11***
To get together and meet other people	4(3,5)	4(3,5)	0.30***	3(2,4)	4(3,5)	0.24***
To learn new things	3(2,4)	4(4,5)	0.30***	3(2,4)	4(3,5)	0.21***
To feel independent	4(3,5)	4(4,5)	0.30***	3(2,4)	4(4,5)	0.18***
To seek adventure and excitement	3(2,4)	4(3,4)	0.42***	3(1,4)	3(2,4)	0.40***

* tau b: correlation coefficient observed using Kendall rank correlation

[a] The asterisks beside the correlation coefficient show significance level of 1%(***), 5%(**), 10%(*)

4.3.4 Regression model of 'being vigorously active'

Table 4.5 shows the estimates of reduced regression model for being vigorously active, which were consistent with the base model presented in Appendix 4.5. Emphasis is however placed on the reduced model because it provides better fit and specification.

Perceived benefits

An individual who perceived that either feeling mentally alert or having fun is a benefit of vigorous physical activity was 6% more likely to be vigorously active compared with those who did not perceive either. Perceiving 'to get outdoors' as a benefit also led to an increased likelihood of being vigorously active, albeit with a smaller impact (5%).

Socio demographic variables

The decision to be vigorously active is explained by socio demographic variables, with gender being the most influential as males were 8% more likely to be vigorously active. The second most influential factor was ethnicity as a 7% increased likelihood to be vigorously active was associated with being White compared with Non-White. Similarly, a high likelihood to be vigorously active was related with highly educated (5%), singles (5%); or divorce/widowed/separated (4%) compared with married, and adult carers (4%).

Conversely, a one-year increase in age (e.g. from 42.2 to 43.2 years), and being neither discouraged nor encouraged by family/friends to do exercise (compared with being encouraged) reduced the probability to be vigorously active. The impacts in both cases were relatively small, with reduced likelihood of 1% and 3% for the former and latter respectively.

Table 4. 5 Estimation results of regression model of being 'vigorously active'

INDEPENDENT VARIABLES	**DEPENDENT VARIABLE**	
	Vigorously active	
	Reduced model	
	Coef. [a]	*ME* [b]
Perceived benefits related to PA		
To have fun	0.66**	0.06
To get out of doors	0.50*	0.05
To feel mentally alert	0.61**	0.06
Socio demographic variables		
Age	-0.05***	-0.01
Gender (male)	0.70***	0.08
Educational qualification (high) [d]	0.41***	0.05
Ethnicity (white)	0.81**	0.07
Marital status [e]		
Single	0.41**	0.05
Divorced/widowed/separated	0.35*	0.04
Subjective norms [f]		
Discouraged	0.19	0.02
Neither	-0.27**	-0.03
Adult care responsibilities (yes)	0.31*	0.04
Barriers to PA (Yes)		
Not sporty	-0.33**	-0.04
Time to relax	-0.31**	-0.03
Fear of injury	0.56*	0.07
Health variables		
Health status [g]		
Good	-0.37***	-0.04
Fair	-1.43**	-0.10
Poor	-0.46**	-0.05
BMI	0.03**	0.003
Others		
Adequate level of PA [h]		
Yes	1.09***	0.12
Don't know	-0.63	-0.06
Level of PA compared to peers (active)	1.13***	0.10
No .of observations	2440	
Constant	-7.42	
Pseudo R2	0.24	
Link test	p=0.27	
Goodness of fit	p=0.12 [c]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*)
[b] Marginal effects [c] Chi-square(8)=12.76 [d] High: degree/higher degree/ professional /HND
[e] Omitted category: married; [f]Omitted category: encouraged [g] Omitted category: excellent health;
[h]Omitted category: no *The average VIF for the variables was 1.52, and tolerance levels above 0.1.

Barriers to physical activity (PA)

In terms of barriers to vigorous physical activity, only three variables were found to have a significant association though varied signs were reported. The greatest impact was related to ‘fear of injury’ as those recognising it as a barrier were 7% more likely to be vigorously active. Those who identified ‘not sporty’ and ‘time to relax’ as barriers were however, 4% and 3% (correspondingly) less likely to be vigorously active.

Health variables

BMI had a small positive effect, indicating that for example, if person’s BMI increases by one (e.g. from 28.5 to 29.5 kg/m^2), the likelihood of him/her being vigorously active rises by 0.3%. For health status, individuals reporting good, fair or poor health compared with excellent health were less likely to be vigorously active though as expected, the likelihood for those with fair (10%) and poor health (5%) was bigger than those of good health (4%).

Others

Overall, the greatest impact on physical activity was found in this category. People who considered themselves to be active (compared with their peers) were found to be 10% more likely to be vigorously active. An even greater impact was found for individuals who perceived their level of physical activity participation to be adequate compared with those who thought otherwise, with the latter group 12% more likely to be vigorously active.

4.3.5 Identification of target groups for increasing awareness of PB

This section reports the results of regression models for the probability of placing importance on perceived benefits given that individuals do (do not) expect these benefits but are ‘not vigorously active’. It is important to re-state that the analyses were limited to perceived benefits (and their equivalent RIPB variables) found to be significantly related to physical activity behaviour (i.e. ‘to have fun’; ‘to get out of doors’; and ‘to feel mentally alert’).

Appendices 4.6-8 show the results of both base and reduced models of the estimated models. The estimates of both models were similar though the following presentation focuses on the latter as it provides better fit and specification.

Table 4.6 gives a summary of the characteristics of ‘not vigorously active’ people who were likely to place importance on the benefits though they do not perceive them as related to physical activity.

Table 4. 6 Characteristics* of people with high RIPB but low PB (i.e. 4th quadrant)

To have fun	To get outdoors	To be mentally alert
Married	Own accommodation (proxy for high income)	Drinkers
Older (i.e. a year increase in average age - from 42.2 to 43.2 years)	White	Do not recognise ‘unavailability of facilities’ as a barrier
Encouraged by family/friends to do exercise	Do not recognise potential boredom associated with participation in physical activity as a barrier	
Do not recognise ‘caring for young children’ or ‘unavailability of facilities’ as a barrier to participation in physical activity		

The opposite of these characteristics represent ‘not vigorously active’ people who were <u>less likely</u> to place importance on the benefits given that they do not expect them from doing physical activity (3rd quadrant).

Conversely, vigorously inactive individuals with characteristics showed on Table 4.7 are likely to place importance on the benefits and also perceive them as related to physical activity.

Table 4. 7 Characteristics* of people with high RIPB but high PB (i.e. 2nd quadrant)

To have fun	To get outdoors	To be mentally alert
Do not recognise affordability of physical activity as a barrier	Non smokers	Have driving license
Drinkers	High BMI (i.e. a kg/m^2 increase in average BMI (i.e. 28.5 to 29.5 kg/m^2)	High BMI (i.e. a kg/m^2 increase in average BMI (i.e. 28.5 to 29.5 kg/m^2)
Do not have current health problems that affect participation in physical activity	Do not think their level of physical activity participation is adequate	
High BMI (i.e. a kg/m^2 increase in average BMI (i.e. 28.5 to 29.5 kg/m^2)		
Do not think their level of physical activity participation is adequate		

The opposite of these characteristics represent ‘not vigorously active’ people who were <u>less likely</u> to place importance on the benefits given that they do expect them from doing physical activity (1st quadrant).

4.4 Further analysis

The purpose of this section is to further explore potential insights into the influence of perceived benefits on physical activity based on the results already presented. How can the relationship between physical activity behaviour and perceived benefits be further understood?

4.4.1 Health vs. non health PB

The results thus far point to a positive relationship between 'non-health' perceived benefits (i.e. 'to have fun'; 'to get out of doors'; and 'to feel mentally alert') and vigorous physical activity. A plausible interpretation of this finding is that people tend to do vigorous physical activity not to improve their health per se but for 'non health benefits'. Assuming the classification of 'non health perceived benefits' is appropriate, raises a potential question as to whether these benefits are stronger predictors of vigorous physical activity participation than 'health perceived benefits'. To answer this question, an exploration to determine the relative influence of 'health', and 'non-health' perceived benefits on vigorous physical activity behaviour is conducted here. The upshot of such an investigation is that it may inform policy as to which of these perceived benefits (i.e. health or non-health) ought to be prioritised, if any at all.

Methods

For the analyses, the following steps were undertaken. First, the 13 variables representing perceived benefits were collapsed into 'health' and 'non-health' categories respectively. This categorisation was however challenged by the uncertainty surrounding which of the categories the following items fit: 'to feel in good shape physically'; 'to control or lose weight'. To account for this uncertainty, three differing classifications of the categorisation were assumed: 1st classification: the unclear items were counted as 'health' perceived benefits; 2nd classification: the unclear items were counted as 'non health' perceived benefits; 3rd classification: the unclear items were excluded from the categorisation. Table 4.8 provides details of the three classifications.

Table 4. 8 Classifications for the categorisation of health and non -health PB

Classifications	Health benefits	Non health PB
1st classification	‘to improve or maintain your health’; ‘*to feel in good shape physically*’; ‘*to control or lose weight*’	‘to relax and forget about your cares’ ; ‘to get together and meet other people’; ‘to have fun’; ‘to get out of doors’; ‘to feel a sense of achievement’; ‘to feel mentally alert’ ‘to learn new things’ ‘to look good’; ‘to seek adventure and excitement’
2nd classification	‘to improve or maintain your health’	‘to relax and forget about your cares’ ; ‘to get together and meet other people’; ‘to have fun’; ‘to get out of doors’; ‘to feel a sense of achievement’; ‘to feel mentally alert’ ‘to learn new things’ ‘to look good’; ‘to seek adventure and excitement’ *to feel in good shape physically*’; ‘*to control or lose weight*’
3rd classification	‘to improve or maintain your health’	‘to relax and forget about your cares’ ; ‘to get together and meet other people’; ‘to have fun’; ‘to get out of doors’; ‘to feel a sense of achievement’; ‘to feel mentally alert’ ‘to learn new things’ ‘to look good’; ‘to seek adventure and excitement’

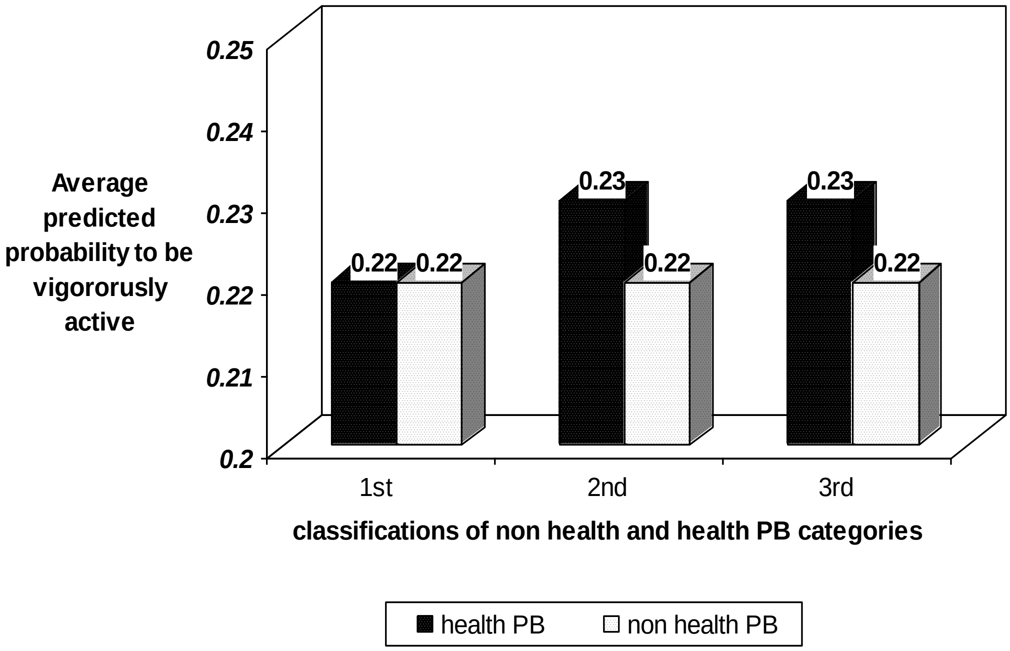
unclear items are in italics

Second, the probability to be ‘vigorously active’ was regressed on both ‘health’ and ‘non-health’ perceived benefits allowing for other independent variables. Three separate regressions were run to reflect the three differing classifications. Third, probabilities of being vigorously active were predicted for both ‘health’ and ‘non- health benefits’ for the three classifications respectively based on the regression estimates. Fourth, averages were calculated for the predicted probabilities, and plotted to check their distribution.

Results

Based on the 1st classification, an individual who perceives either health or non-health benefits were equally (22%) more likely to be vigorously active. A similar pattern was observed for 2nd and 3rd classifications, though the likelihood to be vigorously active was slightly higher for those perceived health benefits (23%).

Figure 4. 3 Average probability to be vigorously active by health and non health perceived benefits (PB) per three classifications



4.5 Discussion

The aim of this chapter was to examine the role of perceived benefits among other factors in understanding the demand for physical activity. The findings suggest that perceived benefits play an important role as having higher expectations about these benefits promote participation in vigorous physical activity, all things being constant. Notably, individuals tend to do vigorous physical activity not only for 'health' but also 'non health' perceived benefits. Several other factors apart from perceived benefits also affect the vigorous physical activity behaviour. In particular, psychological factors have a great impact; with people who perceived their level of participation to be adequate or perceive themselves to be more active than their peers, having the greatest levels of participation. Interestingly, it appears variables indicating economic status such as ownership of accommodation (proxy for income), access to vehicle, and employment status have a small impact on uptake.

It is difficult however, to fully claim the small influence of economic factors particularly in the case of income, given the way it was measured. Income was proxied by ‘ownership of accommodation’, which despite its usage in the literature, could be argued as more of an indicator for wealth (Shaw et al., 1999) considering that it is a physical asset. If so, interpreting the impact of this proxy in terms of income is of questionable validity because wealth and income influence health related behaviour in different ways (Morris et al., 2000). Yet, such an interpretation may be considered valid since in the midst of lack of data on income, asset indicators constitute appropriate proxies and thus provide useful insights on the effect of income (Stewart and Simelane, 2005).

The substantial influence of psychological factors can be debated given that variables indicating ‘adequate exercise’ and ‘perceived activeness among peers’ may be measuring the same thing because seeing one’s self as more active (compared with peers) could be synonymous to perceiving your level of exercise to be adequate. If this holds true, then those psychological variables were collinear and hence had inflated estimates. An assessment of collinearity however proved otherwise, as both variables were found not to be collinear[99].

Interpreting the findings on perceived benefits as evidence of the set of benefits that people expect from vigorous physical activity is not straightforward because the completeness of the 13 benefits chosen for the survey is questionable. For example, respondents could not declare any other benefits from vigorous physical activity not required by the survey. There is evidence (Jones, 2005) to suggest that ‘feeling good about self’; and ‘confident’ are perceived benefits of physical activity but neither were on the list of benefits. If these are better indicators of preferences of individuals, then the findings in this chapter partially reflect the impact of perceived benefits on physical activity. Still, some confidence could be drawn from findings because the perceived benefits captured in this chapter generally offer a full coverage of those revealed in chapter 2 (specifically section 4) as relevant to general population in England.

The extent to which the respondents understood and differentiated between the benefits is also contentious. For example how different is ‘to stay in good shape

[99] The VIF and tolerance indicators were found to be within ‘non-collinearity’ levels

physically' from 'to look good'? Although these two benefits might not necessarily be the same; differentiating them in an interview (as in the case of HEANSAH) or even a self-administered survey can be difficult. Assuming this was the case, it may imply potential bias in the responses. Nonetheless, the results as based on the median scores, suggest that respondents interpreted the two benefits differently. Again, the strength of association between these benefits, when assessed, indicated a weak association (correlation coefficient: 0.47), suggesting that respondents did differentiate between them.

The findings presented in this chapter are consistent with other studies. A study investigating perceived benefits of physical activity in European Union countries including UK identified comparable perceived benefits as our analyses did (Zunft et al., 1999). Though the wordings may not necessarily be the same, benefits such as 'to maintain good health'; 'to release tension', 'to get fit'; 'to socialize'; 'to control weight' 'for fun' found in that study match those in this chapter to a large extent. Previous studies also found a significant positive relationship between physical activity and perceived benefits (Gillison et al., 2006; Mullineaux et al., 2001). However, extra knowledge has been gained in this chapter. First, it has been explicitly shown that people place importance on these perceived benefits, which is important to know because promoting physical activity behaviour via increasing perception about benefits related to uptake can only be attained if people want the benefits (DH, 2005). Second, the relative impact of 'health' and 'non-health' perceived benefits were assessed, and it was revealed that vigorous physical activity behaviour is not only influenced by 'health' perceived benefits but 'non-health' as well thereby hinting that policy should focus on both. However, given the aim of this chapter, it is still unknown whether and how these perceived benefits relate to other indicators of physical activity (e.g. moderate intensity physical activity). This is essential to know considering that predictors of physical activity behaviour can vary depending on the type of physical activity in question (Sallis and Hovell, 1990). Thus, though this chapter has given insights on how perceived benefits could explain physical activity behaviour, it offers an incomplete picture because it concentrated only on vigorous physical activity due to inadequate data.

With the exception of two variables (‘fear of injury’ and BMI), all a priori expectations about the association between the independent variables and vigorous physical activity were met in this study. People who cited ‘fear of injury’ as a barrier to their physical activity participation were more likely to be vigorously active. It could be argued that people who cited that barrier might only be selective in the type of physical activity, which does not suggest non-participation. As Zunft et al. (1999) found in their study, people who cited ‘no need to do more’ as a barrier to their physical activity participation tended to do more gardening and walking, compared with those who did not cite it as a barrier.

BMI had a positive effect on vigorous physical activity suggesting that people who are overweight are more likely to exercise. For BMI, the plausible explanation is that overweight people are the ones likely to exercise as a way of reducing their weight. After all, one expects that overweight people who are exercising may be aware of the benefits of physical activity or are following the advice of their general practitioners. One should also not ignore the fact that the effect of BMI could depend on a time lag. To illustrate this point, let’s consider two time periods. Time period 1: when a person is not exercising and hence becomes overweight; and time period 2: when the person starts exercising because he has become overweight. The qualitative effect likely to be captured depends on which of the designated periods is considered. A negative BMI effect is likely to be captured if the illustrated individual is investigated in the time lag between period 1 and 2. However, if he/she is studied in period 2, the effect of BMI is likely to be positive. Moreover, though BMI is accepted as the standard approach for determining overweight or otherwise, it has still got some measurement problems (Kirk et al., 2003), hence could lead to overweight people being classified as underweight or vice versa.

The analyses in this chapter have limitations. First, the data on the physical activity participation were measured via questionnaire (i.e. self reports). Despite appropriate validity and reliability tests, the use of self reports to measure physical activity behaviour may be fraught with overestimation or problems with recall (Gillison et al., 2006). However, objective measurements of physical activity participation like pedometers were not attainable within the logistical constraints of this chapter. Secondly, the dataset used for analysis was collected in 1991, a situation which places questions on the currency of the findings. Perceived benefits as a social construct may evolve over time and, as such, using the findings as basis of understanding current physical activity behaviour should be treated with caution.

Nonetheless the findings provide implications for policies to improve physical activity participation in England. Strategies aimed at promoting uptake of physical activity ought to increase peoples' awareness of perceived benefits related to physical activity. To do so, mass media campaigns could be employed to provide persuasive messages to the population about these benefits. Such campaigns have proved successful in changing behaviour related to passive smoking and immunisation (Smith, 2002). Perhaps, a hint of the effectiveness of such campaigns could be ascertained by assessing the proportion of adults in England likely to become vigorously active if implemented. Let's consider a hypothetical scenario: if a mass media campaign were to make every adult in England perceive doing physical activity as having fun, the likelihood of them being vigorously active should increase by 6%. Given that at the current likelihood (14%), 21.7% of the population are vigorously active, it could be assumed that at 20% likelihood (induced by the 6% increase), 23% of the population would become vigorously active. In absolute terms, this represents about 509,000[100] more adults becoming vigorously active as result of the campaign. This corresponds to a quarter of the estimated target of the 'Legacy Action Plan' that intends to 'help at least two million more people in England be more active by 2012' (DCMS, 2008).

The messages of such mass media campaigns should however portray physical activity not only as a prospect for health improvement but non-health benefits such as relaxation, and broadening of social network, as the results indicate that people do physical activity for both sets of benefits. Various media to transmit those messages include broadcast, internet, podcasts and print though to

[100] This calculation was based on the current adult UK population sourced from census 2001 (National Statistics, 2009).

maximise effectiveness regular contacts are needed in either option (Marcus et al., 1998). The government could for example, sponsor television programmes that would communicate messages on the benefits of physical activity. These programmes could be tailored along the lines of erstwhile 'Fighting fat, fighting fit'[101], a 7 week health education programme on BBC, which exceeded its projected penetration (25% to 29%) though had small impact (1%) on behaviour (Wardle et al., 2001). Consequently, to achieve greater impact, such programmes should be funded on long term basis and aim for long-term behaviour change (Cavill and Baumann, 2004).

Another relevant strategy to maximise effectiveness is to adopt a discriminatory campaign that targets people who want the benefits (but are not aware they are accruable from physical activity) because uptake is likely among them (DH, 2005). For example married, and older people ought to be targeted if the object of campaign is make people aware that they could have fun through physical activity (Table 4.6 describes the characteristics of people to target for different perceived benefits).

Chapter 4 also offers inputs for further research in this thesis. First, future work should investigate which perceived benefits relate to variant indicators of physical activity (e.g. number of days, total time; irrespective of intensity) because as already indicated the relationship may differ. Second, it has been shown that though people expect and place importance on benefits of physical activity participation, they may not exercise sufficiently enough to be 'vigorously physically active'. This may be due to the confounding effect of costs of participation because having expectations about benefits but even greater costs may discourage uptake. As postulated by the theoretical model described in chapter 3, under a rational decision making framework, individuals consider both costs and perceived benefits in making decisions regarding physical activity participation. Thus, it is important to examine the effect of cost on physical activity to afford a more complete demand analysis, and such an investigation steers subsequent chapters.

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[101] A health education programme that tutored audience on ways of improving exercise and dieting.

CHAPTER 5 Costs and physical activity behaviour

5.1 Introduction

Chapter 4 hinted at the need to account for not only perceived benefits but also cost in an attempt to understand physical activity behaviour because people may still not do enough physical activity given the former due to confounding effect of the latter. Chapter 5 aims to explore the role of costs among other factors in explaining physical activity behaviour.

In section 2 of chapter 2, current literature on costs related to physical activity behaviour was reviewed and revealed notable gaps. First, there is limited research on the relationship between costs (i.e. time or/and money costs) and physical activity participation. A few studies (Tai et al., 1999; Humphreys and Ruseski, 2007) investigated the effect of cost on physical activity participation, but only partially (either time or money cost; not both). Second, the literature tends to ignore an important aspect of understanding physical activity behaviour, which is the decision to become physically active (i.e. meeting the recommended level of participation) (details in section 2, chapter 2).

This chapter therefore seeks to address these gaps by examining the relationship between costs and the decisions to: (a) participate in physical activity, and (b) meet the recommended level of participation, given participation. Notably, the focus[102] is on time cost, typified as opportunity cost of time. It is however suspected that the relationship between time cost (i.e. opportunity cost of time) and physical activity may differ by gender. Evidence from chapter 2 (section 1) suggests that opportunity costs of time[103] impact differently on participation in leisure activities in males and females (Alenezi and Walden, 2004; Kooreman et al., 1987). Kooreman et al. (1987) found that the time spent on leisure activities such as sports and hobbies tends to increase with the opportunity cost of time in females but decrease in males. Conversely, Alenezi and Walden (2004) found a

[102] Data constraints preclude accounting for money costs. Refer to chapter 3 for details.
[103] Wage rate.

positive effect of opportunity cost of time on total leisure time in males but negative effect in females.

Based on findings from chapter 2 (section 2), it is also considered that the effect of time cost on meeting the recommended level of participation (given participation) may differ across different types of physical activities (i.e. different types of sports). Different types of physical activities have varying time requirement levels hence different time costs (Humphreys and Ruseski, 2007; Taks et al., 1994). Therefore, given participation, the gradient of opportunity cost of time and meeting the recommended level of participation may be different across type of physical activities with different time requirements.

Hence, the objectives of this chapter are three fold:

(a) To investigate the relationship between time cost and the decisions to: (i)participate in physical activity, and (ii)meet the recommended level of participation given participation

(b) To examine how time cost relates to decisions to: (i)participate in physical activity, and (ii)meet the recommended level of participation given participation by gender

(c) To determine the association between time cost and the decision to meet the recommended level of participation given participation by different types of sports activities.

Methods, results, further analyses and discussion of this chapter are presented in subsequent sections.

5.2 Methods

5.2.1 Data

The data[104] used for the analysis was accessed from the Health Survey for England (HSE) 2006. The HSE is a routine cross sectional survey that draws a nationally representative sample of persons residing in private households in England. The samples and focus of the survey vary each year. For 2006, the

[104] See chapter 3 for how the selection of datasets in this thesis was conducted

sample included a core sample of adults aged 16 or more and a boost sample of children aged 2-15 years. The method of data collection involved the use of face-to-face interviews, self completion, clinical measurements and physical measurements. The interviews were undertaken throughout the entire year to compensate for seasonal variation in responses, with the fieldwork spanning January 2006-May 2007. The main topics covered by interviews were: cardiovascular disease and risk factors, levels of physical activity, general health, smoking, fruit and vegetable consumption, smoking and alcohol intake.

5.2.2 Dependent variables

Physical activity participation is measured in this study as: (a) decision to participate in physical activity, and (b) decision to meet recommended level of participation, given participation. The *decision to participate in physical activity or not* is measured with a variable that indicates whether respondents had done a list of sports and exercise activities during the last four weeks. Respondents were asked: *Can you tell me if you have done any activities on this card during the last four weeks that is since (date four weeks ago)? Include teaching, coaching, training and practice sessions.* The possible responses were 'yes' or 'no'. The list of activities include *swimming, cycling, workout at gym/exercise bike/weight training, aerobics/keep fit/gymnastics/dance for fitness, any other type of dancing, running/jogging, football/rugby, badminton/tennis, squash, and exercises (e.g. press ups, sits ups).* Follow up questions to this question were administered to respondents that answered 'yes'. Such questions probed further for other activities the respondents may have done, and also collected data on the intensity, frequency and duration of days of participation.

Based on this data, the *number of days (with each of the days lasting for at least 20 minutes) of vigorous sports done during the last four weeks* was derived. From this, a binary variable was created that takes the value of one if *the number of days of vigorous sports done during the last four weeks* is 12 days or more and zero otherwise[105].

[105] Refer to section 4.2.2 for basis for this variable specification.

5.2.3 Independent variables

The independent variables considered for this study are grouped under main or control variables. Measures of opportunity cost of time, whose potential relationship with physical activity is the primary focus of this chapter, are defined as main variables. Control variables comprise socio-demographic, health, and others (refer to chapter 3 for details on the selection, specification and a priori expectations[106] of these variables).

Opportunity cost of time

To date, opportunity cost of time has been specified in practice as the shadow price of leisure (i.e. foregone earnings in the labour market), which is wage earnings (Cesario and Knetsch, 1976; Hellerstien and Mendelsohn, 1993; Ekelund and Ritenour, 1999; Hagerty and Moeltner, 2005). The idea is that time spent in a leisure activity for example physical activity, could have been used for other alternatives. Thus the cost of the time spent on physical activity can be equated to the benefit foregone in the next best alternative. The next best alternative foregone is assumed to be labour time; hence wage earnings are lost when time is spent on say physical activity participation. Such an application posits that the individual is in the labour market and faces a flexible number of working hours, and that labour time can be substituted for leisure at the margin, where the labour market is assumed to be in equilibrium. As such the individual is assumed to increase his labour hours till the value of an hour spent in leisure time is equal to the wage rate (Amoako-Tuffour and Martinez-Espineira, 2008). Another assumption is that the individual is assumed to have only a pecuniary utility or disutility for labour market, and also faces no fixed costs of having a job (Coffey, 1983).

Measuring the opportunity costs of time as wage earnings is the standard approach used in the economics literature in general (Parsons, 2003), and the

[106] It is worth noting that the a priori expectations applies to ‘decision to participate or not’ and ‘decision to meet the recommended level, given participation’ since there is paucity of evidence in the reviewed literature on the latter. For this same reason, the a priori expectations were considered only for the whole sample and not the sub samples (i.e. female and male samples).

demand for physical activity literature in particular (Taks et al., 1994; Humphrey and Ruseski, 2006, 2007). This standard approach in the literature is followed in this chapter. However, the challenge here is, though the HSE (2006) presents a rich source of data on physical activity participation, there is no data on the wage earnings of respondents. Following Humphrey and Ruseski (2006, 2007), the opportunity cost of time is thus proxied with *employment status,* and *educational attainment*. According to the human capital approach, the labour market compensates for the costs of education and that high educational attainment is likely to reflect high wage earnings (Mincer, 1974), whereas being employed indicates the receipt of wage earnings. The indication of high educational attainment as high wage earnings have been empirically proven extensively (Co et al., 2005; Baros and Alves, 2003; Verner, 2005; Lee and Lee, 2006).

To further explore the effect of opportunity cost of time on the physical activity participation, a proxy index for opportunity cost of time was constructed using principal component analysis (full details provided in the section below). Summarising two separate measures of opportunity cost of time are used: (a) separate proxies for opportunity cost of time measure (i.e. *educational attainment* and *employment status*), and (b) a proxy index of opportunity cost of time based on proxy indicators of opportunity cost of time, including *educational attainment* and *employment status*. For clarity of presentation the former measure is henceforth referred to as proxies (*educational attainment*-proxy 1; *employment status*-proxy 2), and the latter as proxy index.

5.2.4 Control variables

<u>Socio-demographic variables</u>

These variables included gender, age, marital status, ethnicity, access to vehicle, household income, working hours, number of adults in the household, and number of children in the household. It is important to note that income is specified as equivalised income. The HSE (2006) has data on two income measures: ordinary household income and equivalised household income. The latter is used in this study because it reflects the 'real' income of the household by adjusting[107] for its size and composition.

Health variables

A range of variables were used as health indicators: general health status, smoking status, drinking status, and obese status (BMI =/>30)[108].

'Other' variables

This category comprised participation in voluntary activities, membership of social and sports club, urban residence, and region of residence. A potential seasonal effect on physical activity behaviour was also accounted for, by categorising the month of interview to represent the four main seasons in England: winter, summer, spring, and autumn.

5.2.5 Analysis

The analyses in this chapter were conducted in three stages. First, descriptive analyses of all variables were undertaken. This was followed by the construction of a proxy index for opportunity costs of time, using principal component analysis. Next, regression models were estimated to investigate the relationship between opportunity cost of time and the decisions to participate in physical activity, and to meet the recommended level of participation given participation.

Descriptive Analyses

Descriptive statistics were conducted by calculating the means and proportions of both dependent and independent variables, as appropriate. The associations between the dependent variables and the independent variables were analysed using Kendall rank tests, Kruskall Wallis test and Mann Whitney test. The analysis of missing data followed the same approach in chapter 4 (see section 4.2.4).

[107] To do this, a McClement score is calculated for each household (a score which depends on the number, age, and relationship of adults and children in the household). The ordinary household income is then divided by this score to derive the equivalised income.
[108] The study of the effect of obese was only exploratory. The definition of obese status was adapted from DH (2007).

Principal component analysis

A proxy index for opportunity costs of time was constructed using principal component analysis. In the absence of data on wage earnings, which conceptually is an approximation of opportunity costs of time, proxies (i.e. education attainment and employment status) are used to measure the opportunity cost of time (Humphrey and Ruseski, 2006, 2007). However, the use of few proxies may lead to unreliable findings as these proxies may not be sufficient to detect the differential levels of the concept they are intended to measure. Thus the recommended approach is to include more proxies to account for the potential measurement errors that may exists between the proxies and the concept they are intended to measure (Kolenikov and Angeles, 2004).

Entering the proxies as separate variables in the regression model may still not provide an adequate assessment of the effect of the concept (i.e. opportunity costs of time) as some of the proxies may have direct and indirect influences on the dependent variable (Filmer and Pritchett, 2001). For example, considering the case of educational attainment, though it may proxy opportunity cost of time, as high educational attainment is indicative of high wage earnings, on the other hand, high education may make people efficient producers of health (Grossman, 1972) hence may lower their costs of production of health (in this case the cost of engaging in physical activity). Also, incorporating several proxies is likely to increase the dimension of the data and may also lead to redundancy in the proxies if they are correlated (Giri, 2004). A typical way of resolving such issues is the use of principal component analysis to create a uni-dimensional measure for all proxies.

Popularised by Pearson (1901) and Hotelling (1933), the principal component analysis is a multivariate statistical method often used to aggregate data from a number of variables (Rabe-Hesketh and Everitt 2004). It has been extensively used to create wealth and socio economic status indices to study the effect of wealth and socio economic status on health care utilisation (O'Donnel et al., 2008; Lindelow, 2006; Schellenberg et al., 2003; Gwatkin et al., 2000) and educational enrolments (Filmer and Pritchett, 1999, 2001; Mckenzie, 2003). Similar to the current context, most of the applications of principal component analysis to create an index have been in pragmatic approaches to dealing with data unavailability. To author's knowledge, there exists no proxy index for the opportunity cost of time in the literature.

In practice, the principal component analysis derives uncorrelated indices or components from a set of correlated variables (i.e. proxies of opportunity cost in this context). Each of the indices or components represents a linear weighted aggregation of the set of variables.

Mathematically, the derived indices or principal components say from I_a ……… I_f, can be specified as:

$$I_a = z_{a1}X_1 + z_{a2}X_2 + \ldots\ldots\ldots\ldots\ldots\ldots.. z_{a10}X_{10}$$

$$I_f = z_{f1}X_1 + z_{f2}X_2 + \ldots\ldots\ldots\ldots\ldots\ldots.. z_{f10}X_{10}$$

where X_{jth}= the original variables (or proxies)
z_{jth} = the weight for the variables (or proxies)

The components or indices are presented in decreasing order of importance, which is measured by the variance explained by the components or index from the given data. The first component or index explains the largest variation followed by the successive components in decreasing order. Thus in the literature, the first component or index is often used to measure the intended concept (Vyas and Kumaranayake, 2006; Mckenzie, 2003; Houweling et al., 2003).

A first step in constructing the proxy index for opportunity cost of time, involved the selection of extra variables (in addition to educational attainment, and employment status) that may be proxy indicators of high wage earnings, and hence high opportunity costs of time. Given the data set (HSE 2006), five variables that are theoretical and empirical indicators of high wage earnings were selected to create the proxy index for opportunity cost of time. These included *educational attainment, employment status, union membership*[109], *size of firm*[110], and *skill of the occupation*[111].

The appropriateness of principal component analysis (PCA) in this context was assessed using standard tests such as *Bartlett's test for sphericity*[112], and the *Kaiser-Meyer-Olkin Measure of Sampling Adequacy*[113] (Azevedo 2006), before constructing the proxy index for opportunity cost of time. Both statistical tests measure the strength of relationship and results should indicate an acceptable[114] strength of correlation among the selected variables, for PCA to be considered valid. A further assessment of the face validity[115] of the proxy index was undertaken by checking the direction of correlation between the proxy index and the individual variables used in its construction.

Regression models

The investigation of the relationship between opportunity costs of time and the decisions to participate in physical activity and meet the recommended level of participation requires a two-equation model. However, the estimation of these two equations as separate discrete models was considered inappropriate, as such a method would not account for the potential correlation between the error terms of the single equations. For instance, the reasons behind the decision to participate in physical activity may be correlated with unobservable factors that affect the decision to meet the recommended level of participation. A potential sample selection bias may exist in this context, as the observed data for meeting the recommended level of participation was not randomly selected since it was conditioned on participation in physical activity. Thus the distribution of the data on meeting the recommended level of participation could be referred to as incidental truncation (Wooldridge, 2003). Those who had missing values for the variable (i.e. meet the recommended level of participation) might be

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[109] Being a member of trade or workers union has been widely found to indicate high wage earnings (Maxwell, 2008; Verner, 2005; Lee and Lee, 2006; Contoyannis and Rice, 2001).
[110] The size of a firm (specified in practice as the number of employees at working place of respondents') reflects positively on wage earnings (Heyman, 2007; Contoyannis and Rice, 2001).
[111] Having a highly skilled occupation (i.e. managerial, professional and administrative roles) is also a positive indicator of high wage earnings (Dickey, 2007; Contoyiannis and Rice, 2001; Verner, 2005).
[112] This test measures the null hypothesis that the sample intercorrelation matrix is obtained from a population with variables that have an identity matrix (i.e. non collinear).
[113] It measures the degree of common variance among a set of variables.
[114] This is indicated by statistical significant (at 5%) result for Bartlett test of sphericity and a value of not less than 0.50 for the Kaiser-Mayer-Olkin measure of sampling adequacy.
[115] To check if the proxy index is measuring what it intends to measure (Fitzpatrick et al., 1998)

systematically different from those who had real values, hence resulting in a potential sample selection bias. Failure to account for sample selection bias may lead to inconsistent estimates (Heckman, 1979).

Therefore, a potential selection problem was dealt with using bivariate probit model with selectivity correction, which is typically used in such context (Montmarquette et al., 2001; Afxentiou and Hawley, 1997). The bivariate probit model propounded by Van de Ven and Praag (1981) is analogous to the traditional Heckman sample selection model[116]. A probit model was estimated for the probability that an individual participates in physical activity or not and a selection term (lambda) saved and included in a second probit model. The second probit model estimates the decision to meet recommended level of participation given participation, on a sub-sample of only those who participated in physical activity (refer to Appendix 5.1 for mathematical formulation of the bivariate probit model with selectivity correction).

To guarantee unique estimates for the two equations, the first probit model should be identified by applying an exclusion criteria (i.e. at least one or more explanatory variables in that model should not enter the second probit model) (Jones, 2007). It is however often difficult to select the variables for the exclusion criteria (Wooldridge, 2003; Jones, 2007). So, in this study the selection of those variables was based on evidence in the literature (Humphreys and Ruseski, 2006). As such a number of regressors in the first probit: 'number of children', 'region of residence', and 'health status' were excluded from the second probit model.

The robustness of the exclusion criteria was however examined by formulating another exclusion criteria based on evidence in the dataset used in this chapter, and the estimates of the bivariate model with selectivity correction compared in both cases. The process of identifying the variable for the exclusion criteria involved using bivariate regressions between the dependent variables and the control variables to find variables that influence the dependent variable for the

[116] It models an initial probit or logit equation followed by an OLS equation

selection equation but not that of the outcome equation. Separate bivariate analyses were conducted for the whole sample, and separate gender to this effect.

A problem of selection bias is suggested if the correlation coefficient between the error terms of the two equations of the bivariate probit model with selectivity correction is found to be statistically significant (Jones, 2007). In such a case, the bivariate probit model with selectivity correction is considered the suitable model, otherwise, a 2 part model is considered. The 2 part model treats both probit equations as separate and unrelated models which are modelled separately.

The regression models in this chapter were estimated in practice as follows. First, the decisions to participate in physical activity and to meet the recommended level of physical activity participation given participation were regressed against the opportunity cost of time and the set of control variables, using bivariate probit regression models with selectivity correction. Sampling weights were applied in all regression model estimations as appropriate. Three models each were estimated for the two variant measures of opportunity cost of time: (a) the constructed proxy index, and (b) proxies' indicated by *education* and *employment status*. The sets of three separate models each covered: (i) estimated model for the whole sample (gender combined) (ii) estimated model for males separately, (iii) estimated model for females separately.

To investigate the effect of opportunity cost of time on the decision to meet the recommended level of participation across different physical activities, given participation, the average time spent on each occasion of participation in each of the different physical activities in the HSE (2006) was calculated. Following this, the different types of physical activities were categorised[117] into 3 groups based on their time requirement levels (Taks et al., 1994): *low*, *moderate* and *high time intensive activities*. The decision to meet the recommended level was then regressed on the measures of opportunity cost of time controlling for covariates in sub-samples of *low*; *moderate* and *high time intensive physical activities* respectively. Probit regression models were used in all cases.

[117] The groupings were also to afford sufficient observations for statistical analyses.

Reduced models were derived for each of the base regression models. However, in the context of models with selectivity correction, the derivation of reduced models is not straightforward. Firstly, the identification of the selection of model requires that some variables or at least one variable should be in the first probit model (i.e. the decision to participate or not in physical activity) but not in the second probit model (i.e. decision to meeting the recommended level of participation or not give participation). Secondly, it is often expected that the first probit model should include all variables in the second probit model, and that removing variables that are in the second probit model, from the first probit model should be done correctly (Wooldridge, 2003). Therefore, the removal of insignificant variables to derive the reduced model was based on both a statistical and theoretical basis.

To reach the reduced model, insignificant variable(s) from the base model were removed only if they satisfied all the following properties: (a) they/it were/was jointly insignificant (b) they/it were/was not used to identify the selection model (c) they/it were/was not a measure of the opportunity cost of time, our main independent variable. The Wald test was used to test significance of variable(s) before their removal (Baum, 2006).

The model diagnostics followed the approach in chapter 4, covering the use of linktest to detect specification errors, and *Hosmer Lemeshow test* to examine the goodness of fit of regression models. In addition, multicollinearity was checked in the models

To assess the strength of influence of independent variables, marginal effects were calculated for all of them (see chapter 4 for details on methods). All statistical analyses were undertaken using Stata version 10 software.

5.3 Results

The results section first describes the sample, followed by descriptive statistics of missing observations, principal component analysis, and regression models.

5.3.1 Description of sample

The sample was predominately White (89.1%) with the remaining 11% constituting Asians, Chinese, Mixed race, Blacks, and had a mean age of 49.3(18.6) years. Of the sample, 55.3% were female. Most were married and living with their partners (54.5%), and reported good health status (73.1%). Few (21.3%) were defined as obese, and smokers (21.9%) though majority were 'drinkers' (79.9%). About 44.2% participated in physical activity while, given participation, 21.5% met the recommended level of participation. Detailed summary statistics of the sample can be found in Appendix 5.2.

5.3.2 Missing observations

The main dependent variable (i.e. decision to participate in physical activity) had 10 missing observations, while the other dependent variable (i.e. meet recommended level of participation given participation) had no missing observations. All the independent variables except region of residence; age; gender; urban residence, number of children in household, number of adults in household; and seasonal effect had missing observations (Appendix 5.2). The pattern of missingness in the data was thus observed as multivariate or general (Briggs et al., 2003). 'Obese' had the highest number of missing observations (n=2115) while 'marital status' and 'health status' had the lowest (n=3).

The proportion of participants in physical activity who had missing values for independent variables were statistically significantly different from 'non-participants', for those variables except 'marital status'; 'working hours'; 'drinking status'; 'smoking status' and 'access to vehicle'(Appendix 5.3). Therefore, the mechanism under which the missingness occurred may not be completely at random.

To ensure a complete use of the data and account for the potential ‘non randomness’ of the missingness, analyses adjusted for missing observations (refer to chapter 4 for details of the method used).

Table 5. 1 Descriptive statistics of variables*

Variables	**Obs.**	**Mean (SD) / %**
DEPENDENT		
Participate in physical activity		
Yes	6248	44.2
No	7884	55.8
missing	10	0.07
Meeting recommended level		
Yes	1343	21.5
No	4905	78.5
INDEPENDENT		
Opportunity cost of time		
Have a degree (proxy 1)		
Yes	2711	19.2
No	11383	78.5
missing	48	0.3
Employed (proxy 2)		
Yes	7642	54.0
No	6460	45.7
missing	40	0.3
CONTROL		
Socio demographics		
Age	14142	49.3 (18.6)
Marital status		
Other	2872	20.3
Married(living with partner)	7709	54.5
Single	3558	25.2
missing	3	0.01
Income[118]	14142	28359 (23752)
Ethnicity		
White	12834	89.1
Mixed	123	1.0
Asian	831	5.9
Black	395	2.8
Chinese	158	1.1
missing	35	0.01
Gender		
Male	6324	44.7
Female	7818	55.3
Health		
Health status		
Good health	10464	73.1
Fair health	2650	18.7
Bad health	1025	7.3
missing	3	0.01
Drinkers		
Yes	11295	79.9
No	2760	19.5
missing	87	0.6
Smokers		
Yes	3101	21.9
No	10934	77.6
missing	107	0.8
Obese (BMI:30 plus)		

[118] Missing observations for income were 2792, and the mean(SD) unadjusted for missing observations is 29112 (2569).

Variables	Obs.	Mean (SD) / %
Yes	3010	21.3
No	9017	63.7
missing	2115	15.0

***** adjusted for missing observations

5.3.3 Principal component analysis

The strength of correlation among the variables selected for construction of the proxy index showed an appropriate intercorrelation. A score of 0.60 was found for the *Kaiser-Meyer-Olkin Measure of Sampling Adequacy* while *Bartlett test of sphericity* was highly statistically significant (p<0.001). The first component of proxy index explained a variation of 39% of the total data, which is comparable to that in the literature that often ranges from 11.1% (Vyas and Kumaranayake, 2006) to 27% (Mckenzie, 2003). The proxy index was also found to be positively correlated with the individual variables used in its construction.

5.3.4 Regression model

Bivariate regression analyses showed that 'number of children' is correlated with the dependent variable of the selection equation but not that of the outcome equation and hence could be a variable for exclusion criteria. Similar results were found when selectivity bias in the models were checked using the two different exclusion criteria [(a) 'number of children' - via empirical evidence in the dataset, and (b) 'number of children', 'region of residence', and 'health status - via evidence from literature]. In both cases, there was no difference in the statistical significance of the correlation coefficient between the two error terms of the selection equation and the outcome equations. Hence, the latter approach was followed using an exclusion criteria based on 'number of children[119]', 'region of residence', and 'health status'.

Tables 5.2-5.9 show the estimated reduced regression models. Prominence is placed on the reduced models because they provide better fit and specification. Notably, results were similar across both base and reduced models (see

[119] However it was observed that among the three variables used for the exclusion criteria (i.e. number of children, health status, and region of residence) 'number of children' was not found to be statistically significant in the selection equation (as shown on forth coming estimation results of the sample selection models). This may raise the question as to whether it was an appropriate instrument, and if it was not, does it have implication on the results found for identification of selection bias found. This was explored by running all the sample selection models without 'number of children' as a variable for the exclusion criteria. The results on the identification of selection bias in both cases were consistently similar across all samples (i.e. whole sample, male, and female samples).

Appendices 5.4-9). A problem of selection bias was identified only in females. Hence, for whole and male samples, 2 part models were considered (results of the bivariate probit models[120] for these samples are however provided in Appendices 5.10-13).

Opportunity cost of time

(a) Decision to participate

The opportunity cost of time measure as captured by the proxies, was positively associated with the decision to participate in physical activity. In the whole sample, people with high opportunity cost of time were 7%[121] more likely to participate in physical activity (Table 5.2). Table 5.3 shows that the association was also positive and significant in females, but with a slightly higher impact (7.7%). In males, the correlation was mixed, as proxy 1 indicated that males with high opportunity cost of time were 6.4% more likely to participate in physical activity, while proxy 2 suggested that these individuals were 3.2% less likely to participate in physical activity (Table 5.4).

The proxy index measure of opportunity cost of time also showed a positive correlation with the decision to participate in physical activity. This positive relationship was significant only in the whole and female samples (Table 5.5-6) albeit the impact was greater in the latter (3.4%).

(b) Decision to meet recommended level

Results from the 'decision to meet recommended level of participation' equation also revealed a positive association between the opportunity cost of time (both proxies' and proxy index measures) and the decision to meet recommended level of participation given participation. Notably, the importance of opportunity cost of time to this decision is smaller compared with the decision to participate in physical activity.

In the whole sample, a person with a high opportunity cost of time (via proxies' measure) was 2.5% more likely to meet the recommended level of participation.

[120] It is notable that the results of these models were generally similar to that of the 2 part models

[121] This number indicates the percentage version of the marginal effects, which is the predicted probability as a result of a unit increase (for continuous variables) and discrete change from 0 to 1 (for dummy variables), at the means of other independent variables. This applies to all effects of independent variables.

Females with high opportunity cost of time also showed an increased likelihood (5.4%) but no significant relationship was found in males. Appendix 5.14 shows that an individual with high opportunity cost of time was likely to meet the recommended level irrespective of the ‘type of physical activity’ he/she does (Appendix 5.16 describes the different types of physical activity). This positive influence of opportunity cost of time was greatest for those doing high time intensive physical activities (11.9%), followed by moderate time intensive physical activities (5.3%) and low time intensive physical activities (4%) respectively.

For the proxy index measure of opportunity cost of time, a partial positive correlation was observed as people with high opportunity cost of time were significantly more likely to meet the recommended level only if they were females (2.5%) or participants of moderate time intensive physical activities (1.9%) (Appendix 5.15).

Table 5. 2 Estimation results of 2 part model for whole sample (proxies)

	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
Variables	Coef [a].	ME	Coef [a].	ME
Oppor. cost				
Proxy 1(educ[122].)	0.175***	0.070	0.054***	0.016
Proxy 2 (employed)	0.006	0.003	0.087**	0.025
Socio demographics				
Age	-0.020***	-0.008		
Ethnicity [b]				
Mixed	-0.003	-0.001	0.094	0.028
Asian	-0.200***	-0.078	0.107	0.032
Black	-0.068	-0.027	0.047	0.014
Chinese	0.013	0.005	-0.393**	-0.095
Female	-0.111***	-0.044	-0.436***	-0.124
Marital status [c]				
Other	-0.008	-0.003		
Married (living)	-0.090**	-0.036		
Income	0.000***	0.000[123]	0.000***	0.000
Full time work	-0.067**	-0.027		
Health				
Drinkers	0.223***	0.088		
Smokers	-0.195***	-0.077	-0.113***	-0.032
Health status [d]				
Good health	0.585***	0.224		
Fair health	0.335***	0.133		
Obese	-0.125***	-0.049	-0.304***	-0.080
Other				
Voluntary activity	0.082**	0.033		
Club member	1.210***	0.445	0.694***	0.203
Urban residence			0.145***	0.040
Seasonal effect [e]				
Summer	0.257***	0.102	0.096*	0.028
Spring	0.100***	0.040	0.048	0.014
Autumn	0.101***	0.040	0.101*	0.030
Region of residence [f]				
North east	-0.251***	-0.098		
North west	-0.223***	-0.088		
Yorkshire	-0.159***	-0.063		
East Midlands	-0.073	-0.029		
West Midlands	-0.111**	-0.044		
East	-0.037	-0.015		
London	-0.218***	-0.086		
South west	-0.065	-0.026		
Constant	0.018		-1.173***	
Observations	14142		6248	
Link test	*p*=0.132		*p*=0.363	
Pseudo R^2	0.240		0.087	
Goodness of fit	*p*=0.534 [g]		*p*=0.470 [h]	

[a] The asterisks show significance level of 1%(***), 5%(**) and 10%(*) [b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health; [e] Omitted category: winter; [f]Omitted category: south east. [g] Chi-square(8)=7.02 [h] Chi-square(8)= 7.64 * Average VIF for independent variables was 1.6, and the average tolerance levels was 0.4

122 Educational attainment was specified as having a degree or not, as it provides better fit to the regression models.
123 Income elasticity=0.050. See Table 5.8 for income elasticities for other models and decisions.

Table 5. 3 Estimation results of bivariate probit model with select. correct.: female sample(proxies)

	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost				
Proxy 1	0.196***	0.077	0.056	0.015
Proxy 2	0.049	0.020	0.198***	0.054
Socio demographics				
Age	-0.018***	-0.007		
Ethnicity [b]				
Mixed	0.105	0.046	-0.179	-0.045
Asian	-0.422***	-0.155	0.422***	0.133
Black	-0.046	-0.016	0.002	0.001
Chinese	0.036	0.015	-0.246	-0.060
Income			0.000**	0.000
No. of children	-0.002	-0.001		
Health				
Drinkers	0.314***	0.123		
Smokers	-0.195***	-0.075		
Health status [d]				
Good health	0.487***	0.181		
Fair health	0.280***	0.111		
Obese	-0.107**	-0.045	-0.163**	-0.042
Other				
Voluntary activi.	0.114**	0.046		
Club member	1.295***	0.477	0.373***	0.110
Urban residence			0.170**	0.044
Seasonal effect [e]				
Summer	0.203***	0.081	0.154**	0.043
Spring	0.061	0.024	0.017	0.005
Autumn	0.059	0.024	-0.002	-0.001
Region of residence [f]				
North east	-0.123	-0.050		
North west	-0.214***	-0.089		
Yorkshire	-0.133**	-0.054		
East Midlands	-0.037	-0.014		
West Midlands	-0.095	-0.040		
East	0.010	0.000		
London	-0.189***	-0.081		
South west	-0.018	-0.011		
Constant	-0.201*		-1.328***	
Observations	7818		3349	
Rho	-.0364		-0.364	
	p=0.003		*p*=0.003	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Table 5. 4 Estimation results of 2 part model for male sample (proxies)

	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost				
Proxy 1	0.160***	0.064	0.081	0.027
Proxy 2	-0.080*	-0.032	-0.001	0.000
Socio demographics				
Age	-0.021***	-0.009	-0.015***	-0.005
Access to vehicle			-0.169*	-0.058
Ethnicity [b]				
Mixed			0.142	0.049
Asian			-0.120	-0.038
Black			-0.080	-0.026
Chinese			-0.620**	-0.161
Marital status [c]				
Other	0.031	0.012		
Married (living)	-0.103*	-0.041		
Income	0.000***	0.000		
Full time work	-0.139**	-0.055		
No. of children	0.049**	0.019	-0.053*	-0.017
Health				
Drinkers	0.130**	0.052		
Smokers	-0.214***	-0.085	-0.265***	-0.083
Health status [d]				
Good health	0.719***	0.276	-0.087	-0.029
Fair health	0.417***	0.163	-0.549**	-0.153
Obese	-0.128***	-0.051	-0.266***	-0.083
Other				
Club member	1.126***	0.412	0.634***	0.211
Seasonal effect [e]				
Summer	0.307***	0.121	0.048	0.016
Spring	0.130***	0.052	0.080	0.027
Autumn	0.134***	0.053	0.162***	0.054
Region of residence [f]				
North east	-0.406***	-0.159	0.080	0.027
North west	-0.240***	-0.095	0.013	0.004
Yorkshire	-0.183***	-0.073	-0.075	-0.024
East Midlands	-0.133*	-0.053	-0.096	-0.031
West Midlands	-0.136*	-0.054	-0.079	-0.026
East	-0.084	-0.033	-0.192*	-0.060
London	-0.270***	-0.107	-0.032	-0.011
South west	-0.110	-0.044	-0.143	-0.045
Constant	0.146		0.059	
Observations	6324		2899	
Link test	p=0.885		p=123	
Pseudo R^2	0.237		0.103	
Goodness of fit	p=0.297 [g]		p=0.221 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*) [b] Omitted category: white;
[c] Omitted category: single ; [d] Omitted category: bad health; [e] Omitted category: winter; [f] Omitted category: south east.
[g] Chi-square(8)=9.56 [h] Chi-square(8)= 10.67

Table 5. 5 Estimation results of 2 part model for whole sample (proxy index)

	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost				
Proxy index	0.064***	0.025	0.035	0.010
Socio demographics				
Age	-0.019***	-0.008	-0.013***	-0.004
Ethnicity [b]				
Mixed	0.005	0.002	0.004	0.001
Asian	-0.192***	-0.075	0.057	0.017
Black	-0.071	-0.028	0.033	0.010
Chinese	0.050	0.020	-0.414**	-0.098
Female	-0.111***	-0.044	-0.422***	-0.120
Marital status [c]				
Other	-0.019	-0.008		
Married (living)	-0.102***	-0.041		
Income	0.000***	0.000	0.000***	0.000
Full time work	-0.087***	-0.035		
Health				
Drinkers	0.208***	0.082		
Smokers	-0.198***	-0.078	-0.173***	-0.047
Health status [d]				
Good health	0.570***	0.219		
Fair health	0.325***	0.129		
Obese	-0.131***	-0.052		
Other				
Voluntary activi.	0.089**	0.035		
Club member	1.211***	0.445	0.624***	0.182
Seasonal effect [e]				
Summer	0.261***	0.104	0.117**	0.034
Spring	0.104***	0.041	0.063	0.018
Autumn	0.102***	0.041	0.111**	0.033
Region of residence [f]				
North east	-0.245***	-0.096		
North west	-0.220***	-0.086		
Yorkshire	-0.162***	-0.064		
East Midlands	-0.074	-0.029		
West Midlands	-0.109***	-0.043		
East	-0.037	-0.014		
London	-0.205***	-0.081		
South west	-0.066	-0.026		
Constant	0.084		-0.516***	
Observations	14142		6248	
Link test	*p*=0.204		*p*=0.169	
Pseudo R^2	0.238		0.094	
Goodness of fit	*p*=0.524 [g]		*p*=0.255 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east.
[g] Chi-square(8)=7.11 [h] Chi-square(8)= 10.14

Table 5. 6 Estimation results of bivariate probit model (select. correc.): female sample (proxy index)

Variables	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost				
Proxy index	0.087***	0.034	0.088***	0.025
Socio demographics				
Age	-0.019***	-0.007		
Ethnicity [b]				
Mixed	0.109	0.048	-0.188	-0.049
Asian	-0.403***	-0.148	0.424***	0.137
Black	-0.052	-0.018	0.006	0.002
Chinese	0.076	0.031	-0.279	-0.070
Income			0.000**	0.000
No. of children	-0.002	-0.001		
Health				
Drinkers	0.301***	0.118		
Smokers	-0.197***	-0.077		
Health status [d]				
Good health	0.474***	0.176		
Fair health	0.272***	0.108		
Obese	-0.113***	-0.047	-0.154**	-0.042
Other				
Voluntary activi.	0.116**	0.048		
Club member	1.295***	0.477	0.340***	0.103
Urban residence			0.164**	0.044
Seasonal effect [e]				
Summer	0.206***	0.082	0.149*	0.044
Spring	0.063	0.025	0.010	0.003
Autumn	0.060	0.024	0.000	0.000
Region of residence [f]				
North east	-0.116	-0.047		
North west	-0.210***	-0.088		
Yorkshire	-0.134**	-0.055		
East Midlands	-0.037	-0.015		
West Midlands	-0.093	-0.040		
East	0.010	0.000		
London	-0.173**	-0.076		
South west	-0.017	-0.011		
Constant	-0.104		-1.155***	
Observations	7818		3349	
Rho	-0.394		-0.394	
	p=0.001		p=0.001	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Table 5. 7 Estimation results of 2 part model for male sample (proxy index)

	Decision to participate		Decision to meet recommended level	
	Reduced model		Reduced model	
Variables	Coef [a].	ME	Coef. [a]	ME
Oppor. cost				
Proxy index	0.028	0.011	-0.005	-0.002
Socio demographics				
Age	-0.020***	-0.008	-0.015***	-0.005
Access to vehicle			-0.182**	-0.062
Ethnicity [b]				
Mixed			0.132	0.045
Asian			-0.088	-0.028
Black			-0.047	-0.015
Chinese			-0.615**	-0.161
Marital status [c]				
Other	0.010	0.004		
Married (living)	-0.121**	-0.048		
Income	0.000***	0.000	0.000***	0.000
Full time work	-0.184***	-0.073		
No. of children	0.048**	0.019		
Health				
Drinkers	0.111**	0.044		
Smokers	-0.219***	-0.087	-0.267***	-0.084
Health status [d]				
Good health	0.692***	0.266		
Fair health	0.396***	0.155		
Obese	-0.136***	-0.054	-0.287***	-0.089
Other				
Club member	1.129***	0.414	0.635***	0.212
Seasonal effect [e]				
Summer	0.310***	0.123	0.051	0.017
Spring	0.137***	0.055	0.087	0.029
Autumn	0.132***	0.053	0.164**	0.056
Region of residence [f]				
North east	-0.398***	-0.155	0.090	0.031
North west	-0.235***	-0.093	0.023	0.008
Yorkshire	-0.187***	-0.074	-0.063	-0.021
East Midlands	-0.134*	-0.053	-0.091	-0.029
West Midlands	-0.132*	-0.053	-0.062	-0.020
East	-0.085	-0.034	-0.189*	-0.060
London	-0.256***	-0.102	-0.043	-0.014
South west	-0.111	-0.044	-0.134	-0.043
Constant	0.154		-0.172	
Observations	6324		2899	
Link test	p=0.680		p=0.186	
Pseudo R^2	0.236		0.097	
Goodness of fit	p=0.897 [g]		p=0.346 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. [g] Chi-square(8)=3.53 [h] Chi-square(8)= 8.99

Socio demographic variables

(a) Decision to participate

Tables 5.2&5.5 show that in the whole sample, ethnicity is the most important socio demographic variable as Asians were 8% less likely to participate in physical activity compared with Whites. This was followed by females; and married people living with their spouses (compared with singles) with reduced probabilities of 4% respectively. Full-time workers were 3% less likely to participate in physical activity compared with part-time workers. A year increase in average from say 49.3 years to 50.3 years also makes an individual less likely (0.8%) to participate in physical activity. Income had a positive but small influence; a one percent increase in income led to a less than one percent increase in probability to participate in physical activity. Hence, the income elasticity[124] of demand suggests that physical activity is a normal good with probability of uptake rising as income increases, albeit less than proportionately (see Table 5.8).

Table 5. 8 Income elasticity of demand by samples

Samples	Decision to participate (IED)	Decision to meet the recommended level (IED)
Whole	0.050	0.091
Male	0.082	-
Female	-	0.093

*Calculations were based on estimates of regression models containing proxies' measure (i.e. Tables 4.2 to 4.4). It is notable these results are confirmed by models with the proxy index.
*IED: income elasticity of demand

These findings were confirmed in the male sample as well. Males living in households with a higher number of children were also more likely (1.9%) to participate in physical activity (Tables 5.4&5.7). The most important predictor of uptake in males was working hours as full time male workers were about 6% less likely to participate in physical activity. Similarly, males who were: married and lived with their spouses; relatively old were less likely to participate in physical activity respectively.

[124] This shows the responsiveness of participating in physical activity with respect to increases in income, in proportionate terms.

In females, ethnicity had the most influence, with being Asian negatively (15%) associated with uptake. Another finding was that a year increase in average age for females, from 49.3 to 50.3 years, makes them 0.7% less likely to participate in physical activity.

(b) Decision to meet recommended level

The results from decision to meet recommended level of participation equation were quite different and revealed that some factors that predicted the decision to participate in physical activity do not influence the former decision and vice versa. For instance, working hours of individuals' explained their decision to participate in physical activity but not to meet the recommended level. Income was however an exception as the income elasticity was similar across both decisions (see Table 5.8).

Tables 5.2&5.5 show that gender had a substantial influence in the whole sample, with females being 12% less likely to meet the recommended level. This was followed by ethnicity as being Chinese compared with white suggested a 10% reduced likelihood to meet the recommended level. Age[125] was also negatively associated with meeting the recommended level though the impact was relatively low (0.4%). These findings were consistent across participation in different types of physical activities (Appendices 5-14-15) Females who are Asians were 13% more likely to meet the recommended level of participation (Tables 5.3&5.6). For males however, being Chinese showed the greatest influence with 16% less likelihood to meet the recommended level (Tables 5.4&5.7). Older males, those with access to vehicle were also less likely to meet the recommended level. Another important finding was that males who live with more than one child in the household were 2% less likely to meet the recommended level[126].

[125] Not significant in the 2 part equation with proxies.
[126] Found only in the 2 part equation with proxies.

Health variables

(a) Decision to participate

In the whole sample, if an individual had good or fair health status compared with bad, he/she was 22% or 13% (in that order) more likely to participate in physical activity (Tables 5.2&5.5). Being a 'drinker' of alcohol had a positive influence (9%), but a smoker was 8% less likely to do physical activity. Obese people were also less likely to participate albeit the influence was lower (5%).These findings were confirmed in both male and female samples (see Tables 5.3-4; 5.6-7).

(b) Decision to meet recommended level

Whether a person meets the recommended level or not depended on his/her smoking status; if a smoker, he/she was 4% less likely to meet that level (with reference to whole sample). Being obese[127] also had a negative but greater impact (8%). These results were generally compatible with the activity-specific models (Appendices 5.14-15). The negative influence of obesity was also observed in both female and male samples though its influence in the latter was greater (Tables 5.3-4; 5.6-7). Other important findings were that males who smoked or had fair health status[128] were 8.3% or 15.3% (correspondingly) less likely to meet the recommended level.

Other variables

(a) Decision to participate

In general, club membership had the greatest influence on the decision to do physical activity as members of clubs (compared with non-members) were 46% more likely to participate (Tables 5.2&5.5). Non-winter weather conditions were also found to reflect positively (impacts ranging from 4% to 10%) on uptake. Individuals who undertook voluntary activities were 3% more likely to do physical activity. Residing in other regions in England compared with south east however had a negative impact ranging from 6% to 10%. These findings were consistent with results in the gender specific samples, but the exception is that uptake in males was not influenced by participation in voluntary activities.

[127] Observed only in model with the proxies' indicator.
[128] Observed only model with the proxies' indicator.

(a) Decision to meet recommended level

Tables 5.2&5.5 indicate that club members are about 19% more likely to meet the recommended level. This decision is also positively influenced by non winter conditions though the impacts are relatively low (2.8% to 3.4%). Living in urban areas[129] increases the tendency to meet the recommended level by 4%. Again, the results were similar across both gender and activity-specific samples though a few exceptions were noted. For example, urbanisation of area had no influence on males but region of residence had, with those living in eastern England (compared with south east) been 6% less likely to meet the recommended level (see Tables 5.4 & 5.7).

5.4 Further analysis

The results from the regression analyses generally indicate a positive effect of opportunity cost on decisions to participate in physical activity, and to meet the recommended level of participation, given participation. This section seeks to further explore this finding and demonstrate potential interpretations underlying it.

5.4.1 Income and substitution effects

The effect of opportunity cost of time can interpreted in two ways: income effect and substitution effects, using standard consumer theory (Ekelund and Ritenour, 1999; Humphreys and Ruseski, 2006, 2007). The income effect corresponds to a positive effect of opportunity cost of time. This means that since high opportunity cost of time indicates high hourly earnings, hence increases in income; the participation in physical activity if a normal good will be positively related with changes in the opportunity cost of time. The substitution effect however works in the opposite direction and signifies a negative effect of the opportunity cost of time. It suggests that an increase in the opportunity cost of time that indicates high hourly earnings, makes non-labour uses of time non-profitable and increasing the tendency to substitute time spent on non-labour (including physical activity participation) for labour market, to increase earnings. Thus the correlation between opportunity cost of time and physical activity

[129] Observed only in the model with proxies' indicator.

participation depends on the offsetting income and substitution effect, indicating that the direction of overall effect is determined by which effect dominates; in this case a dominating income effect. This income effect is therefore explored further by investigating the probabilities of participating in physical activity, and meeting the recommended level of participation given participation across different income groups. The income measure could include both wage and non-wage income and as such may not be an adequate specification of the income effect via wage earnings. However, as already stated the aim of this section is only meant to further explore our findings and shed some light on the income effect of opportunity cost of time

Methods

For the purposes of this analysis, income quintiles are used; to help identify specific effect within different income groups. In the HSE (2006), household income quintiles are specified in five groups: (a) lowest quintile (<£10598) (b) 2nd lowest quintile (>=£10598 and <£16, 852) (c) middle quintile (>=£16852 and < £25114) (d) 2nd highest quintile (>=£25114 and <£40373) (e) highest quintile (>=£40373). For the analyses, the following steps were undertaken in the whole sample, males, and females respectively. First, probabilities of participating in physical activity, and probability of being physically active, given participation, are predicted for the various income quintiles, based on regression estimates already presented in the results section. Second, averages are calculated for the predicted probabilities, and plotted to check their distribution.

Results

As expected the income effect is found to be positive, with the distribution of probability to participate in physical activity, and the probability of meeting the recommended level of participation found to be upward sloping (Figures 5.1 and 5.2). The results in the whole sample, males and females follow a similar trend. Thus the probability to participate in physical activity and probability of meeting the recommended level of participation are relatively higher in higher income quintiles except in the second income quintile. Even so, as shown in Table 5.9, the difference in the predicted probabilities for the first and second income quintiles is relatively small compared with the differences across the other income quintiles. For example, in the case of females, there is no difference at all between the predicted probabilities for first and second income quintiles.

Figure 5. 1 Predicted probability to participate in physical activity (PA) by income quintiles, for whole sample, male sample, and female sample

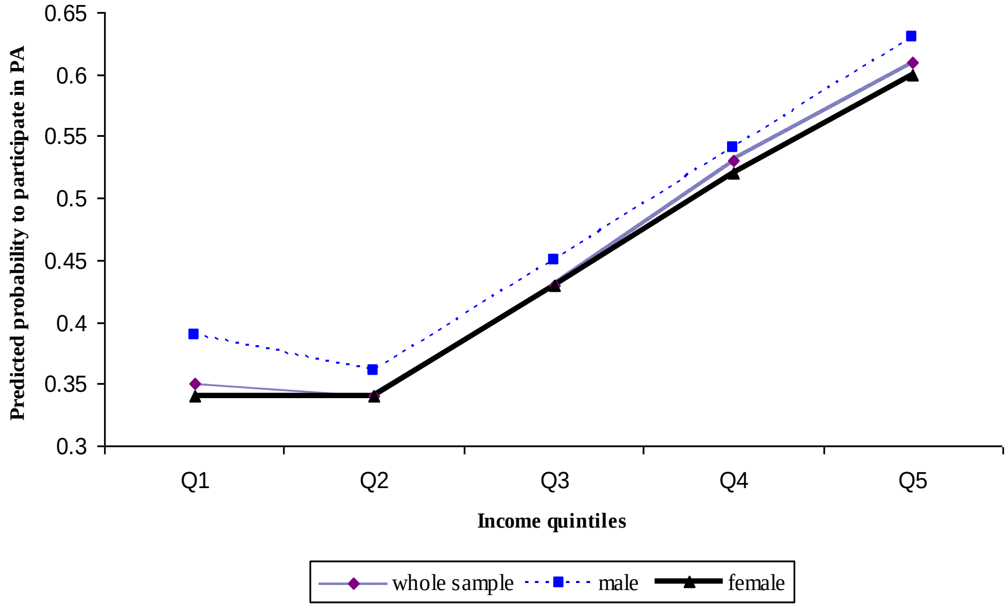
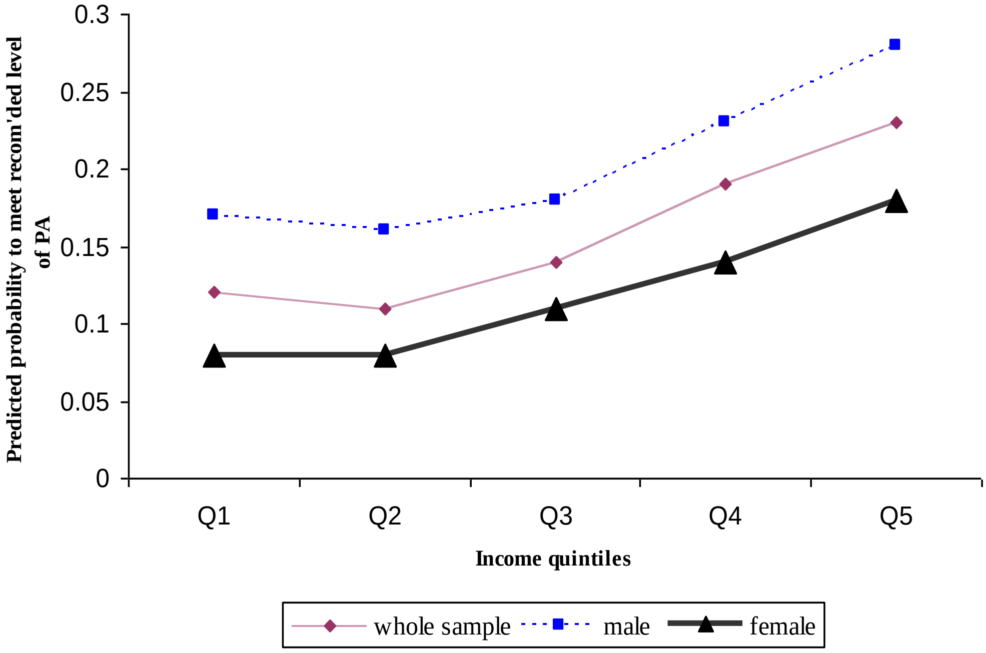


Table 5. 9 Predicted probabilities of participation in physical activity, and of meeting the recommended level of participation given participation by income quintiles, for whole sample, male sample, and female sample

Income quintiles	Participation or not			Meeting recommendation or not		
	w. sample	male	female	w. sample	male	female
Q1	0.35	0.39	0.34	0.12	0.17	0.08
Q2	0.34	0.36	0.34	0.11	0.16	0.08
Q3	0.43	0.45	0.43	0.14	0.18	0.11
Q4	0.53	0.54	0.52	0.19	0.23	0.14
Q5	0.61	0.63	0.6	0.23	0.28	0.18

Figure 5. 2 Predicted probability of meeting recommended level of physical activity (PA) participation given participation by income quintiles, for whole sample, male sample, and female sample



5.4.2 Costs and perceived benefits

A plausible explanation for the positive effect of opportunity cost of time can be approached via the attenuating effect of the perceived benefits of physical activity participation. Recall that the theoretical paradigm presented in chapter 3 indicates that physical activity behaviour are determined by costs (e.g. opportunity cost of time) and perceived benefits. It can therefore be argued that if costs of participation in physical activity are high but the perceived benefits are even greater, there is the tendency for a rational consumer to participate or/and participate more, given participation in physical activity. Data limitations however precluded the investigation of this proposition in terms of accounting for perceived benefits in the analyses conducted so far in this chapter. The dataset used in this chapter, HSE (2006), does not have data on perceived benefits on physical activity participation. Hence, the potential attenuating effect of perceived benefits was explored using data from the dataset applied in chapter 4, where the relationship between perceived benefits and physical activity behaviour was investigated.

Methods

The purpose of this analysis, mainly exploratory, was to investigate whether people with high opportunity costs are likely to have even greater perceived benefits. Data on perceived benefits was sourced from the Health Education Authority National Survey of Activity and Health (HEANSAH) 1991 (see details in chapter 4).

Cost of physical activity participation was specified as opportunity cost of time, analogous to the approach in this chapter, using *educational attainment* and *employment status*. Since the object was to assess whether people with high opportunity costs are likely to have even greater perceived benefits, the indicators of high opportunity cost (i.e. educational attainment and employment status) were used to create sub-groups: (a) people with high opportunity cost of time defined as either employed, or have high educational attainment (degree), and b) people with low opportunity cost of time defined as either unemployed, or have low educational attainment (no degree).

First, median scores with inter quartile ranges (IQR) of the 13 perceived benefits were calculated for the two groups. This was used to analyse the differing perceptions the two groups of people may have about the benefits accruable from physical activity participation. The variables measuring 'perceived benefits' were specified as ordinal variables (see details in chapter 4). Second, Mann Whitney U test[130] was used to examine whether 'people with high opportunity cost of time' have significantly greater perceived benefits or not.

Results

The results (see Tables 5.10&5.11) suggest that people with high opportunity costs of time had significantly greater perceived benefits from vigorous physical activity. In terms of proxy 2, having high opportunity cost means higher perceptions about all 13 benefits except one, with high significant levels (p

[130] A non-parametric test based on ranks and can be used to compare the scores among two groups (Peacock and Kerry, 2007)

<0.001). A similar pattern was observed in the case of proxy 1 though statistically significant differences were not observed in few cases (4 out of 13).

Table 5. 10 Median (inter quartile range) scores and the comparison of scores of 'perceived benefits' for employed (proxy 2)

Perceived benefits	*Employed* **Median (IQR)**	***Not employed*** **Median (IQR)**	**Comparison of scores[131] (p-value)**
Good shape physically	5(4,5)	4(3,5)	<0.001***
Improve/maintain health	5(4,5)	4(3,5)	<0.001***
Sense of achievement[132]	4(3,5)	4(3,5)	<0.001***
Get outdoors	4(3,5)	4(2,5)	<0.001***
Lose weight	4(3,5)	4(2,5)	<0.001***
Mentally alert	4(3,5)	4(2,5)	<0.001***
Look good	4(3,5)	4(2,5)	<0.001***
Have fun	4(3,5)	3(2,5)	<0.001***
relax	4(2,4)	3(1,4)	<0.001***
Meet people	3(2,5)	3(2,4)	<0.001***
Learn new things[133]	3(2,4)	3(2,4)	<0.001***
Feel independent	3(2,4)	3(1,5)	0.311
Seek adventure	3(2,4)	3(1,4)	<0.001***

Significance level of 1%(***), 5%(**) and 10%(*): Mann Whitney U test

Table 5. 11 Median (inter quartile range) scores and the comparison of scores of 'perceived benefits' for degree (proxy 1)

Perceived benefits	***Degree*** **Median (IQR)**	*No degree* **Median (IQR)**	**Comparison of scores (p-value)**
Good shape physically[134]	5(4,5)	5(4,5)	<0.001***
Improve/maintain health	5(4,5)	4(4,5)	<0.001***
Sense of achievement	4(3,5)	4(3,5)	0.765
Get outdoors	4(3,5)	4(3,5)	0.463
Lose weight[135]	4(3,5)	4(3,5)	0.093*
Mentally alert	4(3,5)	4(3,5)	0.822
Look good	3(3,4)	4(3,5)	<0.001***
Have fun	4(3,4)	4(2,5)	0.777
relax	4(3,5)	3(2,4)	<0.001***
Meet people	3(2,4)	3(2,5)	<0.001***
Learn new things	3(2,3)	3(2,4)	<0.001***
Feel independent	3(2,4)	3(2,5)	<0.001***
Seek adventure	2(2,3)	3(2,4)	0.058*

Significance level of 1%(***), 5%(**) and 10%(*): Mann Whitney U test

[131] There could be same median scores but with statistical difference among two groups when there is a small number of possible scores and a high number of tied scores; in such cases, the percentages for the scores could provide more information (Peacock and Kerry, 2007).
[132] However, 42%of employed scored 5 while 37% of non employed scored 5. Also 27% of employed people scored 4 while 24% of non employed scored 4.
[133] 19%of employed scored 5 while 17% of non employed scored 5. Also 21% of employed people scored 4 while 20% of non employed scored 4.
[134] 63%of people with degree scored 5 while 54% of non degree scored 5. Also 25% of people with degree scored 4 while 23% of non degree scored 4.
[135] 31%of people with degree scored 5 while 43% of non degree scored 5. 32% of people with degree scored 4 while 22% of non degree scored 4. 18% of people with degree scored 3 while 14% of non degree scored 3. 0.08% of people with degree scored 2 while 0.07% of non degree scored 2. And 0.09% of people with degree scored 1 while 0.12% of non degree scored 1

5.5 Discussion

People tend to participate in physical activity, and meet the recommended level of participation given participation (regardless of the time intensity of activity), if they have a high opportunity cost of time. Although the influence of opportunity cost of time was also positive in females, for males, it was mixed (or non-existent)[136] for meeting the recommended level but non-existent in terms of participating or not. Irrespective of gender, physical activity is a normal good though not highly sensitive to changes in income. Other important influences on physical activity behaviour are favourable health status and club membership (members), with both factors having positively large impacts (above 20% increased likelihood)[137].

The positive influence of opportunity cost of time may be due to the dominant income effect and the offsetting effect of perceived benefits. People with high opportunity cost of time may have even greater perceived benefits from physical activity and are therefore likely to participate in physical activity and meet the recommended level of participation given participation. Being potential indicators of economic status, the proxies may have also captured opportunities for uptake such as increased access to exercise facilities. While this may be true, its confounding effect may be minimal in this research context because Macintyre (2008) observed that access to sports facilities in the UK is not determined by economic status.

Specifying opportunity cost of time in terms of wage earnings warrants concerns about the findings. An apparent question is whether the underlying assumption that the cost of time spent on leisure say physical activity can be equated to the benefit foregone in labour time-wages? Probably not; because people may value leisure more than labour time (Taks et al., 1994; Coffey, 1983) and also the leisure/labour trade-off breaks down in the context of fixed working hours, as substitution of labour time for leisure do not suffice. Moreover, time may not be indivisible and therefore impractical to treat it like blocks that can be easily

[136] Mixed effects were found by the proxies' indicator while proxy index showed no effect. It must be noted that the findings from the two measures were largely similar in all cases.
[137] It is must noted that health status only affected the decision to participate.

traded off Palmquist et al. (2009). Given the accuracy of alternative approaches[138] accounting for these anomalies have been questioned due to their sensitivity to self-reporting (Mohanty, 2005), the former approach is still widely favoured (Parson, 2003) and thus provides support for the validity of findings.

The observed low impact of income could be debated on grounds that control variables such as age, number of children and adults in household may have been highly correlated with income, and hence minimised its influence. This is because the income measure was derived by adjusting household income using those variables. However, the robustness of the finding on the effect of income is justified due to a number of reasons. First, the collinear levels of these variables including income were within acceptable levels, with average variance inflation and tolerance indicators of 1.6 and 0.6 respectively. Second, the magnitude of the effect of income was consistent in reduced models which excluded those variables (see Table 4.2).

It is interesting to question whether findings on the decision to participate in physical activity, and to meet the recommended level given participation are joint or not, and whether results could have been biased by the 'instruments' used. Valid instruments are expected to identify the dual decision making (e.g. they should predict the decision to participate but not the choice of meeting the recommended level). The selection of instruments here was based on both evidence both in data (see methods section) and the literature (Humphreys and Ruseski, 2006). One of the instruments (i.e. number of children) could not determine the decision to participate, thereby raising questions about the validity of the instruments and whether the systems of equations were properly identified. Such doubts could however be erased for a number of reasons. First, the occurrence or not of joint decision-making, which is indicated by the correlation coefficients of the errors terms of the equations was robust to the removal or not

[138] The standard approach is to use a survey questionnaire to measure an unemployed individual's value of leisure, which is the reservation wage, in other words the wage rate that will attract him to work in the labour market (Coffey, 1983). Other variants approaches include conducting a survey where respondents are asked for their subjective opportunity cost of time (Casey and Vukina, 1995). Similarly, Feather and Shaw (1999) used a survey, but used contingent behaviour questions whereby people were asked about their willingness to work additional hours, or/and their willingness to work or not.

of this instrument. Second, a system of two equations is appropriately identified even with one instrument (Koutsoyiannis, 1977).

The findings on the effect of opportunity cost of time are congruent with that in the literature (Humphrey and Ruseski, 2006, 2007). However, there is a slight difference in the case of Humphrey and Ruseski (2006) as their study found opportunity cost of time to have a mixed effect on the decisions to participate in physical activity, and spend more time participating (given participation). The differences in findings may stem from the variation in methods. First, they used a US sample while an English sample is used here. Second, the specification of the dual decisions of physical activity participation is different because they specified the 'second step' decision as the amount of time spent on participation (given participation). Whereas in this chapter, the specification is: meeting recommended level of participation or not (given participation). The correlation between opportunity costs of time and these two decisions may be different because meeting the recommended level of participation is not necessarily equivalent to spending more time participating. The former is a combination of duration per session, frequency per reference period and intensity of the participation per session, while the latter only comprises duration per reference period.

In the case of the control variables, a priori expectations formulated based on the literature with respect to their association with the 'decision to participate in physical activity' were all met, hence providing further validity to the models.

This chapter has contributed to knowledge in a number of ways. First, it has demonstrated that time cost (captured opportunity cost of time) has an important influence on physical activity behaviour in England, an effect hitherto unknown in the literature. Second, insight has been given on the determinants of the choice of individuals' to meet the recommended level of participation (given participation), and on the fact that these factors may not have the same influence on the initial decision to participate. This is important to know because there is dearth of knowledge on the determinants of the former decision in spite of it being the thrust of current policies. This knowledge offers policy options to encourage participation in England (details forthcoming). Third, the chapter has provided a uni-dimensional proxy indicator of opportunity cost of time which addresses the limitations of using different proxies - current approach in the literature (see details in methods section). Another advantage of using the single proxy indicator is the clarity in interpretation it offers. Interpretation of the direction of opportunity cost becomes complicated if different proxies are used, and each of them suggests varied effects of opportunity cost of time. For example, in males, proxy 1(education) showed a positive effect on uptake while a negative effect was suggested by proxy 2 (employment). The use of the single proxy indicator (i.e. proxy index) however clarified the direction of the effect, revealing it as negative but insignificant[139].

While this chapter sheds light on the relationship between opportunity cost of time and physical activity participation, it does not provide the impetus to establish the potential differential impacts of time cost. Time cost may cover a plethora of different costs such as travel time, and travel distance (e.g. number of miles covered) and either may have varied effects, which is unlikely to be observed if a ‘global’ specification (i.e. opportunity cost of time) is used.

Another potential weakness is the partial definition of cost of physical activity participation. Although the aim was to examine the role of cost (i.e. time and money costs) in explaining physical activity behaviour, the analyses could only account for time cost, data permitting. The cost of physical activity participation includes time and money costs (Gratton and Taylor, 2000; Taks et al., 1994). Therefore, though it has been identified that time costs, as measured by opportunity of time, may have a positive effect, the money cost may have a negative and stronger effect. Assuming that the variable measuring ‘membership in sports or social club’ is a proxy indicator for the willingness and ability to incur money costs of physical activity participation, one can infer from the general significance of that variable in the regression analyses as suggestive of the potential negative effect of money cost on physical activity participation.

[139] It must however be emphasised that findings from either measure were generally consistent.

There were also other limitations with respect to the measurement of physical activity behaviour. First, physical activity participation were measured via questionnaire (i.e. self reports). Despite appropriate validity and reliability tests, the use of self reports to measure physical activity behaviour may be fraught with overestimation (Gillison et al., 2006). However, alternative approaches such as the use of objective measurements like pedometers were not attainable within the logistical constraints of this thesis. Thus the application of the findings in this chapter ought to be treated with caution. Second, given that the aim of the study was to explore how cost could explain physical activity behaviour, a more complete approach would have been to examine the impact of opportunity cost on variant measures of physical activity behaviour. Data limitations did not allow such an investigation. Hence, our knowledge on the impact of cost is still limited considering that explanators of physical activity behaviour can vary depending on the type of physical activity in question (Sallis and Hovell, 1990). For example, cost may relate differently to the choice to spend more days doing physical activity, irrespective of intensity of participation.

Nevertheless, the findings in this chapter provide a number of implications for policies to improve physical activity participation in England. First, policies to increase physical activity may have to concentrate on money costs and not time costs because the latter may not deter uptake. Assuming that ‘membership in sports or social club’ is a valid proxy indicator for money cost, subsidies for physical activity, as implemented in Canada (Madore, 2007), could lead to an improvement in participation. Such subsidies that could be facilitated via the delivery of free membership cards could lead to a 44.5% increase in the likelihood of participation in physical activity. Let’s demonstrate the probable impact of that policy further by determining the proportion of people in England who would take-up physical activity, as a result. At the likelihood (47%) of uptake, 44.2% of the population actually do physical activity; with the subsidy, it could be inferred that over 63% of people would take-up. It must however be recognised that the effectiveness of such a policy could be better assessed if variants subsidies (e.g. 25%, 50% or 75% subsidy) are compared in terms of their induced changes in participation. But data constraints preclude such information here (to be addressed in chapter 8).

Second, some strategies for encouraging people to participate in physical activity may not be effective in encouraging people already doing physical activity to do more. This is hinted at by the finding that some factors may influence take-up but have no effect on meeting the recommended level of participation given participation. For example, devising a policy to reduce working hours may increase uptake in physical activity but have no impact on the level of participation. On the other hand, 'income increment policies' would influence both levels of decisions. So, this offers different policy options to the government ranging from discriminatory strategies that tend to promote only take-up (as in the former policy) and broader strategies that influence both uptake and level of uptake (as in the latter policy).

This chapter also offers indicators for further research in this thesis. Analyses in this chapter were hindered by data insufficiency as it was not possible to account for the effect of money cost, and even in the case of time cost, proxies were used. To date, no published dataset has collected data on both time and money costs, and indicators of physical activity in England (see chapter 3 for details). The importance of collecting such data could be deduced from the high influence found for 'membership in sports or social club'. Thus to advance the understanding of physical activity, future research ought to collect data on costs related to physical activity participation and variant indicators of physical activity behaviour, to demonstrate the effect of both time and money costs. Such data collection should also account for perceived benefits given the potential cofounding effect of these benefits on the relationship between cost and physical activity.

CHAPTER 6 Development of questionnaire on cost related to physical activity participation

6.1 Introduction

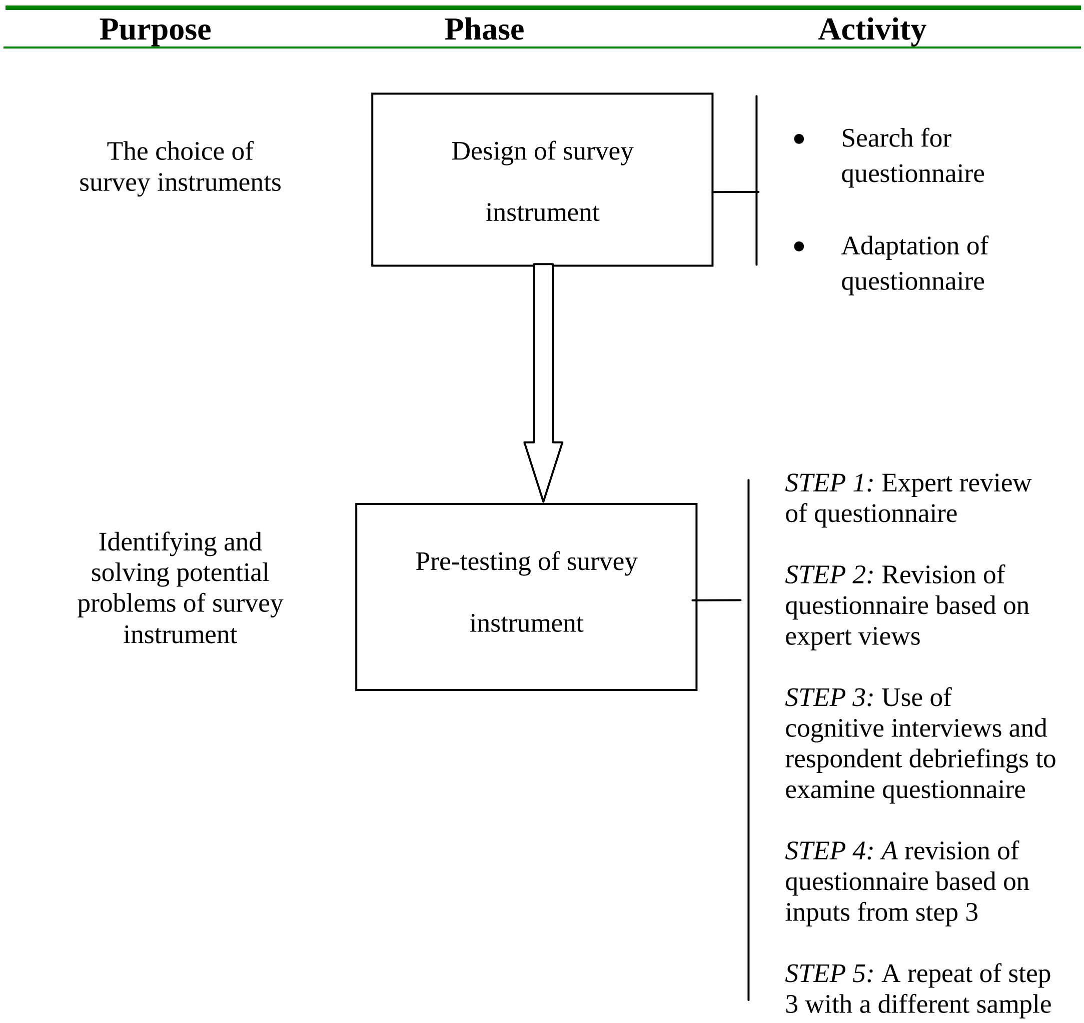
Chapter 6 sets out to address the gap in data sources identified in chapter 3 by developing a reliable and valid data collection tool on unit and total costs related to physical activity behaviour. The objectives are: (a) to design a follow-up survey instrument to HSE (2008) and (b) pre-test this survey instrument. Emphasis is placed on money and time costs because questions on perceived benefits exist in the HEANSAH (1991) (refer to chapter 4), and since these questions had been developed and administered using an English population, it was considered useful to replicate them in a future survey.

The structure of the chapter includes a methods section that describes and justifies the processes of design and pre-testing. This is followed by results of the pre-testing and a discussion of findings, with presentation of the developed questionnaire.

6.2 Methods

The development of the data collection tool involved two main phases: design of survey instrument and its pre-testing. Figure 6.1 shows the activities undertaken in each of the phases (detailed description forthcoming).

Figure 6. 1 Description of processes in the development of data collection tool



6.2.1 Design of survey instrument

A questionnaire (administered as face-to-face) was considered for the survey instrument because it is the preferred approach used to collect primary data on costs (see chapter 2). It is considered good practice to adapt an existing questionnaire (if available) rather than design one from the scratch because it avoids reinventing the wheel (Jackson and Furnham, 2000). Thus, contacts were made with all the authors[140] (n=4) of previous studies on data collection on costs of physical activity identified in chapter 2, and this led to the adaptation of a questionnaire developed by Taks and Kesenne (2000). This questionnaire (see Appendix 6.1 for description) was adapted because it had the most comprehensive coverage of cost components as indicated in chapter 2, and was also readily available. Efforts to adapt other questionnaires in England (Davies, 2002) and elsewhere in Spain (Lera-Lopez and Rapun-Garate, 2005, 2007) proved unsuccessful as they were not accessible despite repeated requests. Table 6.1 shows the costs components of physical activity participation captured in the questionnaire.

Table 6. 1 Components of costs related physical activity participation

Components of costs of participation in physical activity	
• Membership fee • Maintenance costs for own sports equipment • Fees for license required to do sports • Joining fees/registration fees for initial subscription • Purchase of sports kit • Costs for medical care (i.e. sports injuries) • Purchase of books, DVD's to aid sports participation • Purchase of body aids (i.e. elastic limbs) for participation • Cost of insurance • Cost of nutritional supplements • Club activities (i.e. fundraisers) • Other cost	• Entrance charges • Hiring charges for using sports kits, sports clothing • Fees for participation in sports tournaments or competitions • Travel miles • Parking costs • Travel tickets • Nanny costs • Costs of classes, inductions or training sessions • Cost of sports camp • Cost of sports holidays • Cost of refreshments

These costs cover the costs components observed in chapter 2 (specifically Table 2.2.1)

However, given the context of this thesis, the questionnaire had to be modified due to the following reasons. First, it had no questions on unit cost but questions on total costs. Information on the latter is needed to afford the estimation of the effect of cost on physical activity behaviour. Second, the reference period was one year, which is incompatible with HSE that uses a four-week period. Third, there was inadequate coverage of time costs as only distance travelled was covered with no question on travel time. Given the potential flaws of a 'global' specification of time cost identified in chapter 5, the intention was to capture

[140] These authors were Lera-Lopez M; Davies L; Taks M; and Kessene S. The contacts were made via emails and phone.

individual elements of time costs as each could have varied impacts on physical activity participation. Another reason why both travel time and distance travelled were considered important is that the latter may not fully reflect the time cost because it could be mitigated by factors such as time of travel and mode of transport (see details in section 2 of chapter 2). It is notable that 'waiting time' was not captured in this chapter because it was considered a minimal part of time cost in the context of physical activity[141]. Fourth, the context of population was different as the original questionnaire was administered to a Belgian population. Fifth, question on social cost (i.e. cost of refreshment during participation) was considered liable to capture irrelevant expenses which may not be related to physical activity per se but to other social behaviour (e.g. money spent on beer drinking at the sports club).

These limitations were addressed by changing the reference period to 'last four weeks'; excluding the question on social cost; including a question on travel time and adding questions on unit costs (Appendix 6.2 shows the modified questionnaire). The inclusion of questions on unit costs was, however, not straightforward because prior to that, individual cost components ought to be categorised into fixed and variables costs. Gratton and Taylor (1995, 2000) provide such a categorisation and their approach is followed in this study. However, the challenge was that not all the components of costs used in this questionnaire are captured in the categorisation provided in the literature. Thus, to ensure categorisation in this chapter was full, the second author of the approach in the literature was consulted to evaluate it. Table 6.2 shows details of the evaluated and approved categorisation used as the basis to construct questions on unit costs.

[141] The inclusion of a question on waiting time though not captured in the literature was discussed with experts who advised against its inclusion because they considered it to be a minimal cost item. It is also important to note that since physical activity behaviour is measured in terms of time spent on it, capturing time spent on participation as time cost do not suffice in the context of this study.

Table 6. 2 Categorisation of costs components in questionnaire

Categories	Costs components
Fixed costs	Membership fee Maintenance costs for own sports equipment Fees for license required to do sports Joining fees/registration fees for initial subscription Purchase of sports kit Costs for medical care (i.e. sports injuries) Purchase of books, DVD's to aid sports participation Cost of nutritional supplements and to take care of your body, for sports participation Cost of insurance Club activities (i.e. fundraisers) Other cost
Variable costs	Entrance charges Hiring charges for using sports kits, sports clothing Fees for participation in sports tournaments or competitions Travel time Travel miles Parking costs Travel tickets Nanny costs (i.e. baby sitting/child care) Costs of classes or inductions or training sessions Cost of sports camp Cost of sports holidays Costs of refreshments

6.2.2 Pre-testing of survey instrument

Pre-testing is the central strategy to: examine the properties of questionnaire; identify potential problems that may affect respondents and interviewers; and resolve any arising problems prior to field administration (DeMaio et al., 2006; Presser et al., 2004). Thus the questionnaire was pre-tested against a set of required properties of standard questionnaire (i.e. content validity, reliability, acceptability, feasibility and appropriateness). Other properties such as precision, sensitivity, and interpretability were not considered relevant to this study due to reasons described in the third column of Table 6.3.

The pre-testing concentrated on qualitative rather than quantitative techniques because the overarching objective was to identify sources of potential response error and minimize them. Quantitative techniques usually do not afford sufficient coverage of possible misinterpretations of questionnaire by respondents (Bowden et al., 2002) that are key causes of response error. Also, quantitative techniques require large quantitative data (Willis, 2005; Fitzpatrick et al., 1998), which was not feasible for this thesis.

Over the last decade, a wide range of qualitative pre-testing techniques have been used by researchers (Rothgeb et al., 2001). The choice of pre-testing methods is usually not based on 'which single pre-testing method should I choose over the others? but rather 'how can I efficiently combine these into a system of pre-testing that is likely to be effective, given real-world constraints?' (Willis, 2005, p. 248). Thus this chapter considered three qualitative techniques commonly used to pre-test questionnaires: expert review, cognitive interviewing, and respondent debriefing (Hughes, 2004).

As shown in Fig. 6.1, pre-testing was conducted in two stages. The first stage involved the use of expert[142] reviews (description of sample forthcoming) to assess the appropriateness, validity, feasibility and reliability of the questionnaire (Table 6.3). Both subject matter and questionnaire design experts were used to bridge the potential gap which may exist between expertise of the latter and knowledge in the survey subject (Ramirez, 2002).

The second stage employed cognitive interviewing and respondent debriefing (via probes) to assess the face validity, acceptability, appropriateness, and reliability (Table 6.3). The probes were intended to evaluate the respondents' comprehension of key concepts of the questionnaire, as well as their recall and retrieval of responses. Probing questions rather than think aloud technique was preferred because the former lowers the burden on respondents and is better suited to face-to-face interviews (Collins, 2003). For the probing itself, concurrent probing instead of retrospective probing was used because it improves performance as there is no fear of relapse of information (Ericsson and Simon, 1984).

To maximise effectiveness, general directives suggest that cognitive interviews ought to be conducted in 'sets' with findings from the initial set informing the

[142] According to Loveridge (2001), an expert should have the following main characteristics: (a) extensive knowledge in area of interest (b) imagination and ability to examine future evolution in their area of interest. The caveat in this chapter is that the selected experts fulfil these requirements.

revision of questionnaire prior to subsequent sets (Willis, 1994, 2005). What is not clear however is the requisite number of sets (Beatty and Willis, 2007), however two rounds were considered feasible in this chapter, a practice that is consistent with previous research (Irwin et al., 2009; Biener and Bogen, 2007; Kudela et al., 2006; Levine et al., 2005).

Table 6. 3 Properties of standard survey instrument

Property	Description[143]	Is it relevant to this context?	How was it assessed?
Validity	How strong is the strength of the conclusions that will emerge from the survey? The main types of validity are: • *Face validity:* Examines whether an survey instrument measures what it is intended to. • *Content validity*: To assess the ability of the survey instrument to capture the relevant components of the concept it seeks to measure. • *Criterion validity*: This examines the extent to which the survey instrument correlates with a similar survey instrument considered a gold standard. • *Construct validity*: This is considered a more quantitative way of assessing validity and it observes the relationship between variables measured by the survey instrument and other variables, based on current understanding.	• Face validity was deemed relevant. • Content validity had already been accounted for by the authors of the original questionnaire. Albeit, further assessment was conducted with respect to the purpose of this study. • Criterion validity was difficult to assess as there existed no gold standard, owing to the lack of national survey on costs related to physical activity participation • Construct validity was not addressed given the qualitative approach adopted to pre-testing.	Face validity *(1)Expert review:* This mainly involved assessing how best to capture unit costs. Hence, experts were asked to indicate whether or not the use of 'usual payment per occasion' captured unit costs adequately, and if not, provide suggestions (Appendix 6.3). *(2)Cognitive interview/respondents 'debriefings*: Respondents answered probes and debriefing questions which were intended to detect whether their understanding of key concepts of the questionnaire were similar to what is intended (Appendix 6.4 & 6.5 describe probes and debriefing questions. The exact location of the probes is shown in Appendix 6.6). Content validity *Expert review:* Experts were asked if and which cost components were not covered by the questionnaire. It was intended to verify whether all costs components relevant to participation in physical activity had been captured (see Appendix 6.3 for review questions).
Reliability	This examines the extent the measurement instrument is free from random error and that any changes realised are not a result of measurement error. Aspects considered in this regard are: • *Internal consistency*: This examines the correlation between the items that measure a construct of interest. A high correlation is expected between the various items that are measuring a common construct. • *Reproducibility*: How consistent is the survey instrument? This examines whether the measurement item gives the same results each time it is administered to the same respondents, and the domain has not changed. The expectation is that two separate responses from the same respondent should correlate.	• Internal consistency was not seen as relevant because the questionnaire did not include different items intended to measure a single attribute. • Reproducibility was considered applicable and hence formed the basis for assessment of reliability.	*(1)Expert review*: Two processes were used to identify potential threats to reliability (e.g. ambiguously worded, lengthy or jargonised questions): First, experts were asked to tick a 'problem indicator box' (attached to each question) and add comments, if they considered the question to be problematic (Rothgeb et al., 2001). Second, experts answered a brief questionnaire appraisal form (adapted from Willis and Lesser, 1999) that was enclosed at the end of the actual questionnaire[144]. (Appendix 6.7). *(2)Cognitive interview:* Respondents answered probes formulated to assess their recall and retrieval of responses to the questions. This was intended to capture the thought processes employed by them to recall information, and detect whether questions encourage 'guessing' strategy or complex estimations which may cause respondents to answer differently at various times (holding domain constant) (Appendix 6.4).

[143] Description of properties were mainly sourced from Fitzpatrick et al. (1998).
[144] Whilst the two procedures may overlap they were considered useful because the latter was intended to observe general problems whereas the former concentrated on specific problems.

Property	Description[143]	Is it relevant to this context?	How was it assessed?
Sensitivity	Examines the ability of the survey instrument to detect changes over a time period.	This was not considered relevant as the questionnaire was not intended to measure changes over time.	N/A
Precision	This ensures that the measurement instrument can detect differences among the pattern of responses among, say, two arms of a trial.	This is normally considered useful in clinical trial a situation (Fitzpatrick et al., 1998) therefore was not assessed here.	N/A
Acceptability	Is the instrument acceptable to the respondents? To maximise response rates, the instrument should not give respondents undue distress. This includes the speed and ease with which respondents can answer the questionnaire. There is no strict way of doing this, but could cover: • The length of time used in answering the questions. • Length of survey instrument. • Lay out.	It was considered relevant to this study.	*Respondent debriefings*: Respondents answered debriefings questions that intended to determine their assessment of the time spent answering the questionnaire, the order of questions, and any misgivings about the questionnaire (Appendix 6.5).
Feasibility	This considers whether the time and resources needed to collect, process and analyse the data is viable, as well as looking at issues like: • Does the method of administration of the questionnaire put undue pressure on the interviewers? • Any specific training needed for staff, before the data can be collected?	This was considered applicable particularly in the context of a future national survey using the questionnaire.	*Expert review*: Covered asking experts whether it was viable (in terms of time and money resources) using this questionnaire. Prior to the interviews, the experts were equipped with information on the relevance and potential costing of a future survey using this questionnaire See Appendix 6.8 for details of the information given to the experts, and Appendix 6.3 for review questions.
Appropriateness	Does the content of the survey instrument match with the aims of the study?	This should be a primary consideration in the examination of a survey instrument.	*Expert review*: Experts answered questions aimed at detecting whether the aim of questionnaire was compatible with its contents (Appendix 6.3).
Interpretability	Are the results/scores from the instruments interpretable? Can people understand the scores and what they are measuring?	This is normally relevant in clinical trials as most of the instruments may not be familiar to people, which is not the case in our situation.	N/A

6.2.3 Samples

A convenience sample of 6 experts[145] was used for the expert views. The selection of experts was based on two sources of information: (a) literature reviews conducted as part of this thesis, and (b) recommendations from researchers in the field. Overall, a convenience sample of 7 experts were identified and contacted through emails, out of which 6 expressed interests and agreed to participate in the review. The team of experts included 3 questionnaire design experts (with extensive experience in survey design and implementation), 2 subject matter experts (established researchers in physical activity behaviour), and 1 expert in English for academic writing. The expert in English for academic writing was solely to evaluate the 'appropriateness' of the language of the questionnaire. Interviews with experts were conducted in October 2008, with each interview lasting approximately forty minutes to one hour.

Given the absence of a succinct guideline on the composition and size of sample for cognitive interviews (Beatty and Willis, 2007), this chapter followed the common[146] approach in literature (i.e. convenience sample of 5-15 people) and used a convenience sample of 6 people for the cognitive interviews and respondent debriefings. The recruitment of these people was conducted in Brunel University, and in line with institutional protocols. Respondents were recruited via emails that were sent on the author's behalf by managers of the schools in Brunel University. The invitations to participate in the interviews were sent to staff (both administrative and academic) and students. Interviews with respondents were conducted in Brunel University in November 2008 and each interview lasted between one and one and half hours.

6.2.4 Analysis of data

All interviews from the cognitive interviews and respondent debriefing were recorded using tape recorders, with the permission of respondents, and transcribed verbatim. For the expert reviews, data were mainly extracted from

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[145] Expert review of questionnaire usually involves using a group of people (3 to 8) to critique a questionnaire (Czaja, 1998).
[146] Sample sizes between 5 and 15 people are usually used for cognitive interviews (Willis, 2005).

notes (all major quotes were taken verbatim) taken during interviews. Data was analysed using QSR NVivo version 8.

The approach to data analysis follows generic thematic analysis as prescribed by Miles and Huberman (1994) and is consistent with analysis of data for questionnaire development (Knafl et al., 2007; Altschuler et al., 2009). The analysis was primarily based on exploring the themes across and within cases. Key phrases considered to reflect the theme of a response were coded in line with the main aims of the probe or question that elicited that response. For example, responses to a cognitive probe to test the comprehension of key terms was coded to indicate comprehension or otherwise based on its theme. The relationship between the generated codes was assessed by exploring patterns across cases. This aimed to provide a deeper understanding and indications of potential variation in understanding of concepts of the questionnaire among different sets of people. For example respondents who participate in sports tournaments may have a different understanding of participation fees of tournaments relative to other people. To ensure reliability of coding, codes developed by the author were further reviewed by a researcher[147] with experience in qualitative analysis.

6.3 Findings

This section presents the findings of the pre-testing using expert review to assess the appropriateness, validity[148], reliability and feasibility of the survey instrument, and cognitive interviewing and respondent debriefing to assess the face validity, acceptability, and reliability of the questionnaire. For ethical reasons, quotes of experts and respondents are indicated by pseudonyms.

6.3.1 Expert evaluation

Validity

On content validity, both sets of experts (i.e. subject matter and survey design) described the questionnaire as being comprehensive and thought that all the potential cost components had been considered.

[147] A qualitative analyst (sociologist by profession) with over 10 years experience.
[148] The emphasis in this study was on content validity and face validity since the other forms of validity (i.e. criterion and construct) are more suited to quantitative analysis (Fitzpatrick et al., 1998).

S1: The content is OK.

S3: Really, I can't think of any others not mentioned here. I even don't think you need the last question on other expenditure.

The subject matter experts (SM1, SM2) further suggested the inclusion of a question on social cost (i.e. cost of food or drinks associated with physical activity participation[149]') as they thought it was an important cost component. On the other hand, there were recommendations for the exclusion of some questions that were considered to capture rare costs (i.e. sports camping, sports holidays, books and documents, club activities). According to experts (SM2, S1, and S2), in the context of a national survey, these costs may not be relevant and also could result in the capturing of expenditure on sedentary behaviour because people are likely to incur costs specifically for holidays and may then happen to do sports alongside.

For face validity, experts identified no problems with the use of 'usual payment per occasion' to capture cost per unit. While acknowledging its validity, S3 suggested that 'usual payment per occasion' may affect recall of information and hence recommended use of 'payment made the last time' instead.

Reliability

The experts, particularly survey methodology experts, identified the questions on registration, membership fees, license, and subscription as ambiguous. Expert (S1), for example, suggested that respondents may need clarification on the difference between 'registration fees' and 'membership fees':

You may be asked to describe the difference between registration fees and the membership fees mentioned in question 1. Perhaps ask here if they had to pay a 'joining fee' in addition to membership.

Both groups of experts also found the question on 'cost to take care of your body

[149] It was not included in the questionnaire because it was thought it may introduce expenditure that may not be directly related to physical activity participation.

or to buy special nutrition' to be vague. This question was also noted to capture two components of costs (i.e. purchase of body aids, and nutritional supplements) and should be split into two for clarity (S1).

S2: You may have to make it clear that you're referring to nutritional supplements such as dietary supplements.

SM1: Rephrase the question and make it more specific. You may give examples to clarify the question and avoid eliciting incorrect responses.

The 'introduction' to the questionnaire was found to contain too much information which may be difficult to recall by respondents. Also, the definition of physical activity as presented in the questionnaire (see show card A) was considered too technical. Experts (SM1, S2) therefore recommended the use of a list of sports and exercise instead.

Definition of sports is too technical. Consider using a list of sports activities starting with most popular ones to grab interest of respondents….. , a long list may put them off.

Another important finding was the need to filter respondents by locating questions on participation in sports and exercise activities before the questions on 'costs'.

S2: People have to be asked whether they are involved in sports and exercise activities before you continue, otherwise you will face sectional bias as people who are not even doing sports may tend to give positive responses to certain questions they are not normally expected to.

Filtering was also noted to aid subsequent routing of the questionnaire regarding specific sports or exercise activities, which is likely to aid retrieval of information by respondents and cut time down for some respondents (SM1, SM2).

Although the wording of the questionnaire was considered appropriate, there were suggestions to improve clarity by replacing specific phrases: 'fees for initial subscription'; 'registration or entry fees' with 'joining fees' and 'participation fees' respectively (SM1, S1).

Experts found the reference period to be suitable, except S3 who thought it was long and that it may affect the retrieval and recall of information. He/she thus suggested the use of 'last two weeks' instead of the 'last four weeks'.

Feasibility & Appropriateness

The experts did not envisage any issues with feasibility and noted that using this questionnaire in a national survey was an important contribution to understanding physical activity behaviour in England. No concerns were also expressed about the appropriateness of the questionnaire as experts thought that the aim of the study matched the contents of the questionnaire.

Revision of questionnaire (based on feedback from expert reviews)

Table 6.4 outlines aspects of the questionnaire that were revised based on recommendations from experts (see Appendix 6.6 for revised questionnaire). This revision was done before conducting the next phase of pre-testing. Experts' recommendations that were not considered (and reasons why) are shown in Appendix 6.9.

Table 6. 4 Revised items in questionnaire and rationale for revision (after expert reviews)

Location of revision	Original version	Revised version	Rationale for revision
Introduction to questionnaire.	'Now, I am going to ask you about costs related your participation in sports and exercise activities during the last four weeks. By sports and exercise activities I mean activities defined on this card (showcard A). Please include payments on all /any of these activities you have taken part in, but do not include those related to spectatoring of these activities. Please remember to include any payments you made online or had automatically deducted'.	'Now, I am going to ask you about money expenditure on your participation in sports or exercise activities during the past four weeks. Please remember to include any payments you have made online and/or any subscriptions automatically charged to your account. Please do not include money spent spectating any events'.	The introduction was found to contain too much information which may de difficult to recall.
Definition of physical activity on showcard A (in introduction).	Any activity that involves the exertion of force generated by skeletal muscle that result in energy expenditure above resting level[150]. For example[151] workout at the gym, motor sport, dancing for fitness, archery, fencing, walking, bowling, mountain climbing, rugby, windsurfing, and others.	A list of sports and exercise activities (taken from Health Survey for England (HSE) 2006).	It was considered too technical.
Before entire questions on cost.	N/A	Questions on participation in sports and excise activities were added (before questions on cost). These questions were adapted[152] from HSE (2006).	To aid effective routing of questions on costs.
Question on social cost.	No question on social cost.	Question on social cost included.	Constitute an important cost component.
Questions on costs of: sports camping, sports holidays, books and documents, club activities.	These questions were included.	These questions were excluded.	These cost components are rare and a potential source of eliciting inaccurate.
Question on 'cost related to taking care of the body or to buy nutrition.'	This was one question.	Question was split into two: 'cost on body aids such as elastic limb supports' ; and 'cost on nutritional supplements'.	Found to be a double-barrelled question.
Questions on 'registration fees to sports club'.	Question contained phrase: 'registration fees for initial subscription.	This phrase was replaced with 'joining fees for initial subscription'.	To ensure clarity.
Questions on 'fees for participation in tournaments/ competition'.	Question contained phrase: 'registration or entry fees'.	This phrase was replaced with 'participation fees'.	To ensure clarity.
Short introduction to questions on indirect costs.	Introduction contained phrase: 'indirect costs'.	This phrase was replaced with 'indirect expenses'.	The phrase was considered a jargon.

[150] Department of Health (2004): At least five a week - evidence on the impact of physical activity and its relationship to health - a report from the Chief Medical Officer.
[151] The activities were chosen to reflect high intensity and low intensity activities.
[152] The HSE only asks for number of days/time pent doing sports and exercise activities if the duration was at least 15 minutes. This specification was considered restrictive and likely to hinder the specification of variant indicators of physical activity in subsequent analysis. For example total time spent on physical activity will be difficult to specify, as it will exclude times below 15 minutes. Therefore a decision was made to exclude the '15 minute restriction' in the questions.

6.3.2 First set of cognitive interviews and respondent debriefings

First, findings from cognitive interviews are presented, followed by respondent debriefings.

Cognitive interviews

Comprehension of key terms and phrases

Respondents displayed good comprehension of the terms and phrases[153] though issues were observed with the understanding of the concept of the 'introduction', and 'nutritional supplements'. For the 'introduction', one respondent had problems understanding it because of a term it contained:

R1: I am not sure I understand what is meant by spectating.

In the case of 'nutritional supplements', though respondents generally displayed good understanding of what it constituted, potential signs of ambiguity were observed because respondents took a long time to answer the probe. There was also the interesting scenario of a respondent who reported that initially she/he thought 'healthy' food items may count as special nutritional supplements but later realised they were not.

R1: You may think that particularly healthy food like cereal may be considered as nutritional supplements but I just realised that it's not, so it's fine.

Recall of information

Recall of information was not found to be problematic, with respondents displaying two main strategies of recall and no 'guessing'. Those who had made more than one purchase of an item (e.g. sports apparel) used 'counting strategy' as they reported that they actually counted the amount spent on the number of purchases made. Whereas those who had made one-off purchases tended to use special features of the purchase to recall the cost. For example, with respect to the question on cost of 'sports apparel', one respondent stated it was easy to recall because:

R3: I bought it from the supermarket during a promotion, the price attracted me, and it was quite cheap. These are NIKE boots you don't get them that cheap.

[153] See Appendix 6.4-5 for details of those key terms and phrases.

This question was however noted by one respondent to be multi-barrelled, containing many costs components (i.e. sports equipment, sports clothes and shoes).

Another important finding was that respondents seem to provide sure responses as they expressed confidence about their recall of information. This was confirmed by simple observation of respondents as no expression of hesitation was found. Quotes shown below, for example, represent the high level of confidence in recall for 'miles travelled' to do physical activity.

R2: A hundred percent.
R3: It is recorded on my bicycle. There is a metre so I can know the distance I am travelling.

Respondents debriefing

Assessment of general features of questionnaire

Respondents generally did not cite any reasons why they would not like to answer the questionnaire. They also expressed no difficulty answering the questionnaire nor did they find any question unclear in meaning. Nevertheless, one respondent indicated that the length of time spent answering the questionnaire may be a hindrance.

R3: It takes too much time, apart from that it's interesting.

The language of the questionnaire and order of the questions were considered appropriate by respondents.

R1: I think it is fine.

R2: The order is fine, it's correct.

R3: It's appropriate.

On reference period for the questionnaire, while respondents noted it may aid recall, they expressed concern about its potential inability to capture periodic costs.

R1: In my case, it's too short. But I think it is good because it is easy to recall. The only problem is that you miss peoples' physical activity expenditure for a longer period because for some reason I did not exercise in the last four weeks.

R2: It's alright. But if you want to capture sporadic cost, off peak costs, it will be difficult to capture them because it is a matter of chance. At the same time, you have the advantage that you really remember everything because it's like very close.

R3: It's appropriate.

Understanding of concepts

No problems were noted with the understanding of concept of 'usual payment', with respondents defining it as cost they normally incur 'every time' they do sports.

R2… that it comes every time that I am doing sports.

R3: It is any money that I would normally spend….

In addition, respondents appeared to provide cost estimates solely related to their participation and excluded any cost they may have incurred regarding other people's participation in physical activity.

R1: No. In my case, because I don't pay for anybody else. But I think even if I had done that I would not include them in my answers, anyway.

R2: No. Because you were asking for only my payments.

R3: No. I don't pay for other peoples' participation at least not in the past four weeks. In any case, you did not ask for that.

It was also observed that respondents tend to include one-off costs incurred in the reference period when they were quizzed about its inclusion or exclusion.

Revision of questionnaire (based on findings from first set of cognitive interviews and respondent debriefings)

Findings from the first set of cognitive interviews and respondent debriefing were used to revise the questionnaire before conducting the second set (see Table 6.5 for summary of the revisions). Appendix 6.10 presents findings that were not considered and why.

Table 6. 5 Revised items in questionnaire and rationale for revision (after expert reviews)

Location of revision	Original version	Revised version	Rationale for revision
Introduction to questionnaire.	Contained a term- 'spectating'.	This term was replaced with 'watching'.	To improve comprehension of the introduction.
Question on cost of nutritional supplements.	The question had no examples.	Examples of nutritional supplements were included in question.	To enhance understanding and aid recall of responses.
Question on cost sports apparel.	This was a single question.	The question was split into two: cost of sports equipment (with examples provided for clarity and avoidance of double counting); and cost of sports shoes and clothes. In addition, the term –'sports kit' was removed for being too generic[154].	To reduce burden and avoid confusion, as the question was found to be double-barrelled.
Question on cost of maintenance of sports equipment.	This question was located after question on cost of body aids.	It was brought forward in the order of questions, just after question on 'sports equipment'.	To ensure coherence.

6.3.3 Second set of cognitive interviews and respondent debriefings

<u>Cognitive interviews</u>

<u>Comprehension of the key terms and phrases</u>

The respondents in this set also showed good comprehension of the key terms and phrases used in the questionnaire. A few exceptions were however observed. First, respondents seemed unsure about the term- 'body aids'.

R1: Yes. I bought the clothes for the saddle for my bicycle to make it comfortable so I can cycle longer. I am not sure if I should call it a body aid because we put it on a bicycle.

R2: No. I didn't know at the beginning what you meant by body aids but after the examples I'm pretty sure about that.

R3: No.

Second, it was found that the term - 'participation fees for tournament' could be confusing particularly for those who pay it as part of membership fees to sports clubs.

<u>Recall problems</u>

No potential issues were found with recall of information by respondents. Notably, the recall strategies employed by the respondents were similar to those found in the first set.

[154] Kit may refer to set of clothes as well as equipment, hence to avoid confusion and double counting, it was removed in favour of the term-'equipment'.

Respondent debriefings

Respondents appeared to be satisfied with the general features of the questionnaire and also showed good understanding of the key concepts. It is however worth mentioning the potential reasons; respondents noted could prevent people from answering the questionnaire:

R1: If I was doing something expensive like snowboarding I don't think I would want people to know that I am spending so much or if it was the other way round because I don't spend any money on it.

R2: I can imagine if you are absolutely not physically active and you had high BMI, it could be embarrassing to say truthful answers. So it's embarrassing for the individual and that could be a reason not to answer the questionnaire.

An important finding was that while respondents were able to recall the reference period of the questionnaire, repeated requests were made by them as to whether the same reference period applied to sub-questions[155] and main questions.

Revision of questionnaire (based on findings from first set of cognitive interviews and respondent debriefings)

Summary of the changes to questionnaire after the second set of cognitive interviews and respondent debriefings are showed by Table 6.6. (Appendix 6.11 describes findings that were not considered and why). The revised questionnaire is presented in Appendix 6.12.

Table 6. 6 Revised items in questionnaire and rationale for revision (after expert reviews)

Location of revision	Original version	Revised version	Rationale for revision
Question on participation fees for tournaments or competitions.	It contained no phrase to differentiate it from membership fees.	A phrase was introduced to indicate that respondents should answer in the affirmative if the cost was not included in membership fees they had already provided.	To improve comprehension and avoid double counting.
Question on cost of body aids.	This was a separate question.	This question was merged with the question on sports equipment, in addition a show card with examples of sports equipment (with the showcard constructed to include examples of body aids).	To improve clarity as there was the tendency for respondents to count body aids as sports equipment, and rightly so.
Whole questionnaire.	Had no specific mention of the reference periods for sub-questions of main questions on variable cost components.	A phrase indicating the reference period was included to all variable cost components.	To enhance clarity.

[155] These sub-questions were aimed at eliciting information on 'the numbers of times cost were incurred' or the 'usual cost incurred by occasion', and applies to variable cost components.

6.4 Discussion

The development of a questionnaire on cost of physical activity participation and the knowledge that data collected from questionnaires may not be of good quality unless pre-tested (Hughes, 2004), provided the impetus for this chapter. In light of this, the chapter focussed on the adaptation of a questionnaire on these costs and a subsequent pre-testing of the questionnaire using varying methods. Adopting a qualitative approach, the methods of pre-testing used were experts' reviews and cognitive interviewing alongside respondent debriefing, which were administered in a 2-stage scheme. As a result of the pre-testing, the questionnaire was modified based on suggested changes and problems found during pre-testing.

Whilst the process of pre-testing highlighted numerous problems with the questionnaire, an important question is whether it could have been more effective if different sets of techniques had been used. A key consideration here is the use of probing rather than think-aloud for the cognitive interviewing. Although both paradigms are similar, as they aim to discover verbal information about a questionnaire during its administration, the different methods of carrying them yield implications for the type of data generated by each (Beatty and Willis, 2007). For example, the think-aloud technique is acknowledged to minimise interviewer's bias into the process of data collection (Bolton and Bronkhorst, 1996) and also improve clarity of data (Forsyth and Lessler, 1991; Hak et al., 2004). Nonetheless, its effectiveness is questionable given that it could interfere with the response process and hence limit the accuracy of mental calculations by respondents (Russo et al., 1989). Also, considering that the think aloud technique was originally propounded to assess retrieval process, its ability to discover problems with comprehension, which was important for this questionnaire, is unclear (Willis, 2004). Conceivably, what gives the most confidence to the findings in this chapter is the fact that the probing technique generates essential information which may not be discovered unless specifically asked for (Beatty and Willis, 2007) and is also considered most useful to questionnaires administered as face-to-face interviews (Collins, 2003).

A potential that remains is the lack of questions about waiting time, argued by experts as likely to be minimal in the context of physical activity. If experts were wrong, it means an important cost component was missed by the questionnaire. An important consideration could have been to still include a question on waiting time and assess its importance (or not). Such a possibility, though considered, was not pursued for avoidance of increasing burden on respondents given the wide range of costs captured by the questionnaire.

This chapter has limitations that may impinge on the extent to which findings are generalizable. First, the sample used for the cognitive interviewing (and respondent debriefing) was small (n=6) and highly educated (i.e. students and staff of Brunel University) relative to the general population. Whilst using a convenience sample, which is not representative of the general population, to pre-test questionnaire is a standard approach (Willis, 2005), it may be problematic given the selection bias. Respondent differences may hinder the coverage of problems in the questionnaire (Beatty and Willis, 2007). For example, given that education is a positive indicator of cognitive ability (Falch and Sandgren, 2006), the sample used in this chapter is likely to have wider range of vocabulary and better estimation skills. Therefore, the level of comprehension or recall of responses displayed by the respondents may not reflect that of the general population. Related to this issue is the possibility that the pre-testing conducted may have missed problems particularly in terms of comprehension that may be encountered within a general population. This is evident by the knowledge displayed by the sample about the design of questionnaire, leading to instances where the respondents offered hints about potential problems with the questionnaire though the probes had not even inquired about those problems. A case in point is the issue of reminders that was requested about the reference period for sub-questions. Nevertheless, this is not often recognised as a huge limitation because the potential impact on findings due to differences between samples used for cognitive interviews and the target population for the field administration is considered minimal (Willis, 1999). It may also be argued that the use of highly-educated sample highlighted problems which otherwise would not have been discovered because they are more likely to be articulate. In terms of the case of small sample size, it could be classified as a non-issue because the aim of the techniques used, like most qualitative techniques was not to provide precise statistical estimates. Moreover, the choice of the sample size used in this chapter was in line with the common approach in the literature (Willis, 2005).

Second, the use of qualitative techniques of pre-testing also meant that only an indication of the availability of problems with the questionnaire was observed. Thus, no precise evidence was given as to the magnitude of the problems with the questionnaire as well as whether the altered questionnaire (based on findings from the pre-testing) has a comparative advantage over the initial questionnaire (Collins, 2003). However, since the focus of this chapter was specifically to revise the questionnaire based on identified problems respondents had with the questionnaire and not the size of the problems per se, the qualitative techniques adopted were useful.

Notwithstanding these limitations, this chapter adds to knowledge because while research has considered lack of data on costs as challenging demand analysis of physical activity in England (Gratton and Taylor, 2000) no study was found to have actually addressed that gap. The questionnaire developed in this chapter could be of relevance to future primary data collection.

CHAPTER 7 Cost, perceived benefits and physical activity behaviour

7.1 Introduction

The analysis in chapter 5 was hampered by the lack of data, and hence limited to a partial exploration of the role of costs in explaining physical activity behaviour. Also the empirical analyses thus far in the thesis had not been able to account for both costs and perceived benefits in investigating physical activity behaviour using a single sample. Such analyses offer partial empirical testing of the theoretical model, and hence a limited understanding of physical activity behaviour. An indication of the advantage of accounting for both costs and perceived benefits in a single analysis was given in chapter 5 when a potential attenuating effect of perceived benefits on the relationship between cost and physical activity behaviour was hinted at.

Chapter 7 addresses these limitations using data available from an illustrative survey conducted based on the questionnaire on costs of physical activity participation developed in chapter 6. The aim of chapter 7 therefore is to examine the role of both costs and perceived benefits among other factors in explaining physical activity behaviour. The objectives are two fold: (a) to estimate how much it costs people to do physical activity, and describe what the sources of cost are and (b) to assess the impact of cost and perceived benefits on physical activity behaviour.

An illustrative survey using a convenience sample was used because resource constraints did not allow data collection to focus on a randomly selected representative English sample. The value of such a survey is not only in terms of affording inexpensive data collection but also test the questionnaire (on costs) itself in order to provide recommendations for future data collection.

The next section describes the methods used in terms of the questionnaire used; data collected; and how the data was analysed. The results and discussion are presented in subsequent sections.

7.2 Methods

7.2.1 The questionnaire

The questionnaire used in the survey aimed to collect information on indicators of physical activity participation (dependent variables), costs, and perceived benefits alongside control variables (independent variables), and hence comprised three parts (see Appendix 7.1. for the whole questionnaire).

The first part covered questions on indicators of participation in physical activity. These questions were taken from the Health Survey for England (2006) and were selected because they provide a comprehensive coverage of measures of physical activity participation and are most current (see chapter 3 for details). The second part covered the questions on money and time costs of physical activity participation developed in chapter 6. The third part included questions on perceived benefits of physical activity participation (and importance placed on them) and were taken from the HEANSAH (1991), which is the only national survey in England with such questions. The third part also captured questions on socio demographics and economic information such as income, age, education, employment status, gender etc. To ensure valid and reliable data, these questions were taken from national surveys developed and administered in England/UK (see Appendix 7.1 for details).

7.2.2 The sample

The survey was undertaken at Brunel University, London, and used a convenience sample of 60 staff and students of the university. The recruitment of the sample was in line with ethical protocol, with ethical approval obtained from Brunel University Research Ethics Committee. Respondents were recruited via emails asking them to participate in this survey that were sent to both administrative and academic staff as well as students, on the author's behalf, by managers of the schools in the university. A total of 63 individuals expressed interest to participate in the survey and 60 people were finally interviewed because the other 3 people requested interview dates that were beyond the time frame allotted for this study. The sample size was therefore determined by the response rate. Although the sample is limited, non random, and not representative of the English population, it is envisaged that the analysis should still provide useful insights by giving new indicative evidence particularly for the effects time and money costs on physical activity participation.

Face-to-face interviews were undertaken between November and December 2008, with each interview lasting approximately 20 to 30 minutes. All interviews were conducted by the author. No ethical issues were encountered during interviews, with all respondents expressing an understanding of the consent form[156] issued before the interview and willingly deciding to pursue answering the questionnaire. Also, no respondent discontinued answering the questionnaire.

To ensure veracity of data input, data was entered into a STATA version 10 database using a double-entry procedure.

7.2.3 Data

Dependent variables

The indicators of physical activity participation were characterised in five ways: (a) participation or not; (b) number of days doing physical activity; (c) total amount of time spent doing physical activity; (d) meeting the recommended level of physical activity participation or not; and (d) number of days doing vigorous physical activity at recommended duration.

Participate or not in physical activity is measured with a binary variable that indicates whether respondents had done any sports or exercise activities (on a provided list of sports and exercise activities) during the last four weeks. Respondents were asked: *Can you tell me if you have done any activities[157] on this card during the last four weeks that is since (date four weeks ago)? Include teaching, coaching, training and practice sessions.* The possible responses were ‘yes’ or ‘no’. Follow up questions that probed on other activities, and collected

[156] This mainly entailed why they are participating in the survey because they are students or staff of the university, and that their data will be dealt with confidentially and securely. They were also told of the right to discontinue the interview at any point. And it was provided in a consent form which they signed.
[157] See questionnaire, specifically showcard A, in Appendix 7.1.

data on the intensity, frequency and duration of days of participation. Based on this data, the other indicators of physical activity participation were derived.

The indicator of *meeting the recommended level of physical activity participation or not, given participation* was created based on the *number of days of vigorous sports or exercise activities done during the last four weeks at the recommended duration* (i.e. with each of the days lasting for at least 20 minutes)[158]. The derivation of vigorous sports was based on criteria used by the Health Survey for England (2006). See Appendix 7.2 for full description of those criteria. A binary variable was created that takes the value of one if *the number of days of vigorous sports done during the last four weeks at the recommended duration* is 12 days or more and zero otherwise.

Independent variables

The independent variables considered for this study are grouped under two main headings: main variables and control variables. The variables whose potential relationship with physical activity is the primary focus of this chapter are referred to as the main variables. These include the measures of cost related to participation of physical activity and perceived benefits related to participation of physical activity. The control variables are socio-demographic and economic variables that have reported an association with physical activity behaviour.

<u>Costs</u>

Costs related to physical activity participation were specified as time and money costs in line with the literature (Humphrey and Ruseski, 2006, 2007; Gratton and Taylor, 2000; Taks et al., 1994) and results of the illustrative survey. These covered fixed cost and variable cost components (see Table 7.1). The questions asked provided data on costs per unit of activity as well as total costs or expenditure on physical activity participation during the past four weeks.

[158] Refer to section 4.2.2 for the basis of generating the recommended level or duration.

Table 7. 1 Description of cost variables

Cost related to PA**	Description	Specification of unit and total cost
Fixed costs		
Membership fees.	Membership fees for usage of a sports facility (e.g. fees paid as member of a fitness club).	Cost incurred during the past four weeks.
Joining fees.	Fees for an initial subscription to a sports facility.	Cost incurred during the past four weeks.
Apparel purchase.	Cost of sports clothes or shoes purchased to do sports.	Cost incurred during the past four weeks.
Equipment purchase.	Cost of sports equipment purchased to do sports.	Cost incurred during the past four weeks.
Maintenance cost of equipment	Cost for maintenance of personal sports equipment purchased to do sports.	Cost incurred during the past four weeks
Nutritional supplements	Cost of nutritional supplements such as vitamins purchased to do sports.	Cost incurred during the past four weeks.
Medical care	Cost of medical care sought for say an injury sustained as a result of doing sports.	Cost incurred during the past four weeks.
Insurance	Cost of insurance related to doing sports.	Cost incurred during the past four weeks.
Other	Other cost related to doing sports.	Cost incurred during the past four weeks.
Variable costs		
Entrance charges	Cost for using sports facility to do sports (e.g. charges paid to use a tennis court).	a) Total cost incurred during the past four weeks. b) Cost per occasion of usage per sport during the past four weeks.
Competition charges	Participation fees for tournaments or competition related to sports (e.g. football tournaments).	a) Total cost incurred during the past four weeks. b) Cost per day of tournament per sport during the past four weeks.
Classes charges	Cost for attendance in sports classes.	a) Total cost incurred during the past four weeks. b) Cost per day of attendance per sport during the past four weeks.
Refreshment	Cost of drinks or food directly associated with doing sports. This may include the purchase of energy drinks.	a) Total cost incurred during the past four weeks. b) Cost per occasion of purchase per sport during the past four weeks.
Equipment hire	Cost of hiring of sports equipment.	a) Total cost incurred during the past four weeks b)Cost per occasion of hire per sport during the past four weeks
Transport ticket	Cost of transport ticket to travel back and forth to do sports.	a) Total cost incurred during the past four weeks. b) Cost per transport tickets per occasion of purchase per sport during the past four weeks.
Travel time (mins)[159].	Time spent travelling back and forth to do sports.	a) Travel time spent back and forth per occasion of travel per sport during the past four weeks.

* These variables were measured in pounds (2008) and used as continuous variables in the statistical analyses.
**physical activity.

[159] It is notable to state that time cost was only captured as travel time because the categorical nature of data on 'distance travelled' made it impossible to create a variable for 'distance travelled per sport'.

Perceived Benefits (PB) & Relative Importance Placed on Perceived Benefits (RIPB)

The specification of perceived benefits and relative importance placed on them was similar to that of chapter 4 (see section 4.2.3). A question was however raised about the completeness of these perceived benefits in chapter 4. One could argue that people would expect additional benefits from physical activity participation other than these benefits. Though it may not be feasible to capture all perceived benefits about physical activity participation in a survey, it was considered useful to at least have a sense of the existence of other perceived benefits so as to account for them in policy strategies. To explore this issue, respondents in the illustrative survey were therefore also asked: '*Are/is there any other benefit(s) not mentioned on the card that you think participation in sports or exercise activities could help you gain?'* the possible responses were: *yes* or *no.* If yes, respondents were probed to list those benefit(s).

Control variables

A range of socio-demographic and economic variables were also collected. The variables included: gender, age, personal income, household income, educational level, employment status, working hours, size of household, number of children in the household, and number of adults in the household. These variables were selected from literature reviews (chapter 3) and empirical analyses (chapters 4&5) conducted as part of this thesis. Due to concerns of burdening the respondents, the selection was however limited to few variables that mostly showed strong influence on physical activity behaviour in those chapters. Table 7.2 shows a description of these variables and how they were measured.

Table 7. 2 Description of control variables

Control variables	Description	How it was measured
Gender	Sex of respondent	As a binary variable 0=female 1=male
Age (in years)	Age of respondent	As a continuous variable
Income (a) personal (b) household	(a) Net total income received by respondent during the past four weeks (b) Net total income received by household[160] of respondent during the past four weeks	Both variables were measured as ordinal variables: 1= Under £200; 2=£200 - £399; 3=£400 - £829; 4=£830 - £1,249; 5=£1,250 - £1,649; 6=£1,650 - £2,099; 7=£2,100 - £2,499; 8=£2,500 - £2,899; 9=£2,900 - £3,349; 10=£3,350 - £3,749; 11=£3,750 - £4,149; 12=£4,150 or more (TPS 2005)[161]
Education	Type of educational qualification attained by respondent	As a nominal variable: 1= Degree level qualification (or equivalent); 2= Higher educational qualification below degree level; 3= A-levels or Highers; 4= ONC/National level BTEC; 5=O level or GCSE equivalent(Grade A-C) or CSE equivalent(Grade 1) or Standard ; 6=GSCE grade D-G or CSE grade 2-5 or Standard Grade level 4-6; 7=Other qualifications; 8=No formal qualifications
Employment status	Whether respondent was employed or not during the past week	As a binary variable 0=not employed 1=employed
Working hours	How many hours the respondent worked per week given employment	As a continuous variable
Size of household	Number of people residing in the household of respondent	As a continuous variable
Number of children in household	Number of children (i.e. below 16 years) residing in the household of respondent	As a continuous variable
Number of adults in household	Number of adults (i.e. 16 years &plus) residing in the household of respondent	As a continuous variable

7.2.4 Data Analyses

The analyses were conducted in three main stages. First, descriptive analysis[162] of the data was conducted. Second, bivariate analysis assessing the relationship between variables was done. Third, regression models were fitted to investigate the relationship between costs, perceived benefits and the participation in physical activity, given participation.

[160] A household comprises either one person living alone or a group of people, who may or may not be related, living(or staying temporarily) at the same address, with common housekeeping, who either share at least one meal a day or share common living accommodation (i.e. a living room or sitting room). Resident domestic servants are included. Members of a household are not necessarily related by blood or marriage (Jenkinson, 1998).
[161] Household income measurement had the additional response option of 'don't know'.
[162] There was no missing data hence no analysis of missing data was conducted.

Descriptive Analysis

Descriptive statistics provided means, median (inter quartile ranges- IQR), and proportions of both dependent and independent variables. To estimate the average spending related to physical activity participation, both mean and median were used as measures of central tendency. This was intended to capture both the potential effect of outliers and otherwise. The issue of outliers is not straightforward in the case of investigating expenditure patterns as it brings into question what represents the most appropriate measure of central tendency. Using the mean may not be representative as it may be highly influenced by the outliers (Bowers, 2002). However it is the most appropriate since the outliers are essential components of expenditure which ought to be considered, as using median may result in an 'underestimation' (Davies, 2002). On the other hand, the median is useful because it offers an undistorted picture about the distribution as it is not influenced by outliers (Howell, 1989). Previous research has mainly used the mean (Lera-Lopez and Rapun-Garate, 2007; Della Vigna and Malmendier, 2006; Davies, 2002; Taks and Kesenne, 2000). In this chapter both measures of central tendency were used since they both provide useful insights into costs related to physical activity.

To analyse the type of benefits people expect from physical activity and whether they place importance on these benefits, the medians with inter quartile ranges (IQR) were used as the variables measuring 'perceived benefits' and the 'relative importance placed on perceived benefits' are treated as ordinal variables therefore all 'don't know' responses (i.e. score '6') were excluded (see Table 7.3). The median is the most appropriate measure of central tendency with regards to ordinal data (Bowers, 2002). To be regarded as being actually perceived or valued by respondents, each of the 'perceived benefits' and the 'relative importance placed on perceived benefits' variables should have a median equal to 2 or more. This is because according to the survey question, a score of '1' indicates that the respondent do not perceive or place importance on a benefit at all.

Bivariate analysis

The relationship between the dependent variables and the independent variables were analysed using both parametric and non parametric statistical tests of association. The choice of statistical tests of association was accessed using Peacock and Kerry (2007) and Bland (2000). Table 7.4 describes the types of descriptive analyses undertaken and their purpose. Since the costs and other continuous dependent variables were not normally distributed, a logarithmic scale was used to afford the application of parametric tests of association (i.e. t test, Pearson correlation test). For the cost variables data, a logarithmic scale of [u=log10(x+0.001)] was used as the data had both positive values and zeros. Otherwise, the default logarithmic scale of [u=log10] was used.

Table 7. 3 Summary of descriptive & bivariate analyses

Study element	Questions	Type of analysis	Measures
Costs.	What is the average spending related to participation in physical activity? What are the components of the expenditure and what is the relative contribution of different components? Which sports or exercise activities are most expensive? and which ones do people spend more on? Which people spend more than others?	Univariate analysis of the individual cost components. Univariate analysis of unit cost/expenditure specific to the different types of sports or exercise activities. Bivariate analysis of total costs, and its components with demographic variables.	Mean (SD), median (IQR) of individual costs components, total costs, total variable costs, and total fixed costs (e.g. mean travel time). Mean (SD), median (IQR) of cost specific to the different types of sports or exercise activities (e.g. mean total /unit cost of playing tennis).
Perceived Benefits (PB).	Which benefits are expected from participation in physical activity? And do respondents place importance on these benefits?	Univariate analysis of PB, and RIB variables.	Median (IQR) of the PB and RIB variables (e.g. median score of ‘to relax and forget about cares).
Relationship between physical activity behaviour and costs/PB as well as control variables.	Is there an association between the indicators of physical activity participation and the independent variables?	Bivariate analysis between dependent variables and independent variables using both parametric and non parametric tests of association.	The main statistical tests of association used can be found in Table 7.4.

Table 7. 4 Summary of statistical tests of association

Independent variables	Dependent variables			
	Number of days	***Total amount of time spent***	***Meet recommended level of participation***	***No. of days doing vigorous PA (rec. duration)***
Continuous variables Cost variables; Age; Size of household; Number of children in household; Number of adults in household; Working hours.	Pearson correlation test / Kendall's rank correlation test. [a]	Pearson correlation test / Kendall's rank correlation test. [a]	t-test /Mann Whitney U test [b]	Pearson correlation test / Kendall's rank correlation test. [a]
Ordinal variable Perceived benefits; Income (personal and household).	Kendall's rank correlation test.	Kendall's rank correlation test.	Mann Whitney U test	Kendall's rank correlation test.
Binary variables Gender; Employment status; Existence of other PB; Education.	Mann Whitney U test.	t-test.	Fischer exact test[163] / Chi-squared test.	Mann Whitney U test.

[a] This applies if both dependent and independent variables do not follow normal distribution (Peacock and Kerry, 2007).
[b] This applies if the independent variable does not follow a normal distribution (Bland, 2000).

Regression models

Relying on bivariate analysis to draw conclusions on the relationship between independent variables and the dependent variables may not be rigorous enough, because of the inability to account for potential confounders. However, owing to the limited size of the sample, the application of multivariate regression analysis is not straightforward as not many independent variables can be accounted for in the regression models. A decision was therefore made to fit a parsimonious model.

The individual unit cost variables were therefore collapsed into 3 main variables: fixed money cost, variable money cost and travel time (same specification was used for the bivariate analysis). The unit variable cost used was operationalised as unit variable cost per sport. Table 7.5 presents an exemplar of the derivation of the unit variable cost per sport. In this exemplar, the unit variable cost per sport (i.e. £8.33) was calculated as the sum of unit costs (representing different cost components) per sport. To get the unit cost per sport for a particular cost component, the unit cost for different sports activities were added and then divided by the number of these sports activities. To illustrate this lets consider the case of refreshments. To derive the unit cost of refreshments per sport, a sum

[163] Alternative to chi square test due to small (below 5) number of observation in one or more cells.

of the unit cost of refreshments for say football, swimming and tennis were taken. This sum (i.e. £9.00) was then divided by 3 (i.e. the number of sports activities in this exemplar) to get unit cost of refreshments per sport, which is £3.00 in this exemplar.

Table 7. 5 An example of the total derivation of unit variable cost

Sport type	**Variable cost component**			**Total**
	Refreshments	**Entrance charge**	**Equipment hire**	
Football	2.00	0.00	6.00	8.00
Swimming	3.00	4.00	3.00	10.00
Tennis	4.00	1.00	2.00	7.00
Total	9.00	5.00	11.00	25.00
Unit cost	3.00*	1.67	3.67	8.33**

*This is the unit cost of refreshments per sport, i.e. £3 per refreshments per sport. It is a weighted average that accounts for frequency of participation.
** This is the unit variable cost per sport, i.e. £8.33 per sport.

In the case of perceived benefits, only the significant ones from the bivariate analysis were selected. In addition, its equivalent 'relative importance placed on perceived benefit' variable was controlled for in the regression. The variables measuring 'perceived benefits' and 'relative importance placed on perceived benefits' were entered as binary variables. For example '*to relax and forget about your cares'* takes the value of one if the observed score lies between 3 and 5 but zero otherwise. This was to afford enough[164] observations in the omitted category that included observations of both scores 1 and 2. Control variables were also accounted for in the regression models if found to be significant in the bivariate analysis. However, income was an exception given its theoretical importance to demand analysis and hence it was included in the regression models regardless of the significance (or not) of the bivariate analysis.

To examine the effect of cost and perceived benefits on participation in physical activity, a set of different types of regression models was fitted depending on the nature of dependent variable in question. Notably, one dependent variable (i.e.

[164] Imprecise estimation may occur if the omitted category of a variable has small numbers of observation (Peacock and Kerry, 2007).

‘participation or not’) was not included in this analysis because it was successfully predicted[165] by costs. Hence the regression analysis was limited to investigating the level of participation in physical activity given participation.

Before the regression models are introduced, it is important to note a few potential issues with respect to fitting the regression models. First, a potential sample selection bias may exist as the observed data for the dependent variables representing the ‘level of physical activity participation, given participation’ was not randomly selected since it is conditioned on the participation in physical activity. Thus the distribution of the data on ‘level of participation’ given participation could be referred to as incidental truncation (Wooldridge, 2003). Those who had missing values might be systematically different from those who had real values. Failure to account for sample selection bias may lead to inconsistent estimates (Heckman, 1979). There are standard models for addressing this problem, as showed in chapter 5. However, sample selection bias could not be adjusted for in this chapter due to the following reasons. First, given the small number of observations, the inclusion of many predictors as in the case of sample selection models may not suffice. Second, the method of data collection in this chapter which was non-random and exploratory in nature may make the issue of sample size a ‘non issue’ in this context. This is because the intuition behind accounting for sample selection bias is to ensure that the sample used in the regression analysis is randomly selected whereas in this context, the entire sample was not even randomly selected, hence the issue of ‘non randomness’ is prevalent by definition.

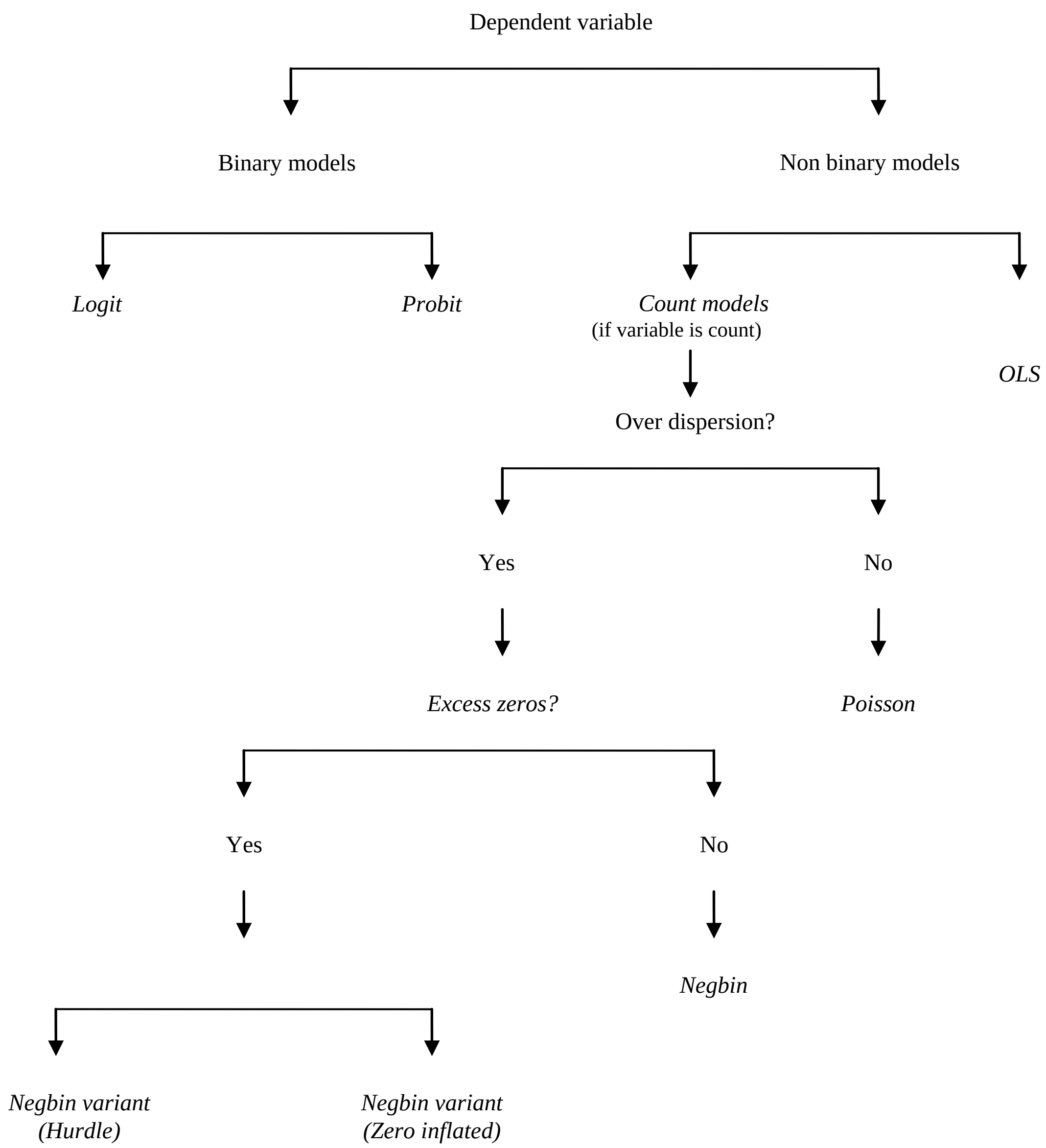
The potential heterogeneity of unit cost with respect to the different types of sports activities may have to be accounted for in examining the effect of costs because the cost related to physical activity may be dependent on the type of sports activities undertaken (Humphreys and Ruseski, 2007). A potential route to tackling such heterogeneity could be to model the effect of specific costs related to specific sports activity, on say the participation level of that specific activity,

[165] This is because respondents who did not participate in physical activity mostly did not incur any cost. In the few instances (n=3) where cost was incurred by those people, it was fixed cost (specifically purchase of apparel).

given participation. However, it was only possible to do this for one sports activity due to the small number of observations (i.e. the most common).

Figure 7.1 provides an overview of the conceptual framework used to select regression models to estimate the effects of costs, and perceived benefits on physical activity behaviour.

Figure 7. 1 Conceptual framework for selecting regression models to estimate the effects of cost and perceived benefits on physical activity behaviour



Source: Mariko (2003)

The different regression models run are described as follows: First, a probit model was fitted to regress the dependent variable: *meeting the recommended level of physical activity participation or not, given participation* on a set of independent variables. As this dependent variable is binary, logistic regression is the standard approach (refer to chapter 4 for details).

Second, a count model was used to investigate variation in *number of days doing vigorous physical activity at recommended duration,* and *number of days doing physical activity, given participation.* These dependent variables are non-negative integers valued count, hence signifying the use of count models since such data violates the normality assumption of linear regression model (OLS) (Jones, 2007; Cameron and Trivedi, 1986; Wooldridge, 2003).

There are variants of count models and the standard approach is to select that, which best fits the data, using the following procedures. A poisson model was first run. The underlying assumption of this model is that the probability of an event happening in a given time period is constant and proportional to the time duration (Jones, 2007). For an appropriate specification of the poisson model, the equi-dispersion rule has to be satisfied. In that, the mean of the dependent variable should be equal to its variance, given explanatory variables. However, most datasets are over dispersed (i.e. the mean of the dependent variable is exceeded by the variance) and therefore likely to lead to underestimation of parameters. In the event of such a dataset, an alternative specification is a negbin model[166], which is a special case of the poisson, as it relaxes the equi-dispersion rule by specifying an inter-person heterogeneity[167]. Thus the probability of the dependent variable occurring is constant but unequal among individuals as the error term is assumed to follow a gamma distribution (Jones, 2007).

The negbin model becomes inappropriate if the data has a high concentration of zero values as it assumes a single underlying process for all values of the

[166] To discriminate between poisson and negbin models, measures of over-dispersion (i.e. alpha parameter and its log likelihood ratio test) were used. Over dispersion occurs if the estimated alpha is greater than zero and significant; thus indicating preference for negbin model.
[167] This allows a random variation in the dependent variable.

dependent variable; whether they are zeros or otherwise (Jones, 2007). Models that differentiate between non-zeros and zero values are: zero inflated models, and hurdle models. The former treats zero values as a special case, by giving more weight to the probability that the dependent variable will take a zero value. The latter explicitly partitions the process underlying the observed values of the dependent variable, with the first part specifying the probability that the individual did physical activity or not and the second part investigates the number of days doing physical activity given participation.

Third, OLS was used in the context of *total amount of time spent doing physical activity given participation.* Also, as already discussed, to address the issue of heterogeneity of cost related to different sports activities, a separate model is fitted to regress the number[168] of days people do the most common sports activity on the specific unit cost related to that sports activity.

Demand curves, which show the relationship between time price, money variable price (unit costs) and the quantity demanded of physical activity correspondingly, were constructed based on the predicted quantities demanded at different prices ceteris paribus. The predicted quantities were based on estimates of the regression models.

Reduced models were derived for each regression model, with the derivation following the same approach used in chapter 4. Model diagnostics covered testing specification errors and goodness of fit using linktest and Hosmer Lemeshow test respectively. The validity of the assumptions of OLS model was examined with Breusch-Pagan/Cook-Weisberg test for heteroskedasticity and Shapiro-Francia test for normality (Chen et al., 2003). In addition, the collinearity of independent variables was assessed (see procedure in chapter 4).

Marginal effects were also computed for each of the independent variables. Statistical significant levels were set to 10% in all analyses. Stata version 10 was used for all analyses.

[168] The dependent variable in that context was modelled as a count variable since the other available option (i.e. modelling it as total time spent) was not feasible since its distribution was non-normal even after log transformation.

7.3 Results

This section first presents results of descriptive analysis which offers a description of the sample and the dependent variables. This is followed by descriptive statistics of independent variables (in terms of costs and perceived benefits), results of bivariate analyses, and the regression models respectively.

7.3.1 Description of sample

No missing observations were recorded though one variable (i.e. household income) had 6 don't know observations[169]. The sample was predominately highly educated with 75% (n=45) having degree level qualifications and the remaining 15% holding either 'A' or 'O' level qualification. Of the sample, 60% (n=36) were male. The mean age of the sample was 27.2 years, and half were employed. Majority (72%; n=43) had personal income ranging between £400 and £2899 per month while 52% (n=31) had household income more than £1249 per month. Detailed descriptive statistics of the sample can be found in Table 7.6.

[169] Analysis however show that the don't know responses may have occurred at random because those observations were not significantly different from those with real responses in terms of doing physical activity or not (p=0.757), gender (p=0.598) and level of personal income (p=0.121).

Table 7. 6 Descriptive statistics of respondents

Variables	Whole sample (n=60)				
	Obs.	**Mean(SD) / %**	**Median (IQR)**	**min**	**max**
Age	60	27.2(6.5)	25.5(23,30)	18	46
Size of household	60	3.6(2.8)	3(2,5)	1	15
No. of children in h'hold	60	0.5(0.8)	0(0,1)	0	4
No. of adults in h'hold	60	3.1(2.7)	2(2,4)	1	15
Personal income					
Under £399	17	28.3			
£400-£1,249	28	46.7			
£1,250-£2,899	15	25			
Household income					
Under £1,249	23	38.3			
£1,250-£2,899	15	25			
£2,900-£4,150 or more	16	26.7			
Don’t know	6	10			
Gender					
Male	36	60			
Female	24	40			
Employment status					
Employed	30	50			
Not employed[170]	30	50			
Working hours	30	23.5(13.2)	21.3(13,37.5)	6	45
Educational qualification					
Degree level	45	75			
Below degree level	15	15			

Most respondents (78.3%; n=47) participated in some physical activity, as shown in Table 7.7. Given participation in physical activity, 34% met the recommended level of physical activity participation for vigorous activity. On the average, given participation in any physical activity, people exercised on 11 days during the past four weeks but exercised vigorously at the recommended duration on 9.3 days during that same period. An average total of 692.6 minutes (i.e.11.5 hours) were spent doing any physical activity given participation during the four weeks prior to the survey date (Table 7.7).

[170] All unemployed were students but not all students were unemployed.

Table 7. 7 Descriptive statistics of dependent variables

Variables	Obs.	Mean(SD) / %	Median(IQR)	min	max
Participate in physical activity (PA)					
No	13	21.7			
Yes	47	78.3			
If yes,					
No. of days on which PA was undertaken	47	11.0 (7.4)	10(4, 16)	1	28
Total time (mins) spent on PA	47	692.6(720.6)	480(180, 970)	60	3360
Meet public health recommendation for PA (vig.)					
Yes	16	34			
No	31	66			
No. of days on which vigorous PA at recommended duration was undertaken	47	9.3 (7.5)	8(2, 16)	0	28

Half of the respondents spent 8 hours doing physical activity with one spending 56 hours while five spent an hour. Half of them exercised on 11 days but vigorously (at the recommended duration) on 8 days. Appendices 7.3-5 show graphical distributions of these variables.

Those who did not participate in any physical activity were relatively older (mean age: 29.8), more likely to be female (61.5%) or employed (53.9%) but likely to undertake paid work for fewer hours (average of 19.7 hours per week), as shown in Appendix 7.6. The differences between the participants in physical activity and the non participants were however not statistically significant except for gender.

7.3.2 Costs

Table 7.8 provides a summary of the money costs (in 2008 UK pounds) related to physical activity participation, given participation. Individuals spent £27.4 related to physical activity participation on the average, and the median amount spent was around 19.5 pounds. The maximum amount spent on physical activity participation during the last four weeks was £84.4 (n=1) while the minimum amount was zero (n=6). Of the average total amount spent on physical activity participation, £21 was spent on fixed costs components.

The money costs related to physical activity participation were found to cover (in descending order of average expenditure): *membership fees*, *entrance charges, purchase of sports apparel, purchase of sports equipment, purchase of nutritional supplements, purchase of refreshment, other cost, joining fees to sports clubs, fees for medical care, participation fees for sports competition, maintenance cost of sports equipment, insurance premiums, purchase of transportation ticket, participation fees in sports classes, and hire of sports equipment.* On the average, membership fees contributed most to total spending (£9), followed by entrance charges (£4.8). Hiring of sports equipment contributed least to total spending (£0.03). Consideration of median values did not change findings. Regarding travel time, people spent on average 19.8 minutes travelling back and forth per each occasion of physical activity participation, with half spending 14 minutes and one person spending one and half hours.

Table 7. 8 Descriptive statistics of cost related to PA, given participation (n=47)

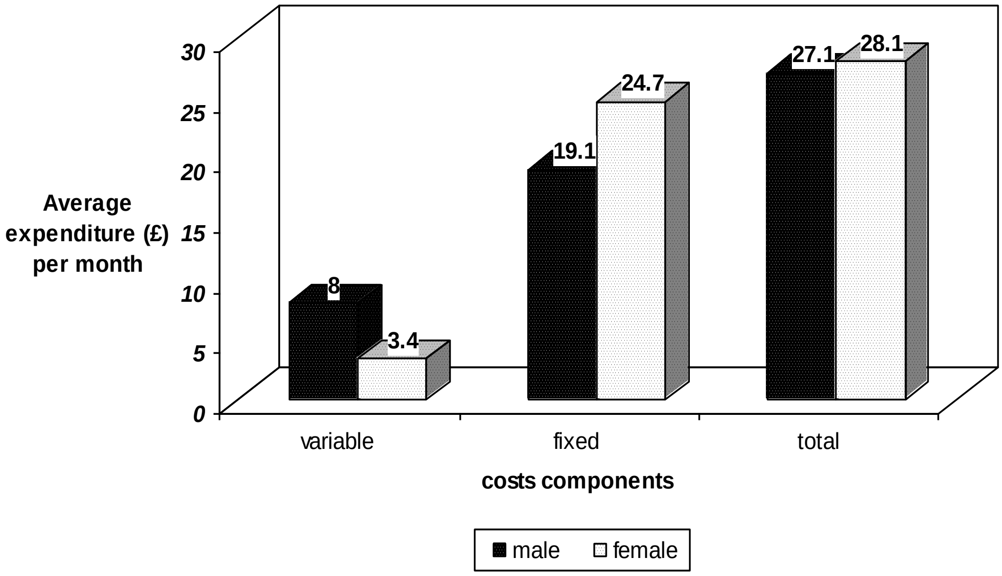
Cost related to PA	Mean(SD)	Median(IQR)	Min (n)	Max (n)
Total cost	27.4(25.5)	19.5(9.2,47)	0(6)	84(1)
Total fixed cost	21.0(25.4)	10(0,42)	0(19)[171]	80(1)
Total variable cost	6.4(10.1)	2.0(0,10.5)	0(19)	45(1)
Components of fixed costs				
Membership fees	9(14.6)	0(0,17)	0(30)	50(2)
Joining fees	1.0(6.7)	0(0,0)	0(46)	46(1)
Cost of Apparel	4.2(11.3)	0(0,0)	0(39)	57(1)
Cost of equipment	2.9(11.4)	0(0,0)	0(42)	60(1)
Maintenance cost of equipment	0.2(1.5)	0(0,0)	0(46)	10(1)
Cost of nutritional supplements	2.1(7.5)	0(0,0)	0(43)	31(1)
Cost of medical care	0.3(2.2)	0(0,0)	0(46)	15(1)
Cost of insurance	0.1(1.0)	0(0,0)	0(46)	7(1)
Other	1.1(6.0)	0(0,0)	0(44)	40(1)
Components of variable costs				
Entrance charges				
Unit cost	1.3(1.8)	0(0,2.8)	0(27)	8(1)
Total cost	4.4(8.6)	0(0,6)	0(27)	45(1)
Competition charges				
Unit cost	0.04(0.3)	0(0,0)	0(46)	2(1)
Total cost	0.2(1.2)	0(0,0)	0(46)	8(1)
Classes charges				
Unit cost	0.06(0.4)	0(0,0)	0(46)	3(1)
Total cost	0.06(0.4)	0(0,0)	0(46)	3(1)
Cost of refreshment				
Unit cost	0.4(0.7)	0(0,0.7)	0(31)	3(1)
Total cost	1.6(3.5)	0(0,1.5)	0(31)	16(1)
Cost of equipment hire				
Unit cost	0.01(0.1)	0(0,0)	0(46)	0.5(1)
Total cost	0.03(0.2)	0(0,0)	0(46)	1.5(1)
Cost of transport ticket				
Unit cost	0.1(0.4)	0(0,0)	0(45)	2(1)
Total cost	0.1(0.6)	0(0,0)	0(45)	4(1)
Travel time (mins)	19.8(17.8)	14(7.5, 30)	2.5(2)	90(1)

Which people spend more money on physical activity participation than others?

Given participation, males tend to spend slightly less money on physical activity participation with an average total spending of £27.1 (median: £18.3) compared with an average total spending of £28.1 (median: £20.5) by females. Across gender, most of the total spending covered fixed costs and females spent more than males (see Fig.7.2). However, males spent relatively higher amounts on variable costs (mean: £8; median: £4) while females spent £3.4 on average (median: £1.5).

[171] Thirteen of these people spent on variable cost hence the difference between the observations for minimum in terms of total cost and fixed cost. The reverse case applies to total variable cost.

Figure 7. 2 Average expenditure (£) per month on physical activity given participation by gender



A clear income gradient was not observed in terms of both expenditure (see Appendix 7.7). For example, in the case of personal income, though the high income group spent most (mean: £38.1), the low income group was found to spend more than the middle income group (mean total spending of £31.1 compared with £20.6). The following people were found to spend most on physical activity: unemployed (i.e. students), highly educated, older (25-46 years), workers with less labour hours (6-22.5 hours), residents in small households (up to 3 persons) or households with less number of adults (up to 2 adults) or no child. The finding was consistent across median and mean values. However, none of the differences in expenditure observed among the groups of people was found to be statistically significant (Appendix 7.8).

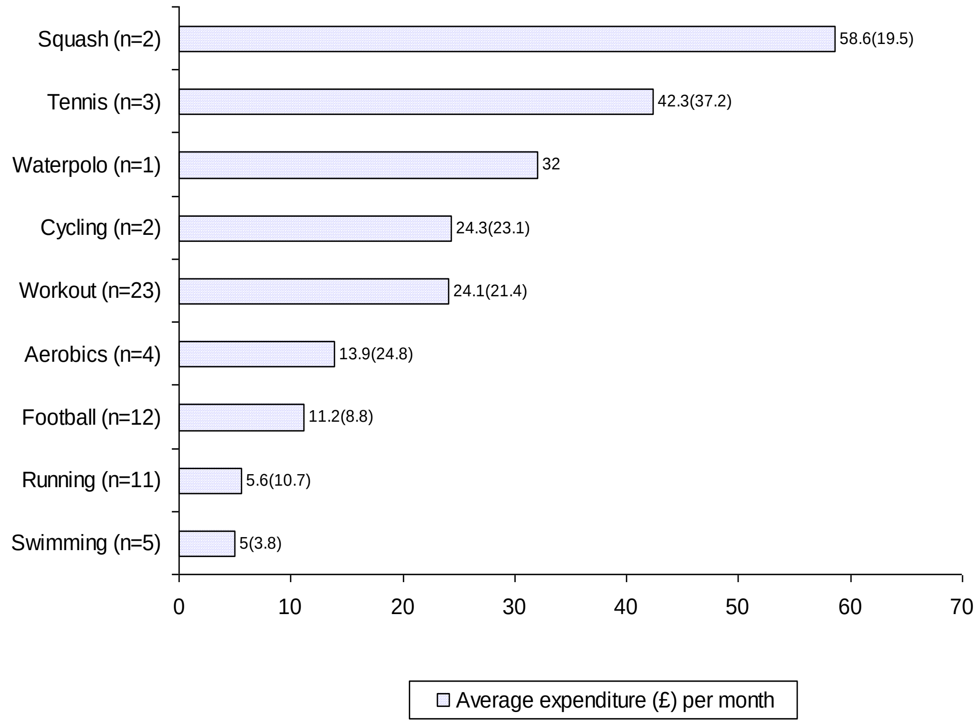
Expenditure by type of sports

Fig.7.3 shows total spending related to participation in specific sports and exercise activities[172]. Individuals spent most money on playing squash (mean: £56.8) followed by tennis (mean: £42.3) and water polo (mean: £32)

[172] Paddle and exercises (i.e. sit ups, press ups) were excluded from this analysis, as there were no specific costs attached to them.

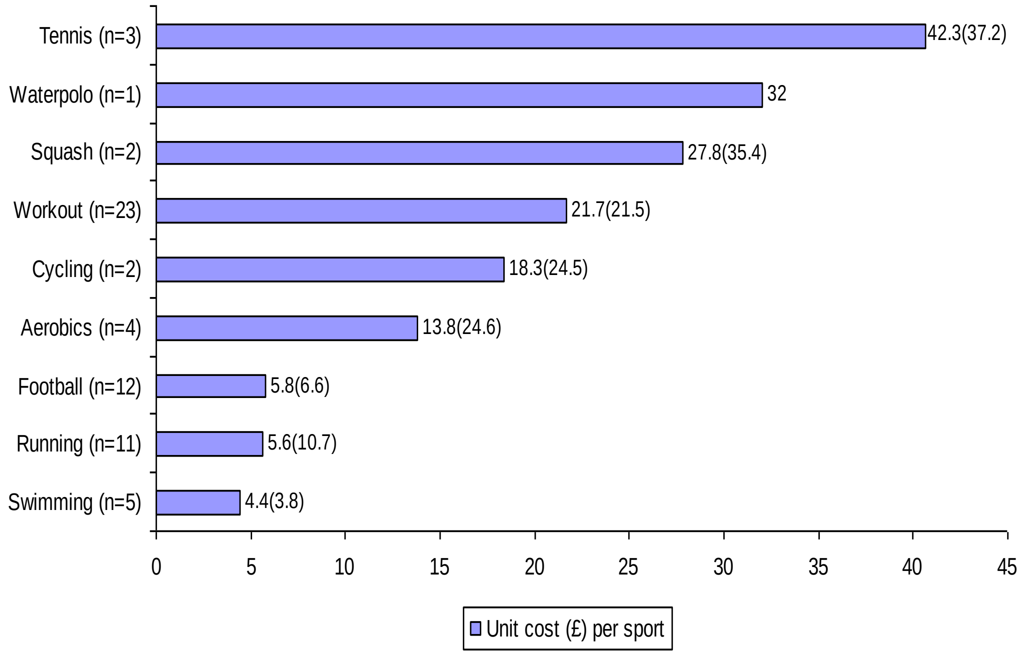
respectively. Swimming emerged as the activity on which people spent the least money during the reference period.

Figure 7. 3 Average expenditure (£) per month by type of sports for participants in that sport



According to Fig. 7.4 however, given frequency of participation, tennis was the most expensive (mean: £42.3(37.2)) and swimming the least (mean: £4.4(3.8)). Findings by median values were consistent with these.

Figure 7. 4 Unit cost (£) by type of sports for participants in that sport



7.3.3. Perceived benefits

The median score for the entire list of 13 items of perceived benefits (except 'to feel independent') was greater than 2 in both the whole sample and sub-samples respectively (see Table 7.9). This indicates that the respondents would expect all the other 12 item perceived benefits from physical activity participation. In the case of 'to feel independent' the sub-sample of participants in physical activity perceived it as benefit of physical activity participation, while the non-participants sample did not. In the whole sample, 'to stay in good shape physically', and 'to improve or maintain your health' were the most expected (median (IQR):5(4, 5)), and 'to feel independent' the least (median (IQR): 3(1.5, 4)).

This pattern was consistent across sub-samples, though the 'participants' had statistically significant higher expectations about all the benefits compared with 'non-participants' except for 'to improve or maintain your health' and 'to control and lose weight' (see last column of Table 7.9).

Are these perceived benefits important to respondents?

Table 7.10 shows all the 13 item ‘relative importance on perceived benefits’ had median scores greater than 2 for the whole sample and both sub-samples. This implies the benefits expected from physical activity are things that are also important to the respondents. For the whole sample, ‘to stay in good shape physically’, and ‘to improve or maintain your health’ were the most important (median (IQR):5(4,5)) while ‘to seek adventure’ was the least (median(IQR):3(2,4)). A similar pattern was observed for the sub-samples as well.

The sub-samples did not differ statistically in terms of the level of importance placed on perceived benefits, bar 2 cases (to improve or maintain your health’ and ’to learn new things’), where the ‘non-participants’ tended to place higher importance

Table 7. 9 Median (inter quartile range) scores for whole sample and the sub samples (i.e. participants and non participants in PA) for perceived benefits

Items	Whole sample (n=60)			Participants of PA (n=47)			Non-participants of PA (n=13)			Participants vs. Non-participants
	Median (IQR)	**min**	**max**	**Median (IQR)**	**min**	**max**	**Median (IQR)**	**min**	**max**	**Comparison of scores (p value)** [a]
To feel in good shape physically	5(4,5)	1	5	5(4,5)	1	5	4(3,5)	2	5	0.009**
To improve or maintain your health	5(4,5)	1	5	5(4,5)	1	5	5(4,5)	2	5	0.757
To control or lose weight	4(3,5)	1	5	4(3,5)	1	5	4(2,5)	1	5	0.378
To have fun	4(3,5)	1	5	4(3,5)	1	5	2(2,3)	1	5	0.001***
To feel a sense of achievement	4(3,4.5)	1	5	4(3,5)	1	5	2(1,3)	1	4	0.003**
To feel mentally alert	4(3,4)	1	5	4(3,5)	1	5	2(1,3)	1	4	0.005**
To relax, forget about your cares	4(2, 5)	1	5	4(3,5)	1	5	2(2,2)	1	5	0.008**
To look good[173]	4(2,5)	1	5	4(3,5)	1	5	2(1,3)	1	4	0.002**
To get out of doors	3(3,4)	1	5	4(3,4)	1	5	2(2,3)	1	5	0.014**
To get together and meet other people	3(2,4)	1	5	3(2,4)	1	5	2(2,3)	1	5	0.035**
To seek adventure and excitement	3(2,4)	1	5	3(2,4)	1	5	2(1,3)	1	4	0.002**
To learn new things	3(2,3)	1	5	3(2,4)	1	5	2(2,2)	1	4	0.029**
To feel independent	3(1.5,4)	1	5	3(2,4)	1	5	1(1,2)	1	2	<0.001***

[a] The asterisks show significance level of 1%(***), 5%(**) , 10%(*)

[173] Number of observations for 'To look good' is 59 for whole sample, and 46 for the participants of PA sample. This is because there was 1 don't know response, which was thus excluded from the analysis.

Table 7. 10 Median (inter quartile range) scores for whole sample and the sub samples (i.e. participants and non participants in PA) for 'relative importance placed on perceived benefits'

Items[174]	Whole sample (n=60)			Participants of PA (n=47)			Non-participants of PA (n=13)			Participants vs. Non-participants
	Median (IQR)	**min**	**max**	**Median (IQR)**	**min**	**max**	**Median (IQR)**	**min**	**max**	**Comparison of scores (p value)** [a]
To feel in good shape physically	5(4,5)	2	5	5(4,5)	2	5	4.5(3.5,5)	3	5	0.902
To improve or maintain your health	5(4,5)	2	5	5(4,5)	2	5	5(5,5)	4	5	0.064*
To feel a sense of achievement	5(3,5)	1	5	5(3,5)	1	5	4(3,5)	2	5	0.173
To feel mentally alert	4(3,5)	2	5	5(3,5)	2	5	4(3,4)	3	5	0.247
To control or lose weight	4(3,5)	1	5	4(3,5)	1	5	4(3,4.5)	3	5	0.805
To have fun	4(3,5)	1	5	4(3,5)	2	5	4(3,5)	1	5	0.601
To learn new things	4(3,5)	1	5	4(3,5)	1	5	5(3,5)	3	5	0.069*
To look good	4(3,5)	1	5	4(3,5)	1	5	3.5(3,5)	2	5	0.718
To feel independent	4(3,5)	1	5	4(3,5)	1	5	4(4,5)	3	5	0.318
To relax, forget about your cares	4(3,5)	1	5	4(3,5)	1	5	4(4,5)	2	5	0.561
To get out of doors	4(3,4)	1	5	4(3,4)	1	5	4(3,4)	2	5	0.955
To get together and meet other people	4(3,4)	1	5	4(3,4)	1	5	4(3,4)	1	5	0.993
To seek adventure and excitement	3(2,4)	1	5	3(2,4)	1	5	3(3,4)	1	5	0.636

[a] The asterisks show significance level of 1%(***), 5%(**) , 10%(*)

[174] Number of observations for 'To look good' ; 'To lose weight'; 'To stay in good shape physically' is 59 for whole sample, and 12 for the non-participants of PA sample. Whereas no. of observations for 'To seek adventure and excitement'; and 'To relax and forget about cares' is 59 for whole sample, and 46 for the participants of PA sample This is because there was one don't know response, which was thus excluded from the analysis.

Existence of other perceived benefits

Twenty-seven percent (n=16) of respondents answered yes to the question: '*Are/is there any other benefit(s) not mentioned on the card that you think participation in sports or exercise activities could help you gain?'*. These respondents were also significantly (p value=0.08) more likely to participate in physical activity. Table 7.11 presents the list of benefits (and associated frequencies) mentioned by those respondents, with these benefits covering either aspects of personal development or broadening of social ties.

Table 7. 11 List of additional perceived benefits

Types	Components*	Freq.
'Self development'	'Sense of self discipline'	2
	'Makes you calm in real tense situations'	2
	'To while away time'	2
	'Self defence'	1
	'Improves communication skills'	1
	'Leadership skills'	1
	'Help in creating awareness about one's physical capabilities and shortcomings'	1
	'Do not make you lazy'	1
	'Improves decision making'	1
'Widening of social ties'	'Facilitate social networking'	2
	'Find a partner'	1
	'People become receptive of you'	1

* The phrases are presented verbatim for avoidance of potential alteration of their meaning.

7.3.4 Variation in physical activity behaviour (bivariate analysis)

Appendix 7.9 illustrates whether the bivariate relationship between dependent variables and independent variables was statistically significant or not. In terms of costs, travel time and fixed cost were associated with all dependent variables while variable cost was related with all except one: 'meeting the recommended level'. The direction of association was negative for both variable cost and travel time, and positive for fixed cost.

For perceived benefits, 'to relax and forget about cares' was positively correlated with all dependent variables while 'to feel a sense of achievement' was positively associated with three (days doing either vigorous physical activity at recommended duration or any physical activity; time doing any physical activity). ‘To control or lose weight’ exhibited positive association with meeting the recommended level and days doing vigorous physical activity at recommended duration whereas ‘to look good’ was directly associated with the latter. ‘To learn new things’ was also found to be positively related with both time and days doing physical activity, the latter of which was negatively related with age. Other findings on control variables were that gender was positively associated with time and days doing physical activity at recommended duration while ‘existence of other perceived benefit (yes)’ was positively correlated with both time and days doing any physical activity.

7.3.5 Regression models

Table 7.12 shows estimates of reduced regression models for all dependent variables. Emphasis is placed on reduced models because they showed better specification and fit though results were similar across both base and reduced models (see Appendices 7.10-11).

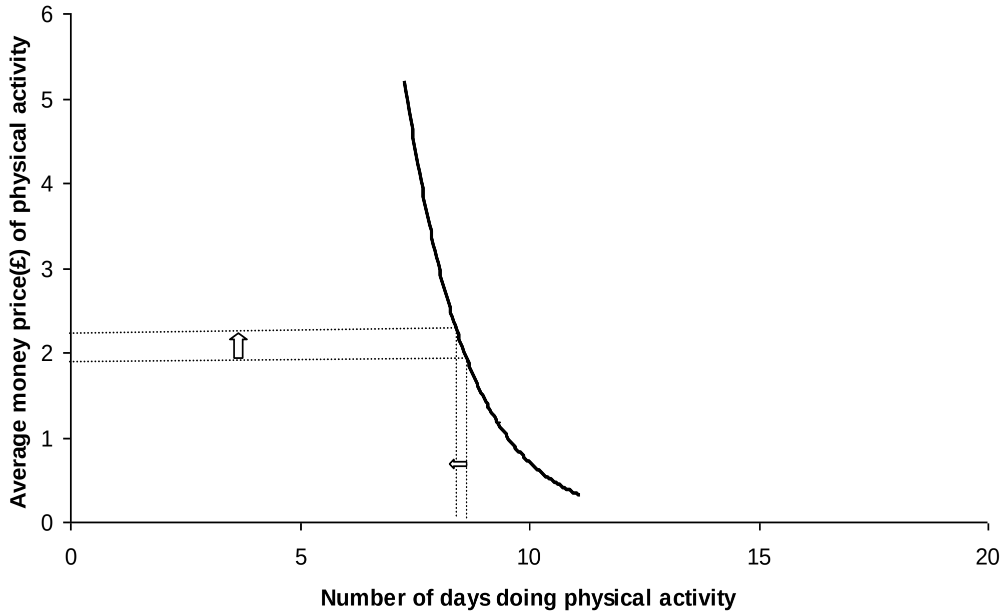
The estimates for ‘number of days doing vigorous physical activity at recommended duration’ and ‘number of days doing physical activity’ used the negbin model as the estimated alpha parameters were greater than zero (0.185; 0.075) and highly significant (p<0.001; p=0.003); and, both dependent variables had low zero observations.

Costs

The demand for physical activity was found to decrease with increases in time (time cost) and money price (variable cost), but less than proportionately. For example, at the mean price of 19.8 minutes, a 10% percent increase in time price is associated with individuals reducing the time and days spent doing physical activity by 6.4% and 4.7% correspondingly (all things being equal) (see Table 7.12). They also decreased the number of days spent doing vigorous physical activity by 3.6% but were more than ten percent (20.2%) less likely to meet the recommended level. For money (variable) price, a 10% percent rise led to a 2.4% reduction in number of days doing physical activity.

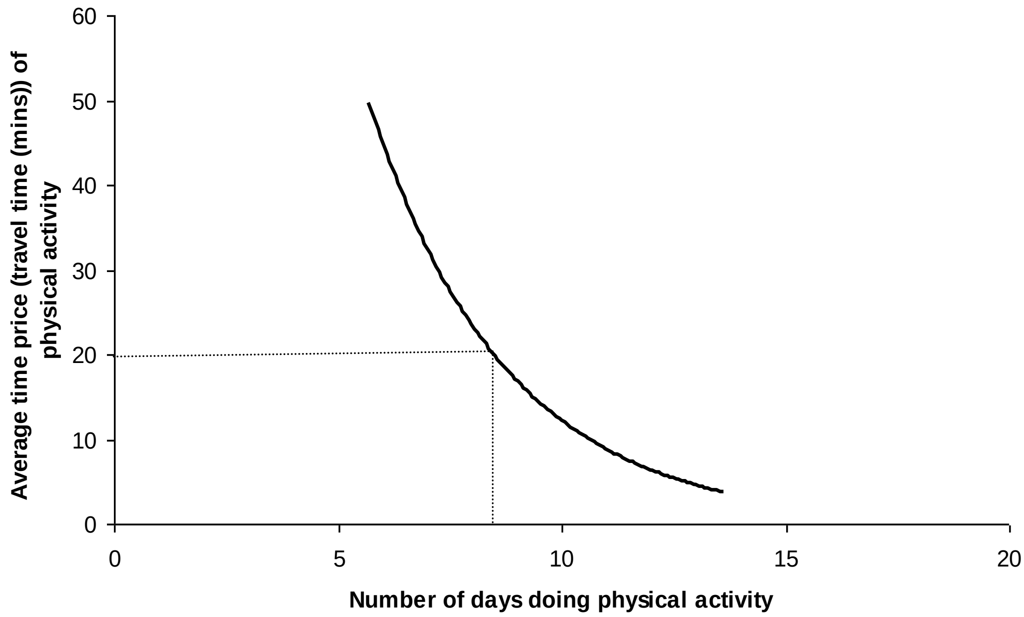
Figures 7.5-6[175] show the demand curves, which demonstrate a negative relationship between price and physical activity ceteris paribus[176], with the steepness of these curves reflecting price inelastic demand. For example, if average money price increases from £1.9 to £2.1 (10% rise), the number of days doing physical activity decreased from 9 to 8.8 (2.5% fall).

Figure 7. 5 Demand curve for physical activity (using money price)



[175] These curves were plotted based on the 'number of days doing physical activity' model because it was the only model that reported the significant findings for both variable and time costs.
[176] Factors such as income, age, perceived benefits, fixed cost and existence of perceived benefit were held constant.

Figure 7. 6 Demand curve for physical activity (using time price)



In terms of fixed cost, a ten percent increase resulted in 3% rise in the time spent doing physical activity, and 2% increase in the number of days doing vigorous physical activity (Table 7.12). Individuals were also 10.1% more likely to meet the recommended level of participation given a ten percent increase in fixed cost.

Appendix 7.12 shows that the influence of costs on general physical activity appears to be similar for specific sports activities as exemplified by workout at gym.[177]

Perceived benefits

Only 'to relax, forget about your cares' and 'to look good' were found to have a statistically significantly positive correlation with physical activity behaviour. Individuals who highly expected physical activity to help them 'relax and forget about their cares' did more than 3 additional days of physical activity than those who had lower expectations (all things being constant). People with higher expectations about 'to look good' also did more than 6 extra days of vigorous physical activity.

[177] Recall that to investigate potential heterogeneity with respect to the effect of costs on participation in different types of sports, an additional regression was fitted for the most popular sports (i.e. workout at the gym-23 observations).

Control variables

Income[178] had a positive influence on demand for physical activity as 'high income earners' (between £830 and £2899 personal income)[179] did 2 more days of physical activity compared with 'low income earners' (below £829 personal income). Age was negatively correlated (ME=-0.54) with number of days one did sports and exercise. People who expected extra benefits from participation in physical activity did 3 more days of physical activity compared with those who did not. Males were also found to spend more time and days (4 more days of vigorous PA than females) doing physical activity.

[178] Income was operationalised as personal income as household income had incomplete observations (6 don't knows). Notwithstanding, the findings on income was consistent when either was used.
[179] Income was specified as a binary to ensure enough observations within categories as imprecise observations will occur if either category has low observations (Peacock and Kerry, 2007).

Table 7. 12 Estimation results of regression models of dependent variables

INDEPENDENT VARIABLES	DEPENDENT VARIABLES							
	Number of days		**Total time**		**Meet recommended level**		**No. of days (vigorous activity)**	
	Reduced model		*Reduced model*		*Reduced model*		*Reduced model*	
	Coef. [a]	***ME (Elas'ty)*** [b]	***Coef.*** [a]	***ME (Elas'ty)*** [b]	***Coef.*** [a]	***ME (Elas'ty)*** [b]	***Coef.*** [a]	***ME (Elas'ty)*** [b]
Unit cost related to PA								
Fixed cost	0.00	0.04 (0.09)	0.01**	0.01 (0.30)	0.03**	0.01 (1.05)	0.01**	0.07 (0.20)
Variable costs	-0.13***	-1.14 (-0.24)	-0.05	-0.05 (-0.09)	-0.02	-0.00 (-0.04)	-0.00	-0.03 (-0.01)
Time cost (travel time)	-0.02***	-0.21 (-0.47)	-0.03***	-0.03 (-0.64)	-0.07**	-0.02 (-2.15)	-0.02**	-0.13 (-0.36)
Perceived benefits								
To relax, forget about your cares	0.44**	3.41	0.40	0.40	0.83	0.18	0.15	1.02
To feel a sense of achievement	-0.48	-5.29	-0.19	-0.19			-0.71	-7.05
To learn new things	-0.11	-0.98	0.13	0.13				
To control or lose weight					-0.64	-0.90	0.35	2.27
To look good							1.40**	6.71
Control variables								
Personal income (high)	0.30*	2.76	0.19	0.19	0.77	0.19	0.03	0.20
Age	-0.06***	-0.54 (-1.60)						
Gender (male)			0.69**	0.69			0.65**	4.33
Existence of other PB (Yes)	0.29**	2.78						
No. of observations	47		47		47		47	
Constant	3.75		5.71		-2.02		1.55	
Linktest	*p*=0.20		*p*=0.95		*p*=0.36		*p*=0.39	
Goodness of fit					*p*=0.66 [d]			
Test for heteroskedasticity			*p*=0.44 [c]					
Normality test			*p*=0.43					
R squared			0.38					
Pseudo R squared	0.18				0.41		0.14	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*) [b] Marginal effects (Elasticity -calculated for only continuous variables) [c]Chi-square(1)=0.58 [d] Chi-square(8)=5.90

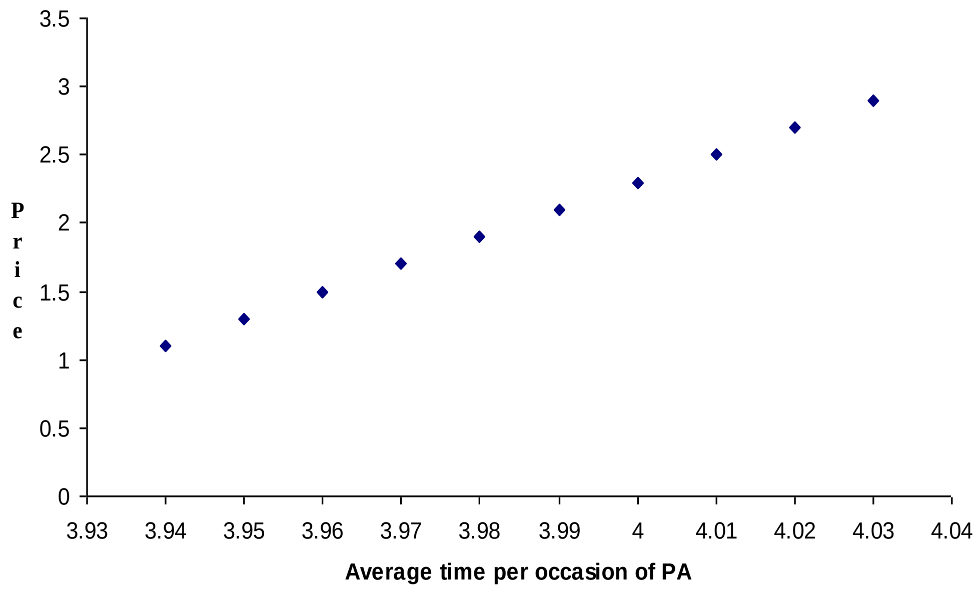
*Variables indicating the equivalent values placed on perceived benefits were accounted for in the regression models ** Average VIF for the independent variables was 1.5, and average tolerance levels were 0.7

7.4 Further analysis

7.4.1 Why does the negative relationship between variable money price and physical activity appear statistically significant only for 'number of days' of participation?

A plausible explanation could be the offsetting responsiveness of frequency of participation and the duration per occasion of participation to changes in variable money cost. In other words, though variable money price is inversely related to the frequency of participation, it is positively related to the duration per occasion of participation. The latter relationship is illustrated by figure 7.7 which plots the predicted[180] responses of average time per occasion of participation to changes in the variable money price.

Figure 7. 7 Predicted average time per occasion of physical activity (PA) by changes in money of PA



So, when uptake of physical activity is measured by only frequency of participation (i.e. number of days) the inverse relationship is more apparent than when it is measured by a combination of frequency and duration of per occasion of participation (i.e. total time spent, meet recommended level, number of days-

[180] The predictions were based on a regression model that had average time spent per occasion of physical activity as the dependent variable and variable money price as an independent variable amongst other variables such as income, and perceived benefits.

recommended duration of vigorous activity) because in the latter measurement, the inverse and direct effects offsets each other in the latter case.

Let's consider a hypothetical scenario; at a money price of 2 pounds per occasion of playing football, an individual plays football for six days each week and spends 30 minutes of playing time per occasion. Once the price increases to 4 pounds, the person is likely to reduce the frequency of participation to say 2 days but he/she is likely to compensate for this reduction in frequency by spending more time once he/she participates (from 30 to 40 minutes). Underlying factors for the increase in time spent per occasion could be the increased value for occasions of participation due the price increases. In addition, given the willingness to stay active, an individual may still strive to be active by spending more time per occasion to assuage the reduction in frequency of participation. Still, the total effect of price increases on physical activity emerges as negative because the negative impact response of frequency of participation overpowers the positive response of duration per occasion. This is evident by comparing the response of number of days (see Fig. 3.1) with average time per occasion (see fig.7.7) when price increases. While a 10% increase in price, from 1.9 to 2.1 leads to a 2.5% fall in number of days (9 to 8.8), it results in a lesser increase in average time spent per occasion, 0.3% (from 3.98 to 3.99).

7.4.2 Costs and Perceived benefits

The findings thus far suggest the negative effect of cost and positive effect of perceived benefits could be offsetting. Chapter 5 indicated that people incurring high costs may do more physical activity if their perceived benefits are greater but that the analysis was plagued with uncertainty owing to the 'out of sample' data on perceived benefits used. This section explores the attenuating effect of perceived benefits on the relationship between cost and physical activity behaviour by investigating the number of days doing physical activity, given participation, when cost increases but perceived benefit is constant and low, compared with when both cost and perceived benefit increases.

Methods

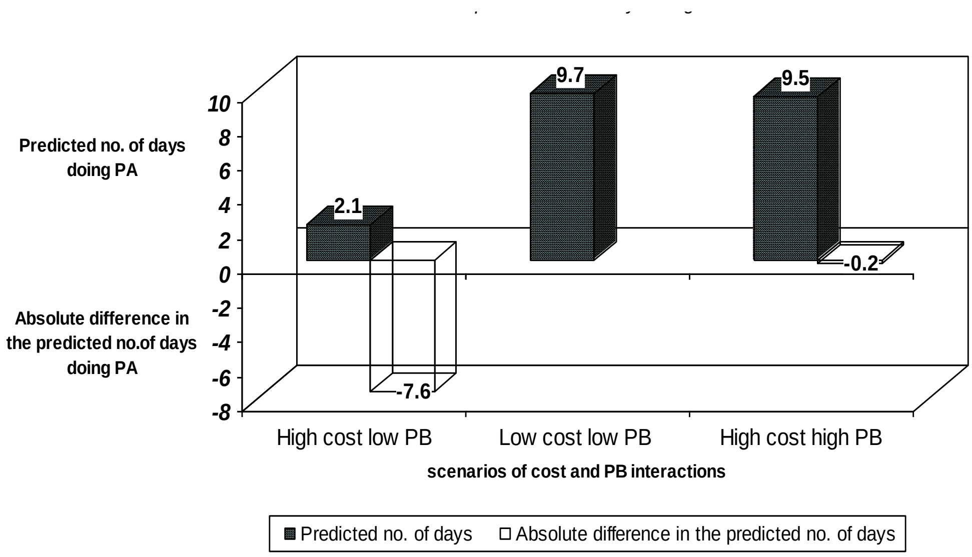
To do this, the following steps were undertaken. First, three[181] differing scenarios were assumed based on potential variant interactions between cost and perceived benefit. The scenarios were created for when cost is specified as variable cost or as travel time[182]: (a) Scenario 1: if cost is low[183] and perceived benefit is also low (b) Scenario 2: if cost is high but perceived benefit is low (c) Scenario 3: if cost is high and perceived benefit is also high. Second, number of days doing physical activity given participation, was predicted for these scenarios based on regression estimates already presented in the results section. Regression estimates of the model on 'number of days doing physical activity, given participation' were used for the predictions because it showed the most variability with respect to both cost and perceived benefit. Third, averages were calculated for the predicted events and compared. Using scenario 1 as the comparator, the average number of days doing physical activity predicted for scenario 2 and 3 were compared respectively with the former.

Results

The results indicate that perceived benefit has an attenuating effect on relationship between cost (either as variable cost or travel time) and physical activity participation. As expected, the change in the number of days doing physical activity when cost increases, is negative and observed either way: when perceived benefit is constant and low or when it increases. However, the negative effect of an increase in cost on physical activity participation is lesser when perceived benefit increases, compared with when is constant and low. Figures 7.8-9 present the average number of days doing physical activity per scenario.

[181] These three scenarios out of a potential four were chosen because the objective is to show how perceived benefit mediates the effect of cost increases on physical activity participation.
[182] This is because these variables best exemplify the negative effect of cost.
[183] The separation of cost into high and low was done on the basis of median values to ensure enough observations.

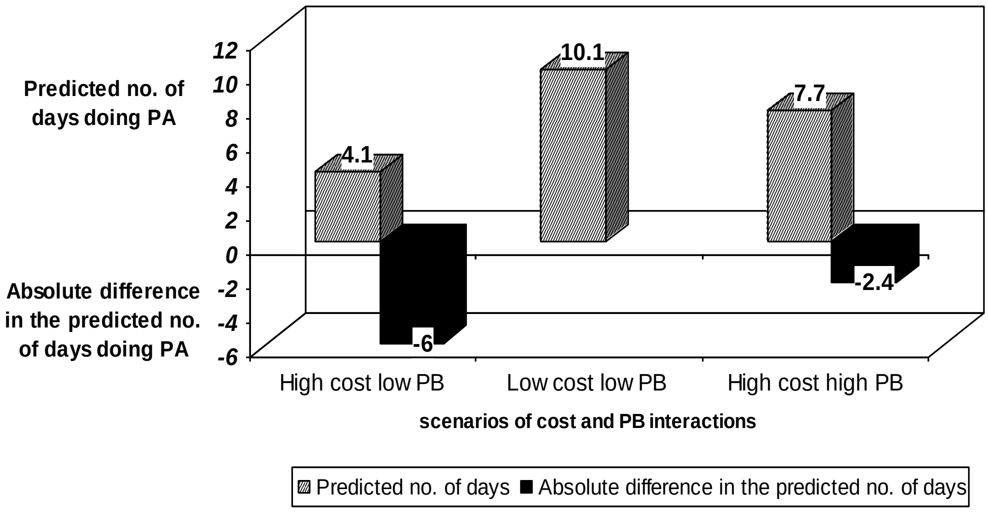
Figure 7. 8 Average no. of days doing physical activity (PA) given participation by scenarios of cost and perceived benefit (PB) interactions (where cost is variable cost)



As shown in Figure 7.8, when variable cost increased but perceived benefit was constant (i.e. high cost low PB vs. low cost low PB), as represented by the middle bar vs. the first bar (bars in check), the decrement in average number of days doing physical activity was from 9.7 to 2.1 days. This implies an absolute difference of -7.6 (represented by the first plain bar). On the other hand, when both cost and perceived benefit increased (i.e. high cost high PB vs. low cost low PB), middle bar vs. the last bar (bars in check), the decrement in average number of days doing physical activity was from 9.7 to 9.5 days, indicating a lower absolute difference of -0.2 (shown by second plain bar).

A similar trend emerges when cost is specified as travel time (see Figure 7.9), with increases in cost and perceived benefits (i.e. high cost high PB vs. low cost low PB) showing a lower absolute difference (-6 days) than when cost increases but perceived benefit remains constant (i.e. high cost low PB vs. low cost low PB) (-2.4 days).

Figure 7. 9 Average no. of days doing physical activity (PA) given participation by scenarios of cost and perceived benefit (PB) interactions (where cost is travel time)



7.5 Discussion

The findings show that people spend an average of £27.4 on physical activity participation per month and an average of 19.8 minutes travelling, per occasion of physical activity, per month. The money costs of physical activity participation mostly included membership fees; entrance charges; and purchases of sports apparel, sports equipment, and nutritional supplements. Females, less educated individuals, older people, and students tend to spend more money on physical activity.

Demand for physical activity is likely to decrease in response to increases in both time and money price (cost) per occasion of participation, given participation. Price elasticity for the variants of demand was inelastic except for the meeting of the recommended level of participation, which was highly responsive to changes in time price. This may be expected given that time requirement for the latter is higher as it does not just involve increasing either duration or frequency of participation but a combination of both.

Another finding was that people may not be doing physical activity because they have less awareness about the benefits accruable from participation rather than not placing importance on those benefits. It was also found that people do perceive extra benefits other than those specified in chapter 4 and the illustrative survey. A potential mitigating effect of perceived benefits on the relationship between physical activity behaviour and cost was also found. These findings whose robustness could be attributed to their consistency across variant models of demand support the predications of the theoretical model underlying the empirical research of this thesis (see chapter 3).

These findings, however, needs to be treated with caution for a number of reasons. First, the validity of the findings can be challenged as the regression models do not account for sample selection bias. The failure to account for selection bias could have led to biased estimates because the observed sample (participants in physical activity) may have been systematically different from the unobserved (non-participants in physical activity). Consequently, it may be impossible to use the regression estimates to establish inferences about the general population particularly in terms of the impact of costs and perceived benefits on physical activity behaviour. Still, some confidence could be drawn from the findings because the characteristics of both samples were generally found not to be significantly different (Appendix 7.6). This however is not evidence of similarities between the two groups just that the sample used in this study did not show any differences. Even so, if such differences exist, the sample size may not have been large enough to detect them, and hence future studies using a larger sample may provide definitive results on existence (or not) of sample selection bias.

Second, the small sample size and the exclusion of important predictors such as health status, ethnicity and smoking status (see chapters 4 and 5) in the analyses may have affected the precision of estimates (Peacock and Kerry, 2007). It is also logical to expect that the university sample may, for example, have higher levels of physical activity compared with the general population due to unobservable factors such as increased access to sporting facilities (Farrell and Shields, 2002). Nevertheless, some confidence can be drawn from the findings because post-hoc sample size estimation showed the findings had 96% power (alpha=5%) to be true and also all regression models had good specification. While statistically confirming the inclusion of relevant predictors, the latter does not indicate 'theoretical' parsimony of the models. Therefore, in theory the models missed out some relevant variables. However, this is expected as regression models can rarely capture all potential predictors of the regressand; hence the error term (Greene, 2008). This is not to suggest that the predictors controlled for in the regression and the sample size were adequate enough to provide definitive findings particularly in terms of general population.

Another potential consideration is whether the findings were biased by measurement errors in variables considering that data collection and entry was conducted by one person. However, such bias if any is minimal because data entry was reviewed by an additional person.

It is possible to argue that the low influence found for income might not be actual but occurred because income was measured as categorical rather than continuous variable. Although the former was used in this study to minimise non-response (Tourangeau et al., 2000), it could have led to inaccurate estimates because detailed effects are usually masked when an otherwise continuous variable is captured as categorical. Second, the operationalisation of income as a binary to ensure enough observations in categories could have further compounded the inaccuracy of the finding. It can be argued that alternative specifications (based on different cut-off points) of the binary could have produced different results though data insufficiency precluded the testing of such hypothesis. Still, the finding on income could be reliable given that a similar finding was observed in chapter 5, where income was measured as a continuous variable. In addition, the loss of precision associated with capturing income as a categorical variable compared with as a continuous variable is usually considered minimal (Milyo, 1999).

The relationship between the findings and those of previous research including chapters 4&5 and the literature is mixed. In terms of perceived benefits, both sets of results point to a positive impact on physical activity behaviour. However, this chapter extends knowledge by showing that the people may perceive additional benefits other than those provided in the literature. Such information is useful as it hints at the existence of other perceived benefits and minimises the possibility of missing out on them in policy strategies. However, there is an urgent need to verify the reliability and validity of this finding because the question was not pre-tested. What still remains unknown is the level of perception associated with these extra benefits and whether they determine participation in physical activity or not. If that is known, it would help to ascertain which of the perceived benefits ought to be prioritised in terms of policy, if and when need be.

For costs, there were differences as the findings in chapter 5 and the literature showed a positive impact of time cost while no effect was found for money cost. A potential reason for this difference could be attributed to the measurement of time and money costs; time costs were measured via proxies in chapter 5 and the literature (Humphreys and Ruseski, 2006, 2007) while money costs were specified as only entrance charges (Tai et al., 1999). Exploring the impact of costs in terms of both time and money in this chapter, offers an improvement in knowledge as it is the only study to have done so. This study therefore provides new indicative evidence on the influence of these costs on participation and hence fully informs policies as to how demand responds to changes in either type of cost. In addition, it provides a framework of analysis indicating how the impact of costs could be conducted in the future using a bigger representative sample. To date there is a paucity of research on economics of participation in physical activity (Downward, 2007; Farrell and Shields, 2002; Gratton and Taylor, 2000) particularly regarding the effect of cost, which has been attributed to a lack of data (Gratton and Taylor, 2000).

The findings do not however provide the impulsion to establish the differential impacts of individual components of money costs as they were all collapsed into ‘variable cost’ owing to the low observations. Second, given the potential heterogeneity of cost regarding different types of physical activity (Humphreys and Ruseski, 2007), which were hinted at by descriptive statistics in this chapter, it is unknown whether the observed effect of cost relates to individual types of physical activity or not. Attempts to shed light on the issue of heterogeneity was limited to only one activity and thus cannot provide strong evidence to fill that void in knowledge. Thirdly, it is difficult to claim whether the observed impact of cost on physical activity behaviour given participation applies to participation or not as well. Owing to data constraints the exploration of the impact of costs was limited to physical activity behaviour given participation. As indicated in chapter 5, the predictors of participation or not could differ from those of the level of participation given participation. There may be the urgent need to fill these gaps in knowledge, as encouraging uptake or level of participation given uptake may require different strategies for various costs and even so for different activities as well.

The use of self reports to measure physical activity behaviour in spite of appropriate validity and reliability tests may be fraught with overestimation or problems with recall (Gillison et al., 2006). However, alternative approaches such as objective measurements like pedometers were not attainable within the logistical constraints of this thesis. Nonetheless the use of sports and exercise activities to indicate physical activity in this chapter is likely to offer an improvement in recall as those activities are usually undertaken in a premeditated mode (Craig and Mindell, 2008). Second, the definition of ‘meeting the recommended level of physical activity participation’ was limited to vigorous intensity physical activity. This is however unlikely to restrict our understanding of physical activity behaviour as the other dependent variables covered all types of intensity. Third, generalising the findings may be difficult considering that the sample was limited, and not representative of the population in England.

If generalisable, the findings could offer implications for policies to improve physical activity participation in England. National health agencies intending to promote participation ought to reduce both the time and money cost per occasion of participation. So, price is potential policy variable, but how much cheaper in price does physical activity have to be to increase uptake? The mostly inelastic nature of price elasticity, suggests that large subsidies rather than for instance vouchers may be most effective. Consider an illustration with two price reduction policies aimed at increasing the current number of days on which physical activity is undertaken: policy ‘A’ aims at a 25% percent subsidy and policy ‘B’, 100%. All things being equal, in money price terms, the former could lead to people doing an additional half a day of physical activity and the latter two and half additional days. This means that with full subsidies, sports participants in England would do about 13 days of physical activity per month indicating that they would be exercising sufficiently enough to meet the recommended level of participation (given intensity), which is the target of current government policies.

The pattern is similar for time price, though the benefit of the full ‘subsidy’ is more profound, leading to an increase of more than 5 days. A finding which is expected given that demand for physical activity is slightly more sensitive to time price than money price. For time price, full ‘subsidy’ strategies may involve providing people with personal sports equipments so they would not have to travel to do physical activity. Such a strategy would lead to a more than 200% increase (i.e. from 0.20 to 0.65) in the probability to meet the recommended level of participation. Given that 34% of the population currently meets that level, it can be deduced that all sports participants in England would attain such levels if that strategy is adopted.

While the benefits of full subsidies may be enormous, concerns could be raised about its cost effectiveness given the financial demands. Unfortunately, resolving this concern is not within the scope of this thesis, however if they are not cost-effective, the following alternative policies may be pursued. First, price (money) discrimination interventions may be adopted to apply full subsidies to sections of the population who are less likely to do physical activity. From the findings (via bivariate analysis), potential target groups could for example be females or older people. Such an intervention would be in line with the on-going government strategy: *Legacy Action Plan: Before, During and After: Making the most of the London 2012 Games* (DCMS, 2008). This plan has as one of its headline ambitions to 'help at least two million more people in England be more active by 2012' by making swimming free to over 60 year olds in England. Given the attenuating effect of perceived benefits on the relationship between cost and perceived benefits, an alternative intervention could be to increase awareness about benefits from physical activity via for example GP advice schemes. Such interventions have been shown to be cost effective though their delivery could improve by incorporating the preferences of individuals (NICE, 2006). For example, GP ought to ensure that the perceived benefit of physical activity being promoted is actually valued by individuals.

In terms of fixed costs however, there could be arguments for and against subsidies given that, as expected, people do more exercise as they incur more of the latter because as rational consumers they are likely to base their purchases on rational expectations about consumption. Another plausible argument is that people may be morally obliged to exercise more after spending much money on it. Thus, a cost recovery policy may be adopted whereby the government could increase fixed cost and use revenue from that to offset the full subsidization policy recommended for variable and time costs. Alternatively, fixed costs may still be subsidised as a way of attracting 'moral weight' which could encourage people to participate. Such a strategy may occur in the form of issuing personalised monthly gym subscription cards to people. These cards may then only be activated once the person subscribes to the gym. To further ensure the intended moral weight, a brief message indicating the benefits of physical activity and reminding people that these cards were financed through tax payers' money could be attached to the cards.

There are a number of ways through which future research may advance the understanding of the role of cost in explaining physical activity behaviour. First, future studies ought to use data collected from a larger representative sample of England in order to provide definitive results. This may however be challenged by data constraints as to date, in England, there exists no published dataset with data on both time and money costs related to physical activity participation and indicators of physical activity. Future national surveys are thus encouraged to collect data on costs alongside indicators of participation to make such studies possible. A potential route may be to use the questionnaire developed in chapter 6, which could be further revised using the findings of this chapter (Appendix 7.13 describes the inputs for such revisions).

Second, there exists a potential issue of heterogeneity of cost of participation with respect to the different types of sports and exercise activities. Future research may thus tackle this issue by regressing participation in individual sports activities on cost specific to those activities.

Furthermore, predictors of cost of participation may be examined using area level variables such as region of residence, deprivation of area of residence, urbanisation of area of residence. Future research to that effect could aid policy making, as areas where cost of participation is high may be targeted in attempts to reduce cost of participation.

In summary, chapter 7 is the first study to provide evidence particularly in terms of the impact of time and money costs on physical activity participation alongside the mitigating effect of perceived benefits on such an impact. However, owing to limitations in terms data insufficiency, it is recommended that future research ought to test these hypothesis within a larger representative sample to provide definitive results.

CHAPTER 8 Conclusions

8.1 Introduction

In the current situation of increasing levels of physical inactivity in England, this thesis aimed to contribute to the understanding of demand for physical activity. The relevant components of the demand function for physical activity, which were identified from reviews of theoretical and empirical literature on physical activity behaviour, established the need to account for costs and perceived benefits among other factors in explaining physical activity behaviour. Thus, the empirical studies of the thesis demonstrated the effect of costs (i.e. time and money costs) and perceived benefits on physical activity participation. The findings generally suggest a negative impact of time and money costs, and a positive impact of perceived benefits on physical activity participation. The subsequent sections of this chapter offer an overview of the contributions of the thesis to the literature, the limitations of the thesis, policy implications of the findings from the thesis, recommendations for future research, as well as concluding comments.

8.2 Contributions of the thesis

This thesis has filled a gap in the literature by providing new evidence on the determinants of participation in physical activity by drawing on theoretical framework from economics to explain physical activity behaviour. The potential usefulness of the application of economics to understanding physical activity participation has been documented (Hill et al., 2004; Sturm, 2004; Cawley, 2005). However, to date, there is a paucity of research in this area (Downward, 2007; Humphreys and Ruseski, 2006; Farrell and Shields, 2002; Gratton and Taylor, 2000).

Chapter 2 offered additions to knowledge in a number of ways. First, it established which theoretical framework from economics is the most suitable for explaining the demand for physical activity, and how its arguments could be operationalised. The usefulness of complementing the application of such theories with knowledge from psychological models was also established, with the use of the latter to inform the specification of an argument in the former (i.e. perceived benefits). Second, it identified a significant gap in the current understanding of physical activity behaviour, particularly in terms of the effects of costs of participation on uptake. A few studies (Humphreys and Ruseski, 2006, 2007; Tai et al., 1999) have explored such effects but only partially, with attempts limited to either assessing the impact of time costs only, using proxies to capture the opportunity cost of time (i.e. wage rate) (Humphreys and Ruseski, 2006, 2007) or money cost via the reduction in admission charges to exercise referral programs (Tai et al., 1999). Third, the chapter demonstrated that there is a gap around the linkage between operationalisation of physical activity and the policy. The existing literature was shown to ignore an important aspect of understanding physical activity behaviour, which is the decision to become physically active (and achieve the recommended level of participation[184]). Physical activity behaviour is mainly operationalised in the literature as: level (i.e. frequency or duration) of participation, participation or not, choice of location of participation. This indicates that current research on physical activity behaviour is limited in terms of policy relevance because the thrust of current policies is how to encourage more people to meet the recommended level of participation (DCMS 2008; DH 2005; DCMS 2002). Fourth, it also established that, to date, research on perceived benefits and physical activity had not adjusted for the relative importance placed on these benefits; this limits the robustness of findings in the literature because the latter has a moderating effect on that relationship (William et al., 2005).

Chapter 3 highlighted available evidence that could be used in the analysis of demand for physical activity in England. This showed that no published dataset exists in England with data on both time and money costs of physical activity participation alongside indicators of physical activity, and this may explain the rarity of research on demand for physical activity (Gratton and Taylor, 2000). However, the chapter also showed that only one dataset (HEANSAH) had data on perceived benefits related to physical activity participation, while another dataset (EFS) had data on money cost but no data on indicators of physical

[184] The minimum recommendation for adults is 20 minutes per session of vigorous intensity physical activity on three or more days per week or 30 minutes per session of moderate intensity physical activity on five or more days per week (WHO, 2009).

activity. In addition, chapter 3 highlighted potential workable approaches to the analysis of demand for physical activity given the current evidence and available resources. These approaches included: (a) the use of individual datasets to conduct a series of analyses, and (b) the collection of primary data using a follow up to a national survey with comprehensive coverage of indicators of physical activity or an independent survey using a convenience sample. Another potential approach, which is merging EFS with HEANSAH, was shown not to be feasible because it was not possible to derive unit cost data. Hence, the empirical analysis of this thesis was based on the latter two approaches.

Chapter 4 made a contribution to the literature by explicitly accounting for the relative importance placed on perceived benefits in investigating the impact of perceived benefits on physical activity participation. The chapter showed that people place importance on both 'health' and 'non health' benefits from participation in physical activity, and that individuals may not be doing physical activity because they have less awareness about the benefits rather than not placing importance on those benefits. This is important to know because promoting physical activity behaviour via increasing perception about benefits related to uptake can only be attained if people want the benefits (DH, 2005). It was also revealed that physical activity behaviour was positively and equally influenced by 'health' and 'non health' perceived benefits. In addition, people who perceive their level of participation to be adequate or perceive themselves to be more active than their peers, were shown to have the greatest levels of uptake.

Chapter 5 indicated that time cost (captured as opportunity cost of time) has an important influence on physical activity behaviour in England, an effect hitherto unknown in the literature. For example, individuals with high opportunity cost of time were more likely to participate in physical activity, and meet the recommended level of participation given participation (regardless of the time intensity of activity). To the best of the author's knowledge, previous research on time cost and physical activity had only used samples from the US (Humphreys and Ruseski, 2006, 2007). Second, the chapter established the income elasticity of demand for physical activity to be inelastic, indicating that although physical activity is a normal good, it is not highly responsive to changes in income. Third, it showed that the determinants of meeting the recommended level of physical activity participation (given participation) differ from those of participating or not. For example, working hours is negatively associated with the latter but has no impact on the former. Fourth, chapter 5 demonstrated that a uni-dimensional proxy indicator of opportunity cost of time addresses the measurement errors of using few proxies, the current approach in the literature, and improves reliability of findings (Kolenikov and Angelis, 2004) as well as aids clarity of interpretation.

Chapter 6 fills a gap in research by tackling the issue of data inadequacy on costs that hinders analysis of demand for physical activity. The chapter developed a questionnaire on costs related to physical activity participation, which could be adapted for future data collection. New knowledge gained from this chapter were varied. First, costs covering sports camping, sports holidays, books and documents, as well as club activities may not be relevant in the context of a national survey because they constitute rare cost items and could also result in capturing expenditure on sedentary behaviour. For example, people are likely to incur costs specifically for holidays and may then happen to do sports alongside. Second, the use of 'usual payment per occasion' (compared with 'payment made the last time') to capture unit cost improves face validity though it may affect recall of information. Third, respondents used two main strategies to recall information on costs - counting or 'special features' of items. Respondents who had made more than one purchases of an item (e.g. sports apparel) used a 'counting strategy'- literally counting the amount spent on the number of purchases made, to arrive at the total costs. Those who had made one-off purchases tended to use special features of the purchase to recall the cost.

Chapter 7 provided new indicative evidence on the costs of participation in physical activity, which showed that people spend an average of £27.4 per month and an average of 19.8 minutes travelling, per occasion of physical activity, per month. It also highlighted that females, less educated individuals, older people, and students tend to spend more money on physical activity. Third, time and money prices (costs per occasion of participation) of physical activity were shown to discourage uptake, and this is assuaged where the perceived benefits of physical activity are high. This knowledge corroborated for the first time the mitigating effect of perceived benefits on the relationship between costs and physical activity. Fourth, the chapter proved that price elasticity for various indicators of demand (duration; and frequency of participation) is inelastic except for meeting the recommended level of participation, which is highly sensitive to changes in time price.

Chapter 7 also established that the negative relationship between money price and physical activity was statistically significant only for frequency of participation (e.g. number of days) and not the other indicators that are measured by both frequency and duration of participation (e.g. meeting the recommended level; total time spent). The plausible reason for this pattern was shown to be the offsetting responsiveness of frequency of participation and the duration per occasion of participation to changes in money price. While money price is inversely related to the frequency of participation, it is directly related to the duration per occasion of participation. Finally, chapter 7 established that perceived benefits from physical activity were more than those available in the literature. The newly identified perceived benefits were predominately 'non health' related and covered either aspects of personal development (e.g. improves decision making') or broadening of social ties (e.g. 'find a partner').

8.3 Limitations of the thesis

Despite making contributions to knowledge, this thesis does have a number of limitations.

The search strategy for the review of theoretical economics literature in chapter 2 may have excluded relevant theories because it was steered by a characterisation of demand for physical activity behaviour. On the other hand, the inclusion of general terms such as 'model*' and 'theor*' could have still picked up such theories. In addition, the intention was to capture range of economic theories considered likely to cover the complex demand for physical activity. Second, using the NICE (2006(b)) report as the basis for selection of papers for the review of psychological models restricted the review to a few models. On the other hand, the purpose was to capture the dominant models, and not a broad sweep of theories.

The analysis in chapter 4 used data collected in 1991, a situation which places some restriction on the current relevance of the findings. Perceived benefits as a social construct may evolve over time and, as such, using the findings as basis of understanding current physical activity behaviour should be treated with caution. Nonetheless, some confidence could be drawn from the findings given that they were consistent with findings in chapter 7, which used data collected in 2008. Still, considering the convenience sample used in the latter, it may not properly reflect current perceptions of the general population in England. Yet, evidence from current literature on perceived benefits and physical activity behaviour (reviewed in chapter 2) revealed similar perceived benefits.

Another limitation of chapters 4, 6 and 7 is that data on indicators of physical activity participation were measured via questionnaire (i.e. self reports). Regardless of appropriate validity and reliability tests, the use of self reports to measure physical activity may be fraught with overestimation or problems with recall (Gillison et al., 2006). Alternative approaches such as use of objective measurements like pedometers were not attainable within the logistical constraints of this thesis. The use of sports and exercise activities to indicate physical activity in the context of this thesis is likely however to offer an improvement in recall as those activities are usually undertaken in premeditated mode (Craig and Mindell, 2008). Still, a limitation of focusing on sports and exercise activities is that the findings cannot be generalised to other forms of physical activity such as occupational activity. On the other hand, this thesis centred on sports and exercise activities because it is often planned and aimed at achieving health benefits (DH, 2004), and hence could be relatively modifiable via interventions compared with the other forms of physical activity.

The specification of time cost in terms of wage earnings in chapter 5 warrants some concerns. The assumption that the cost of time spent on leisure say physical activity, can be equated to the benefit foregone in labour time-wages is questionable. If people value leisure more than labour time (Taks et al., 1994;

Coffey, 1983) and also the leisure/labour trade-off breaks down in the context of fixed working hours, as substitution of labour time for leisure do not suffice; then the assumption casts doubt on results. More over, time may not be indivisible and therefore impractical to treat it like blocks that can be easily traded off (Palmquist et al., 2009). However, given that the accuracy of alternative approaches[185] that accounts for these anomalies have been questioned due to their sensitivity to self-reporting (Mohanty, 2005), the former approach is still widely favoured (Parson, 2003).

The nature of sample used in chapter 6 may affect the extent to which the findings are generalisable. This is because the level of comprehension or recall of responses displayed by the sample, who were highly educated, may not reflect that of the general population. Allied to this issue is the likelihood that the pretesting conducted may have missed some problems likely to be encountered when the questionnaire is administered to the general public. Nevertheless, this is not often recognised as a huge limitation because the potential impact on findings due to differences between samples used for cognitive interviews and the target population for the field administration is considered minimal (Willis, 1999). It may also be argued that the use of highly-educated sample highlighted problems which otherwise would not have been discovered because they are more likely to be articulate.

Chapter 7 used data sourced from an illustrative survey, employing a convenience sample that was limited, non random, and not representative of the general population in England. Using such data for quantitative analyses may lead to imprecise estimates (Peacock and Kerry, 2007). It also means that the conclusions about the impact of costs and perceived benefits ought to be reached cautiously. Yet, some confidence could be drawn from the findings in this chapter since post-hoc sample size estimation proved that the regression analysis offered a 96% power (alpha=5%) to yield accurate estimates. In addition, the

[185] The standard approach is to use a survey questionnaire to measure an unemployed individual's value of leisure, which is the reservation wage, in other words the wage rate that will attract him to work in the labour market (Coffey, 1983). Other variants approaches include conducting a survey where respondents are asked for their subjective opportunity cost of time (Casey and Vukina, 1995). Similarly, Feather and Shaw (1999) used a survey, but used contingent behaviour questions whereby people were asked about their willingness to work additional hours, or/and their willingness to work or not.

regression models were subjected to rigorous model diagnostics testing, showing good specification and fit - although they are not indicative of how well the regression estimates relate to the general population. Another limitation of chapter 7 is that the exploration of the impact of costs was limited to physical activity behaviour given participation, owing to data constraints. As indicated in chapter 5, the predictors of participation or not could differ from those of the level of participation given participation. Thus it is difficult to claim whether the observed impact of cost on physical activity behaviour given participation applies to participation or not as well. Also, chapter 7 failed to establish the differential impacts of individual components of money costs as these costs were collapsed into fixed and variable costs, owing to the data insufficiencies.

8.4 Policy implications of the findings from the thesis

The findings in this thesis generally suggest a negative impact of costs and a positive impact of perceived benefits on physical activity participation. If generalisable, these findings provide implications for policies to improve physical activity participation in England.

National health agencies intending to promote participation could reduce both the time and money cost per occasion of participation. This could be done using the economic instruments such as subsidies and tax credits particularly at the point of consumption. To reduce time costs, strategies may involve bringing sports facilities closer to residences to decrease travel time to do physical activity or providing people with personal sports equipments so they would not have to travel at all. For such policies to be effective however, they must be based on the price elasticity of demand (Madore, 2007). Given that the price elasticity was found to be inelastic, indicates that full subsidies would be more effective in promoting uptake. With full subsidies, sports participants in England would do about 13 days of physical activity per month, indicating that they would be exercising sufficiently to meet the recommended level of participation (given intensity), which is the target of current government policies. Currently, given participation, sports participants are not meeting this recommended level and hence not reaping the necessary health benefits.

Although the benefits of full subsidies would be enormous, concerns could be raised about its cost effectiveness given the financial demands. If they are not cost-effective, alternative policies such as price discrimination interventions (e.g. giving full subsidies to sections of the population who are less likely to do physical activity) may be pursued. From the findings, potential target groups could for example be females or older people. Such an intervention would be in line with the on-going government strategy: *Legacy Action Plan: Before, During and After: Making the most of the London 2012 Games* (DCMS, 2008), that makes swimming free to over 60 year olds in England.

Interventions aimed at promoting uptake of physical activity could increase people's awareness of perceived benefits related to physical activity. To do so, mass media campaigns could be employed to provide persuasive messages to the population about these benefits. The messages should portray physical activity not only as a prospect for health improvement but non health benefits such as relaxation, and broadening of social network, as it was found that people do physical activity for both sets of benefits. The transmission of those messages could be via television programmes or GP advice schemes. The latter may however be more suitable, given its well-documented cost-effectiveness, though their delivery should be improved by incorporating the preferences of individuals (NICE, 2006). For example, GP's ought to ensure that the perceived benefit of physical activity being promoted is actually valued by individuals. This is important because people would do physical activity only if they are made aware of perceived benefits they want (DH, 2005). As indicated in chapter 4, to increase uptake among married and older people (say), these people should be told that doing physical activity can make them have fun because they are more likely to value having fun.

8.5 Implications from the thesis for future research

This thesis, as already mentioned, furthers our understanding of demand for physical activity. Yet, there are three ways in which future research may improve the knowledge provided here.

First, to determine the robustness of the findings within the general English population, the impact of costs in particular should be analysed using data sourced from that population. A large nationally representative sample will provide definitive results about the associations between costs and physical activity, potentially varying according to type of activity and among different subgroups of the population. Future national surveys are thus encouraged to collect data on time and money costs of engaging in physical activity alongside indicators of participation. To do so, the questionnaire developed in chapter 6 may be used.

In light of this, the Department of Health has agreed to support such work with sponsorship for a national survey based on the questionnaire developed in this thesis. The aim of the project is to conduct a follow up survey to the Health Survey for England (HSE) 2008 and ask about both the time and money costs expended on physical activity. This survey has been approved by the Information Centre of the NHS, sponsors of the HSE, and will be conducted in association with National Centre for Social Research (NatCen).

Data collected from that survey will add further to knowledge. First, it will examine the potential differential impacts of costs with respect to different types of sports and exercise activities. Indicators of participation in individual sports activities will be regressed on unit time and money costs specific to those activities, controlling for cofounders such as perceived benefits, socio-demographic and health variables. Given the finding that different indicators of participation responds variedly to changes in unit costs, separate regression models ought to represent each of the indicators for each sport. The statistical significance and price elasticity of demand for different sports can be compared to show which sport is most (least) responsive to price changes. The findings could be valuable for setting targeted policies aimed at subsidising costs of participation in physical activity. Second, the predictors of unit costs related to participation could be determined to ascertain if and where in England sports participation is most expensive. Variables of interests in such regression analysis would include area level variables indicating region of residence, deprivation of area of residence, urbanisation of area of residence. Information from such analysis would aid the formulation of discriminatory policies targeted at areas where cost of participation is higher.

8.6 Concluding comments

The overarching purpose of this thesis has been to contribute to understanding demand for physical activity. The effects of costs and perceived benefits (among other factors) on physical activity participation were explored using varied econometric models. The main findings suggest that demand for physical activity is likely to decrease in response to increases in both time and money price (cost) per occasion of participation. Price elasticity for the variants of demand was inelastic except for the decision to meet the recommended level of participation that was highly responsive to changes in time price. Also, people may not be doing physical activity because they have less awareness about the health and non-health benefits accruable from participation rather than not placing importance on those benefits. It was further identified that the negative impact of cost on physical activity participation may be mitigated by perceived benefits. There may, however, be the urgent need to provide robust evidence on the impact of costs in particular, given that the sample used in the empirical analysis, do not reflect the make-up of the general population. Although not generalisable, the findings do indicate some interesting implications for policies to improve sports and exercise participation in England. These options could cover subsidisation policies which ought to provide full coverage of prices given the inelastic nature of price or mass media campaigns that would promote the benefits related to participation. However, future work is needed to determine the cost-effectiveness of alternatively targeted subsidisation policies. This thesis is the only study to have showed that both time and money costs deter participation in physical activity, and that this is mitigated where perceived benefits of participation are high, thereby providing varied policy options to encourage greater take up.

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APPENDICES

Appendix 2.1.1 Final search terms and results

Database	Search terms	Hits	Identified abstracts
JSTOR	(leisure OR “physical activit*” OR health) AND (demand OR price*) AND ("time budget" OR "allocation of time" OR "time use") NOT (psychological OR psychology) NOT (sociological OR sociology) NOT (agricultural OR agriculture)	395	17
IBSS	(leisure OR physical activit* OR keep fit OR health OR fitness) AND (demand OR preferenc* OR choic* OR pric*) AND (model* OR theor* OR time budget OR allocation of time OR time use OR household) NOT (abortion[186] OR sociolog* OR psycholog*) limit to ENGLISH	357	17
SCOPUS	(leisure OR “physical activit*” OR health) AND (demand OR pric*) AND(model* OR theor* OR “time budget” OR “allocation of time” OR “time use” OR household) limit to ECONOMICS and HEALTH subject areas	1196	23
Econ Lit	(leisure OR “physical activit” OR fitness) AND (demand OR pric*) AND (“time budget” OR “allocation of time” OR “time use” OR household”)	312	32
Web of Knowledge	(leisure OR "physical activit*"OR health OR exercis*) AND (demand OR pric*) AND("time budget" OR "allocation of time" OR "time use" OR household)	356	19
Econ Papers	(leisure OR physical activit* OR sports OR sport OR health OR exercising OR exercise) AND (demand OR preferenc* OR pric* OR behave) AND (time budget OR allocation of time OR time use OR household)	892	19
Total		3508	127

[186] To exclude papers on abortion.

Appendix 2.1.2 Review questions

Headings	Review questions
Background data	1. Author(s) of study 2. Year of publication 3. Aim of study
Specification of model	4. Description of the model 5. What are the assumptions? 6. Independent variables 7. How are the independent variables specified in practice? 8. Dependent variables 9. How are the dependent variables specified in practice?
Strength and weakness	*Contextual criteria* 10. What population group(s) is the model focused on? 11. Which other population groups might the model be relevant to? 12. Are there are any population groups the model might not be applicable to? 13. Source of data 14. Which variable might be the best proxy for physical activity? 15. What is the decision making unit covered in the model? -Single person as individual -Single person as household -Multi-person -Intra-household -Other 16. What attributes of the decision-making unit was considered? 17. How are other members of the household accounted for in the model? 18. Which variable might be the best proxy for physical activity? *General criteria [based on attributes of good model adapted from Gujarati(2006)]* (a)Parsimony 19. Are specification tests of the model reported? 20. Do the specification tests give evidence of good specification? (if yes to question 15) (b)Goodness of fit 21. Are goodness of fit tests of the model reported? 22. Do the goodness of fit tests give evidence of good specification? (if yes to question 17) (c)Theoretical consistency 23. Do the coefficients in the model have the correct signs? (d)Identifiably 24. Was identification a problem? 25. How well was identification problem accounted for? (if yes to question 20) (e)Predictive power 26. Do the empirical findings support the model? *Author stated assessment* 27. Strengths (Author stated) 28. Weaknesses (Author stated)
Main findings	29. What are the main findings of this study? 30. What are the significant predictors of the dependent variable?

Appendix 2.1.3 List of selected papers

ALENEZI, M. and WALDEN, M.L., 2004. A new look at husbands' and wives' time allocation. *Journal of Consumer Affairs,* **38**(1), 81-106.

ARONSSON, T., DAUNFELDT, S.-. and WIKSTRÖM, M., 2001. Estimating intrahousehold allocation in a collective model with household production. *Journal of Population Economics,* **14**(4), 569-584.

ASANO, S., 1997. Joint allocation of leisure and consumption commodities: A Japanese extended consumer demand system 1979-90. *Japanese Economic Review,* **48**(1), 65-80.

ATROSTIC, B.K., 1982. The Demand for Leisure and Nonpecuniary Job Characteristics. *American Economic Review,* **72**(3), 428-440.

BARNETT, W.A., 1979. The joint allocation of leisure and goods expenditure. *Econometrica,* **47**(3), 539-563.

BENTZEN, N., CHRISTIANSEN, T. and MOLLER PEDERSEN, K., 1989. Self-care within a model for demand for medical care. *Social Science and Medicine,* **29**(2), 185-193.

BHAT, C.R., 2005. A multiple discrete-continuous extreme value model: Formulation and application to discretionary time-use decisions. *Transportation Research Part B: Methodological,* **39**(8), 679-707.

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EICHENBAUM, M.S., HANSEN, L.P. and SINGLETON, K.J., 1988. A time series analysis of representative agent models of consumption and leisure choice under uncertainty. *Quarterly Journal of Economics,* **103**(1), 51-78.

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GRONAU, R., 1977. Leisure, home production, and work--the theory of the allocation of time revisited. *Journal of Political Economy,* **85**(6), 1099-1124.

HAVEMAN, R., 1994. Market work, wages, and men's health. *Journal of health economics,* **13**(2), 163-182.

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KONG, M.-. and LEE, H.-., 1999. Demand for medical care, consumption and cointegration. *Economics Letters,* **62**(3), 325-330.

KOOREMAN, P. and KAPTEYN, A., 1987. A Disaggregated analysis of the allocation of time within the household. *Journal of Political Economy,* **95**(2), 223-249.

KOSKIEVIC, J.-., 1999. An intertemporal consumption-leisure model with non-expected utility. *Economics Letters,* **64**(3), 285-289.

LECOCQ, S., 2001. The allocation of time and goods in household activities: A test of separability. *Journal of Population Economics,* **14**(4), 585-597.

OWEN, J.D., 1971. The demand for leisure. *Journal of Political Economy,* **79**(1), 56-76.

PHLIPS, L., 1978. The demand for leisure and money. *Econometrica,* **46**(5), 1025-1043.

PROPPER, C., 2000. The demand for private health care in the UK. *Journal of Health Economics,* **19**(6), 855-876.

ROSENZWEIG, M.R. and SCHULTZ, T.P., 1983. Estimating a household production function: heterogeneity, the demand for health inputs, and their effects on birth weight. *The Journal of Political Economy,* **91**(5), 723-746.

SICKLES, R.C. and YAZBECK, A., 1998. On the dynamics of demand for leisure and the production of health. *Journal of Business and Economic Statistics,* **16**(2), 187-197.

SOLBERG, E.J. and WONG, D.C., 1992. Family time use: leisure, home production, market work, and work related travel. *Journal of Human Resources,* **27**(3), 485-510.

VAN DEN BRINK, H.M. and GROOT, W., 1997. A household production model of paid labour, household work and child care. *Economist*, **145**(3), 325-343.

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WU, B. and PORELL, F., 2000. Job characteristics and leisure physical activity. *Journal of Aging and Health*, **12**(4), 538-559.

Appendix 2.1.4: Aims and summary of models reviewed

Type of Model	Papers	Aim	Summary of model
Leisure-consumption choice category	Phlips (1978)	To construct and estimate an augmented system of dynamic demand equations in which the demand for leisure and the demand for transactions balances are embedded.	The consumer maximises a Stone Geary[187] utility function of the expenditure of consumption good, and leisure subject to a constraint of the prices of consumption good and leisure and real cash balances.
	Koskevic (1999)	Test an intertemporal consumption-leisure model with non expected utility	The agent maximises a current period lifetime utility function comprising consumption and leisure. The utility function is constrained by the wealth of the agent for the period between the current period and the period beyond, which is a function of the real returns from holding security and real wage.
	Darrough(1997)	Develop a neo classical framework based on intertemporal allocation of consumption, savings and leisure to explain Japanese experience of allocating resources between consumption and leisure.	The consumer maximises a utility function made of 4 current goods (current food, current consumer durables, current leisure, current miscellaneous) and 2 future goods (future leisure and future composite good) aggregated by a Leontief aggregation method[188] into a single variable ("x"). The utility function is constrained by "full" lifetime wealth and prices.
	Owen (1971)	Establish the relationship between the demand for market recreation and the demand for leisure.	The utility maximisation function of the individual is represented by leisure, market recreation and other consumer goods subject to the maximum full income constraint of price of leisure and wage income as well as a time constraint.
	Barnett(1979)	Test conditions for separation of the consumer's labour/leisure decision from his consumption expenditure allocation decision.	The agent maximises a utility function of consumption-leisure choice constrained by income level and the prices of leisure and consumption goods.
	Kooreman et al. (1987)	To model the demand for goods and allocation of time	The household maximises a utility function of time spent by members and consumption goods constrained by budget and time constraints.
	Eichenbaum et al. (1987)	To empirically investigate a model of aggregate consumption and leisure decisions in which utility accruing from goods and leisure is non-time separable	The agent has consumption services and leisure services as arguments of his utility function. The decisions about leisure and consumption are constrained by income and information.
	Atroistic (1982)	To estimate a demand system whose goods are leisure, non pecuniary job characteristics and other goods, based on individual-level data	The utility function has leisure, goods, and job characteristics, as its main arguments; subject to full income constraint and wage-job characteristics.

[187] Allows the introduction of state parameters (i.e. physical stocks of habit that influences the demand for the dependent variables).
[188] It consider commodities normally consumed in fixed proportions as a single commodity.

Type of Model	Papers	Aim	Summary of model
	Asano (1997)	To estimate the parameters of a household expenditure function that includes a joint choice of leisure and consumption of commodities without separability assumption	The consumer maximises utility from a joint consumption of leisure and commodity constrained by the prices of consumption good and income level.
	Dowd (1992)	To test a model of consumer behaviour in which income and leisure are simultaneously chosen	The household has a utility function with leisure and consumption as its arguments, subject to budget and time constraints.
Health behaviour category	Sickles et al. (1998)	To investigate the production of health that is affected by changes in leisure demand and health related expenditure	The utility maximising individual has a lifetime utility function of consumption goods, leisure and health. This is subject to constraints of non-labour income, wage income and expenditure on goods as well as time.
	Bentzen et al. (1989)	To incorporate self-care in a model of demand for medical care	The health behaviour of the individual is modelled into a 3 stage decision model; where stage one refers to whether ill or not. The second stage depicts the decision to seek professional care, pure self care or a combination of both, when sick. The last stage concerns the volume of professional care utilised.
	Havemann (1994)	To investigate the complex interrelations among work time, wages and health identified in the Grossman model of the demand for health	A 3 equation structural model describes the interrelationship between health, wages and work hours. Health in a stated period is determined by the individual's work hours, both personal and job characteristics (i.e. job hazards). Work hours of the individual is determined by prior health, wages, personal characteristics (i.e. number of children in the family) and job characteristics (i.e. self employed or not).
	Dustmann & Windmeijer (2000)	To present a life cycle model for the demand for health and derive empirical specifications that distinguishes between permanent and transitory wage responses	The utility function of the individual is composed of consumption goods and healthy time. The individual is faced with a time constraint function that allocates available time between labour and time input for health investment, prices of goods, wage income and non labour income.
	Cameron et al. (1988)	To model the interdependent demand for health insurance and health care	The representative consumer maximises a 2-period expected utility function with health and consumption arguments subject to a budget constraint.
	Propper (2000)	To model the use of private health care as a function of its cost and benefits relative to state care and no care	The model denotes that a potential health care user chooses alternative sources of health care (i.e. no care, NHS, private care) depending on the relative costs and benefits.
	Rosenweig et al.(1983)	To estimate a household health production function using information on one important early health indicator: birth weight and a set of behavourial variables considered to be important determinants of birth outcomes in the medical	The utility of the household comprises consumption of goods, goods that affect child health production and the health of child. The utility function is subject to the production function of child's health which is influenced by the goods that affect the child's health, health inputs and the health endowments of the family as well as

Type of Model	Papers	Aim	Summary of model
		literature (i.e. prenatal medical care, working and smoking by the pregnant mother, number of births by mother and her age)	exogenous income and prices of goods.
	Moon-Kee (1998)	To provide, in the context of co-integration, a justification for employing the variables in the usual macroeconomic demand for medical care by examining the health capital model	The consumer's lifetime utility function is composed of consumption goods and health constrained by wage income, expenditure on the arguments of utility and labour income.
	Wrick (1996)	A simultaneous equation to measure the forces that influence the consumption of health services	The demand for health services is determined by need, realization of need, financial resources, motivation and availability of health services
Household production category	Lecoq (2000)	To test for the weak separability hypothesis of household production model between goods and time inputs used in the production of different goods	A household's utility function comprises goods produced in the household, quantity of meals produced outside home and leisure time of both agents. The utility function is subject to budget constraint, time constraint and technological constraint.
	Arronson (2001)	Using an extended collective model to estimate the intra family allocation of income, household production and individual demand for leisure	A household maximises a utility function which has leisure, market produced goods, and home produced goods as its arguments, subject to budget and time constraints.
	Van Den Brink et al. (1997)	To formulate a household production model including four activities: market work, housework, leisure, child care	A utility function comprises consumption goods, time spent on child care services and leisure, subject to budget and time constraints.
Labour supply category	Klaveren van et al. (2000)	To estimate a collective household labour supply model for 3 different population samples of Dutch, Turkish descents and Surinamese.	The household utility function which is the sum of two utility functions of male and female. The main arguments of the utility function are leisure time, time spent in the household, joint household care level, subject to income and time constraints.
	Couprie (2003)	To explain the impact of family status on female labour supply.	The household maximises a collective utility model of aggregate consumption goods, leisure and a public domestic good; subject to both income and time constraint.
	Feather (2000)	To formulate a labour supply model to address overemployment and underemployment.	The individual's utility function consists of leisure and market goods, subject to budget and time constraints.
Allocation time category	Wales and Woodland (1977)	Formulate a household model that allocates available between labour, leisure and housework; where leisure is defined as net of time spent on housework	The household maximises a utility function consisting of the leisure of wife and husband and composite goods. The utility function is subject to budget and time constraints. The original model was modified to derive 4 different specifications[189].

[189]The alteration involved subjecting housework to different definitions: model A(housework was incorporated into leisure), Model B (housework is exogenously determined), model C (housework is not exogenously determined), model D(housework is stochastic not deterministic and regarded as endogenous).

Type of Model	Papers	Aim	Summary of model
	Bhat (2004)	To formulate a utility theory based model for a discrete/continuous choice that assumes diminishing marginal utility as the level of consumption of any particular alternative increases	An individual maximises a sum of utilities accrued from time activities subject to time constraint which allows the participation in one or two activities at a time.
	Gronau (1977)	To extend Becker(1965) Allocation of time theory by dividing non market work into leisure and home production	The household maximises consumption time (i.e. leisure) and goods utility function subject to budget and time constraints
	Solberg and Wong (1991)	To present a formal model of the allocation of time in the manner of Gronau(1977) and derive its comparative static predictions in order to test them against recent data on family time use	The household's utility function comprises leisure and consumption goods, subject to time and budget constraints.
	Alenezi and Walden (2004)	To take a new look at the husband's and wives decisions about market and housework time allocations	The household's utility function consists leisure, consumption of both market and home produced goods; subject to budget, time and technology constraints.
Physical activity behaviour category	Wu and Porrel (2000)	An empirical analysis of factors associated with physical leisure activity level that has direct implications with regards to the alternative theories of work and leisure.	The individual's decision to exercise is determined by the expected benefits and the costs of participation.
	Humphreys and Ruse ski (2006)	To examine the economic determinants of participation in physical activity by developing and analyzing a consumer model of participation and testing the predictions of this model.	The household's utility function comprises separate but related decisions to participate in physical activity, and given participation the decision on the amount of time to spend participating, as well as the decision to consume other consumption goods. This utility function is subject to both time and budget constraints; with the decision to participate in physical activity determined by costs and expected benefits of participation.

The aims of the papers were generally written verbatim to avoid potential alterations via paraphrasing

Appendix 2.2.1 Search strategy

Database	**Search terms**	**Titles/ abstracts screened**	**Selected papers**
SCOPUS	("physical activit*" OR sport* OR "keep-fit" OR "keep fit" OR walking OR walk OR swimming OR swim OR cycle OR cycling OR aerobic OR aerobics OR jogging OR jog OR running OR dancing OR dance OR gym* OR fitness OR exercis*) AND (time OR participa* OR demand OR choic* OR money OR cash OR expend* OR pric* OR cost***)**	7756	9
SPORTS DISCUSS	("physical activit*" OR sport* OR "keep-fit" OR "keep fit" OR walking OR walk OR swimming OR swim OR cycle OR cycling OR aerobic OR aerobics OR jogging OR jog OR running OR dancing OR dance OR gym* OR fitness OR exercis*) AND (time OR participa* OR demand OR choic* OR money OR cash OR expend* OR pric* OR cost*)	856	4
Other sources	N/A	7	0
Total		8619	13

Appendix 2.2.2 Review questions

Headings	Review questions
Basic features	1. Authors 2. Year 3. Aim 4. Country
Methodological features	5. What are the costs of participation in physical activity? 6. How are they specified in practice? 7. How was data on cost collected? 8. What is the dataset used?(if method of data collection is secondary) 9. How was physical activity measured in practice? 10. Nature of sample 11. Any statistical basis for sample size used? 12. What is the sampling method used? 13. Source of data 14. Type of data analysis used 15. Type of statistical model used (if quantitative analysis) 16. Any statistical model diagnostics tests reported? 17. What are the author-stated challenges?
Empirical findings	18. What are the main results on costs? 19. Is physical activity participation influenced by other factors? 20. What is the nature of the influence? 21. How are those factors specified in practice?

Appendix 2.2.3 List of selected studies

BROWN, M.T., RASCHER, D.A., MCEVOY, C.D. and NAGEL, M.S., 2007. Treatment of travel expenses by golf course patrons: sunk or bundled costs and the first and third laws of demand. *International Journal of Sport Finance,* **2**(1), 45-53.

COALTER, F., 2004. Reference pricing: changing perceptions of entrance charges for sport and recreation. *Managing Leisure,* **9**(2), 73-86.

DAVIES, L.E., 2002. Consumers' expenditure on sport in the UK: increased spending or underestimation? *Managing Leisure,* **7**(2), 83-102.

DELLAVIGNA, S. and MALMENDIER, U., 2006. Paying not to go to the gym. *American Economic Review,* **96**(3), 694-719.

DOWNWARD, P., 2007. Exploring the economic choice to participate in sport: results from the 2002 General Household Survey. *International Review of Applied Economics,* **21**(5), 633-653.

DOWNWARD, P., 2004. On leisure demand: a post Keynesian critique of neoclassical theory. *Journal of Post Keynesian Economics,* **26**(3), 371-394.

FARRELL, L. and SHIELDS, M.A., 2002. Investigating the economic and demographic determinants of sporting participation in England. *Journal of the Royal Statistical Society: Series A (Statistics in Society),* **165**(2), 335-348.

HUMPHREYS, B.R. and RUSESKI, J.E., 2007. Participation in physical activity and government spending on parks and recreation. *Contemporary Economic Policy,* **25**(4), 538-552.

LERA-LÓPEZ, F. and RAPÚN-GÁRATE, M., 2007. The demand for sport: sport consumption and participation models. *Journal of Sport Management,* **21**(1), 103-122.

LERA-LÓPEZ, F. and RAPÚN-GÁRATE, M., 2005. Sports participation versus consumer expenditure on sport: different determinants and strategies in sports management. *European Sport Management Quarterly,* **5**(2), 167-186.

TAI, S.S., GOULD, M., SMITH, P. and ILIFFE, S., 1999. Promoting physical activity in general practice: should prescribed exercise be free? *Journal of the Royal Society of Medicine,* **92**(2), 65-67.

TAKS, M. and KESENNE, S., 2000. The economic significance of sport in Flanders. *Journal of Sport Management,* **14**(4), 342-365.

TAKS, M., RENSON, R. and VANREUSEL, B., 1999. Consumer expenses in sport: a marketing tool for sports and sports facility providers? *European Journal For Sport Management,* **6**(1), 4-18.

Appendix 2.2.4: Summary of reviewed papers

Author(s)	Year	Aim(s)	Description of sample	Main findings
Taks and Kesenne	2000	To measure the share of the sports sector in the regional economy of Flanders via expenditure related to active sports participation	1258 representative adult sample (aged between 18-65 years and over) from Flanders, Belgium	(1) Overall, an average of 1507 US dollars was spent on active sports participation (2) Money was spent most on skiing, followed by cycling, swimming, walking and tennis respectively. Gymnastics had the lowest money spent on. (3) The largest sports expenditure was incurred on travel costs followed buy equipment, social costs, membership fees and training/coaching in that order
Humphreys and Ruseski	2007	To estimate an economic model of participation in physical activity	275,455 representative adult US sample (aged 18 years and above)	(1) Time cost (i.e. opportunity cost of time) has a positive impact on physical activity participation (2)Income has a positive effect of physical participation (3)Government spending on parks and recreation increasers participation in group sports but reduces participation in walking (4)Age generally decreases the participation in physical activity behaviour
Della Vigna and Malmendier	2006	To analyse the contractual choices of consumers in light of their actual consumption behaviour	7752 adult members of health clubs (age in their early 30's) from the US	(1) 80% of the members of the health clubs tend to pay over 70% more than what they would paid if they had based their contractual choices on actual attendances (2)Price per average attendance to the health club in the first 6 months was 17.27 dollars (3)Individuals tend to have unrealistic expectations about attendance to the health clubs
Farrel and Shields	2002	To investigate the economic and demographic factors determining sports participation in England	6467 representative adult sample (aged 16 years and above) from England	(1)Income has a positive effect on physical activity participation suggesting that low cost of physical activity participation may promote participation (2)Unemployed people are more likely to do physical activity as compared to employed people (3) A high degree of intra household correlation (0.357) in sports participation was found. This indicates that sports participation may be 'infectious' in the household (i.e. it is likely that members of a household either may all be doing sports or not doing at all)
Downward	2007	To assess hypothesis emanating from theoretical and empirical economics of participation	11726 representative adult sample (aged 16 years and over) from UK	(1)There is a support for the predication on income-leisure trade off hypothesis regarding physical activity behaviour, as income has positive effect on participation while working hours have a negative effect (2) Age is negatively related to participation in physical activity but drinking status (i.e. drinkers) participants in voluntary

Author(s)	Year	Aim(s)	Description of sample	Main findings
				activities tend to have a positive effect on participation in physical activity (3) Being males have a positive effect on physical activity participation (4)Higher educational status relates positively to physical activity participation
Taks et al	1999	To provide an analysis of the determinants of consumer expenditure in active sports participation	900 representative sample of adult men (aged 18 years and above) from Flanders, Belgium	(1)Golf is the most expensive sports with financial expenditure above 4000 euros per year (2)Table tennis, jogging, soccer and swimming are the 'very inexpensive sports' (i.e. below 800 euros per year) (3)Participation in sports tend to impact positively on expenditure on sports participation (4)Club affiliation, income level are also a positive predictor of sports participation (5)Age, education, and professional status have no significant influences on expenditure on sports participation
Lera-Lopez and Rapun-Garate	2005	To compare the demographic and socio-cultural background variables and economic factors determining the frequency of sports participation and consumption expenditure on sports participation	700 representative adult sample (aged between 16-65 years) from Navarre, Spain	(1)Females tend to spend less money on sports participation (2)Age is negatively related to money expenditure on sports participation but positively related to sports participation (3)Education is positively related to money expenditure on sports participation (4) Employed people tend to spend more money on sports participation but tend to participate less in sports participation
Lera-Lopez and Rapun-Garate	2007	To analyse the socio demographic and economic determinants of sports participation and consumer expenditure on sports	700 representative adult sample (aged between 16-65 years) from Navarre, Spain	(1)Among only sports practitioners, sports participation was positively related to age, but negatively related to occupational categories (e.g. entrepreneur, self employed, farmer, middle manager) (2) For sample of both sports practitioners and non sports practitioners, female were negatively related but age was positively related with sports participation (3) Among only sports practitioners, money expenditure on sports was negatively related to female, but positively related to income , and occupational categories (i.e. skilled worker, manager, skilled worker) (4) For sample of both sports practitioners and non sports practitioners, female, and age were negatively related but income and education was positively related to money expenditure on sports
Tai et al.	1999	To examine the determining factors affecting drop-out of GP prescribed exercise schemes to prove if cost of	152 adults patient sample (16 -75 years) from south Islington (London), England	(1)The attendance to the exercise referral scheme particularly among those who considered 'lack of money' as a deterrent to their physical activity participation were not improved as they

Author(s)	Year	Aim(s)	Description of sample	Main findings
		these programmes is a determinant factor		were less likely to drop out of the exercise scheme after costs of attendance was reduced (2) Those ‘not knowing about local exercise facilities’ were 3.5 times more likely to achieve complete adherence to the exercise scheme
Coalter	2004	To explore participants’ attitudes to current entrance charges, value for money of activities and the extent to which participants reference price(expected price) for their activity could be changed by the provision of different types of information	1344 adults (aged 16 years and over) from Scotland	(1) 27% of individuals who reacted negatively to potential increases in entrance charges reported that an increment in entrance charge will deter them from doing any further sports (2)One third of respondents felt the entrance charges to sports facilities provided excellent ‘value for money’ and half rated the value for money as good. Only 4% thought the value for money of the entrance charges was poor (3)80% of participants in all sports activities except racquet/weight rated the entrance charges as having a good value for money (4)90% of people receiving concessionaries rated the entrance charges as having a good value for money
Downward	2004	To draw upon neoclassical economic theory, early post Keynesian, institutional and sociological analysis to offer original empirical insights from the UK using a qualitative choice analysis	4079 representative adult sample (aged 16 years and over) from UK	(1) Little support was found for income-leisure trade off regarding physical activity participation as the positive effect of income was only associated with ‘male oriented sports activities’, suggesting that the prediction of income and substitution may be gender specific (3) Drinking, and favourable health status were found to be positively related to physical activity participation (3)Age, and not being single are negatively related to physical activity participation
Davies	2002	To demonstrate that when sports related expenditure is obtained through consumer survey, financial expenditure on sports is found to be higher than when calculated from published data sources	1412 adult sample (over 18 years) from Sheffield, England	(1) Expenditure on sports in Sheffield from the consumer survey is 2.7 times greater than when captured from published data sources (2) admission and hiring of facilities accounted for a larger percentage of sports expenditure by frequent sports practitioners (3) Golf is the most spent on sports activity with running and cycling being the least spent on sports activities
Brown et al	2006	To determine if golf patrons treated travel costs as sunk costs or if they treated travel costs as bundled costs, when deciding to play a great (relatively expensive) course or an average (relatively cheaper) course	375 individuals from Ohio, US	(1) Travel cost associated with golf playing was treated as a bundled cost and not as a sunk cost (2) Evidence provided in support of Allan-Alchiam theorem suggesting that as travel cost is added to the cost of playing golf, the cost of relatively expensive golf courses become relatively cheaper for visiting golfers

Appendix 2.3.1 Review questions

Headings	Review questions
Description of studies	1. Authors 2. Year 3. Aim 4. Country 5. Which model(s) is the study based on?
Underlying theories	6. Definition of model 7. What are the assumptions? 8. Constructs of model 9. How are these constructs measured in practice?
Methods used	10. What population group/groups was used? 11. What was the sampling technique? 12. Source of data 13. Type of data analysis (including model diagnostics reported) 14. Was there an intervention? 15. If yes to (14), what type of intervention?
Empirical findings of studies	16. Do the results validate the model? 17. What are the main results?

Appendix 2.3.2 List of selected papers

BOCK, B.C., MARCUS, B.H., PINTO, B.M. and FORSYTH, L.H., 2001. Maintenance of physical activity following an individualized motivationally tailored intervention. *Annals of Behavioural Medicine,* **23**(2), 79-87.

CALFAS, K.J., LONG, B.J., SALLIS, J.F. and WOOTEN, W.J., 1996. A controlled trial of physician counselling to promote the adoption of physical activity. *Preventive Medicine: An International Journal Devoted to Practice and Theory,* **25**(3), 225-233.

DOWNS, D.S. and HAUSENBLAS, H.A., 2003. Exercising for two: examining pregnant women's second trimester exercise intention and behaviour using the framework of the theory of planned behaviour. *Women's Health Issues,* **13**, 222-228.

GREEN, B.B., MCAFEE, T., HINDMARSH, M., MADSEN, L., CAPLOW, M. and BUIST, D., 2002. Effectiveness of telephone support in increasing physical activity levels in primary care patients. *American Journal of Preventive Medicine,* **22**(3), 177-183.

HAGGER, M.S., CHATZISARANTIS, N., BIDDLE, S.J.H. and ORBELL, S., 2001(b). Antecedents of children's physical activity intentions and behaviour: Predictive validity and longitudinal effects. *Psychology & Health,* **16**(4), 391-407.

HAGGER, M.S., CHATZISARANTIS, N. and BIDDLE, S.J.H., 2001. The influence of self-efficacy and past behaviour on the physical activity intentions of young people. *Journal of Sports Sciences,* **19**(9), 711-725.

HASLER, T.D., FISHER, B.M., MACINTYRE, P.D. and MUTRIE, N., 2000. Exercise consultation and physical activity in patients with type 1 diabetes. *Practical Diabetes International,* **17**(2), 44-48.

MARTTILA, J. and NUPPONEN, R., 2000. Health enhancing physical activity as perceived in interviews based on the theory of planned behaviour. *Psychology & Health,* **15**(5), 593-608.

MUMMERY, W.K., SPENCE, J.C. and HUDEC, J.C., 2000. Understanding physical activity intention in Canadian school children and youth: an application of the theory of planned behaviour. *Research Quarterly for Exercise & Sport,* **71**(2), 116-124.

NORMAN, P., CONNER, M. and BELL, R., 2000. The theory of planned behaviour and exercise: Evidence for the moderating role of past behaviour. *British Journal of Health Psychology,* **5**, 249-261.

NORRIS, S.L., GROTHAUS, L.C., BUCHNER, D.M. and PRATT, M., 2000. Effectiveness of physician-based assessment and counselling for

exercise in a staff model HMO. *Preventive Medicine: An International Journal Devoted to Practice and Theory,* **30**(6), 513-523.

PAYNE, N., JONES, F. and HARRIS, P., 2002. The impact of working life on health behaviour: The effect of job strain on the cognitive predictors of exercise. *Journal of occupational health psychology,* **7**(4), 342-353.

PINTO, B.M., LYNN, H., MARCUS, B.H., DEPUE, J. and GOLDSTEIN, M.G., 2001. Physician-based activity counselling: intervention effects on mediators of motivational readiness for physical activity. *Annals of Behavioural Medicine,* **23**(1), 2-10.

ROSEN, C.S., 2000. Integrating stage and continuum models to explain processing of exercise messages and exercise initiation among sedentary college students. *Health Psychology,* **19**(2), 172-180.

SARKIN, J.A., JOHNSON, S.S., PROCHASKA, J.O. and PROCHASKA, J.M., 2001. Applying the transtheoretical model to regular moderate exercise in an overweight population: validation of stages of change measure. *Preventive Medicine: An International Journal Devoted to Practice and Theory,* **33**(5), 462-469.

SEVICK, M.A., DUNN, A.L., MORROW, M.S., MARCUS, B.H., CHEN, G.J. and BLAIR, S.N., 2000. Cost-effectiveness of lifestyle and structured exercise interventions in sedentary adults: Results of Project ACTIVE. *American Journal of Preventive Medicine*, **19**(1), 1-8.

SHEERAN, P. and ORBELL, S., 2000. Self-schemas and the theory of planned behaviour. *European Journal of Social Psychology,* **30**(4), 533-550.

SMITH, B.J., BAUMAN, A.E., BULL, F.C., BOOTH, M.L. and HARRIS, M.F., 2000. Promoting physical activity in general practice: a controlled trial of written advice and information materials. *British Journal of Sports Medicine,* **34**(4), 262-267.

STEPTOE, A., KERRY, S., RINK, E. and HILTON, S., 2001. The impact of behavioural counselling on stage of change in fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease. *American Journal of Public Health,* **91**(2), 265-269.

Appendix 2.3.3 Summary of reviewed papers

Models	Authors	Year	Country	Aims	Sample	Main findings
Theory of Planned Behaviour	Hagger et al.	2001	UK	To examine the differential effects of 2 control-related constructs (ie. perceived behavourial control and self-efficacy) on the physical activity behaviour of young people	1152 school pupils aged between 13.5 mean years from government run schools	1.Young people tend to engage in physical activity to have fun 2. Perceived behavioural control (PBC) has a significant relation with barriers like bad weather and others. This means PBC is related to external barriers whereas self-efficacy is largely influenced by internal barriers 4. Intention to engage in physical activity is influenced by attitudes, PBC but subjective norms had no influence 5.Self efficacy has a strong influence on physical activity intention 6.Past behaviour predicts intention via self efficacy and the constructs of TPB
	Sheeran and Orbiell	2000	UK	To explore the implications of self-schemas for TRA and TPB	163 Undergraduates students from UK university	1.The variables of TPB and self schema were all correlated to the intention to exercise 2.TPB better explains the intention to exercise than TRA 3. Schematics are more likely to follow their intention to exercise into behaviour than non schematics. Also schematics exercised more than non schemas if the 2 groups are to uptake exercise behaviour 4. Past behaviour was related to physical activity participation
	Hagger et al (b)	2001	UK	1.To examine the construct and predictive validity of the TPB in physical activity among children 2.To test how previous experiences influences TPB variables regarding children	565 (411 and 154 for study 1 & 2 respectively) high school pupils aged between 12 and 14 years in England	1. Past behaviour was significant predictor of attitudes 2.Intention was a significant predictor of behaviour 3.Intentions to engage in physical activity is a function of attitudes and not perceived behavioural control 4.The physical activity behaviour of children was affected by past behaviour and attitudes
	Norman et al	2000	UK	To examine the social psychological determinants of exercise behaviour as outlined in TPB in the context of health promotion	87 patients attending health promotion clinics on diet, smoking and exercise with mean age of 43.9 years	1.Percieved behavioural control had the strongest correlation with exercise intention 2.Subjective norm has a non-significant correlation with intention to exercise 3.Attitude, past behaviour had significant correlations with exercise intention 4.Future exercise behaviour was significantly correlated

Models	Authors	Year	Country	Aims	Sample	Main findings
						with intention, perceived behavioural, past behaviour and attitude 5.Subjective norms was not significantly correlated with future behaviour 6.Past behaviour largely influenced future exercise behaviour than the main constructs of TPB 7. Past behaviour was found to moderate the strong relationship between PBC and exercise behaviour, if past behaviour was high. However, if past behaviour was low, it had no moderating effect on the relationship 8. Generally, TPB was able to predict exercise intention and behaviour
	Downs and Hausenblas	2003	US	To examine prospectively the TPB's utility for explaining pregnant women's exercise intention and behaviour from the 2nd trimester to the 3rd trimester	89 pregnant women aged between 22 and 43 years	1.Attitude and PBC were strongly correlated with exercise intention; followed by subjective norm 2.Intention was a significant predictor of exercise behaviour 3.Percieved behavioural control was not a significant predictor of exercise behaviour , therefore it's the motivation to exercise not the perceived barriers that determine a pregnant woman's exercise behaviour during the 2nd and 3rd trimester) 4.TPB was found to be capable of explaining exercise behaviour in pregnant women between the 2nd and 3rd trimester
	Payne et al	2002	UK	1.To investigate how accurately exercise intentions and behaviour can be predicted by the TPB 2.To explore the relationship between TPB variables and the job strain models variables	213 employees of a UK company involved in design, marketing and sales of computer software and hardware. Age between 16 and 55 years/over	1.The constructs of TPB aside subjective norms were significantly correlated to intention and behaviour to exercise 2.Intention was the construct with the strongest correlation with exercise behaviour followed by self efficacy 3. High strain workers reported less exercise levels had low self efficacy and low PBC as compared to low strain employees. This difference had nothing to do with the intention to exercise, perhaps the possible explanation is the job barriers that affected the high strain workers to exercise less 4.Self efficacy was the dominant predictor of exercise intention followed by attitude 5.Subjective norms and PBC had significant influences on the intention to exercise 6. TPB was able to explain physical activity behaviour 7.Work affects exercise behaviour in 2 ways: it creates

Models	Authors	Year	Country	Aims	Sample	Main findings
						barriers to exercise that affects self efficacy and intention; work demands affect the implementation of exercise intention into behaviour
	Mummery et al	2000	Canada	To investigate the efficacy of TPB in predicting physical activity intention in Canadian children and youth	746 school pupils with ages between 8 and 16 years	1.Attitude towards physical activity and subjective norms were significant in predicting physical activity intention 2.PBC was the predictive construct that predicts physical activity behaviour followed by attitude and subjective norms 3. TPB is effective in predicting exercise behaviour than TRA 4.Subjective norm has a high influence on physical activity at a young age 5.Girls have higher physical activity intentions than boys 6.PBC was the highest predictor of physical activity intention among girls whereas attitude was the highest predictor of physical activity intention among boys
	Martilla and Nupponen	2000	Finland	To operationalise the components of TPB through interview and find out how the results are compatible with the theory	50 people aged between 42-44 years	1.Subjects indicated normative influence on their Outdoor Exercise Activity(OEA) but on Everyday Commuting Activity(ECA) 2.People who engaged in OEA has a high level of perception of benefits related to mental well being (ie psychological stimulation, recreation, pleasurable positive experiences of nature and fresh air) whereas those who do not practice OEA emphasised more perceived benefits regarding physical health like physical appearance, enhance health and fitness or as a weight reducer. 3.People engaged in OEA mentioned more barriers than those who were not engaging in OEA 4. Those with regular ECA mentioned diverse benefits like personal benefits and reduces pollution as well promoting well being in the community 5.Inactive people had negative attitude towards OEA compared to the active ones 6.OEA was associated with fewer barriers and many positive outcomes than ECA 7.TPB was more compatible with OEA than ECA
Trans theoretical Model	Greene et al	2002	US	To examine the effectiveness of a telephone-based intervention to increase physical activity among	316 patients aged between 20 and 65 who exercised less than 15 minutes per day and wanted to increase their level of exercise	1.The intervention and control groups showed no difference between them regarding the confidence to increase exercise 2.Intervention group showed a higher level of exercise as compared to the control group after the 6 months follow-up

Models	Authors	Year	Country	Aims	Sample	Main findings
				sedentary people who wanted to increase their physical activity in the next 6 months		period 3.Telephone behavioural counselling is effective in increasing exercise among people
	Calfas et al	1996	US	To test the efficacy of brief physician-based counselling to increase physical activity	17 physicians; Sedentary 255 adults (39 year mean age)	1. Intervention group reported increased physical activity compared to the control group. A total of plus 37 minutes/week was found for the intervention group compared to plus 7 minutes/week for control group 2. Movement from the contemplation stage to the active stage was significantly positive for the intervention group(p<0.001) 3. The positive intervention effect was found for both self report and objective measure(accelerometer)
	Smith et al	2000	Australia	To investigate the impact of a simple written prescription for physical activity given by a GP and the effect of supplementing with mailed information materials about physical activity	1142 patients who were between 25-65 years and active/inactive. 55 GP were also involved	1.Average change in total minutes of physical was positive in the intervention groups at 6-10 weeks follow up but non-positive in the control group 2.More subjects in the intervention group increased physical activity by 60mins/week than those in the control group 3.A prescription for physical activity from a GP supplemented by additional mailed information booklets led to short term increment in physical activity for the inactive patients 4.Prescription alone from GP was not effective in increasing physical activity
	Bock et al	2001	US	To examine the maintenance of physical activity during the 6 months following the end of an active intervention period	150 sedentary employed middle class married non-smokers and were educated at least through the 12th grade with a mean age of 44.3 years	1.The IT group(i.e. the group were given self -help manuals to match a person's stage of readiness for exercise and individually tailored feedback reports) increased time for physical activity more than the ST group(i.e. had only manuals on physical activity that were not matched to the individual stage), during the whole active intervention period 2. IT group reported more time for physical activity than the ST group during the 6 month follow up period after the intervention period. Though the difference in the increment in physical activity was not largely significant, the IT group were more likely to be in the maintenance stage or action stage as compared to the ST group 3. Repeated use of manuals can lead to an increase/maintenance in physical activity behaviour. However, the specific manuals tailored to the needs of the

Models	Authors	Year	Country	Aims	Sample	Main findings
						person is more effective than more general manual
	Hasler et al	2000	Scotland	To evaluate the effectiveness of the exercise consultation in increasing the physical activity levels of a small group of patients with type 1 diabetes	22 type 1 insulin dependent diabetic patients with a mean age of 33 years	1. Physical activity at work increased marginally for both control and intervention groups at the 3weeks follow up 2.The increase in leisure time physical activity for the intervention group was statistically significant at follow up in 3 weeks but control group experienced a reduction in their leisure time physical activity(not significant though) 3.The exercise consultation was found to be effective in encouraging people to move up in the stages of physical activity behaviour
	Sarkin et al	2001	US	To examine the validity of TTM to regular moderate exercise in an overweight population	670 adults (mean age of 50.9)	1. Decisional balance and self efficacy had significant relationship with physical activity ($p<0.001$) 2.Action and maintenance groups had significantly higher scores than precomtemplation, contemplation and preparation 3.Precontemplators had a significantly lower scores on the pros than people in the advanced stages($p<0.001$) 4.Those in maintenance stage had significantly high self efficacy than those in the other stages below ($p<0.001$)
	Steptoe et al	2001	UK	To assess stages of change in fat intake, physical activity and cigarette smoking during a randomised controlled trial of behavourial counselling	883 patients the ages was between 44 and 51 years	1.At baseline, few patients in pre-contemplation stage but more in the preparation stage in the intervention vs. control group 2.At 4 months and 12 months; there was a large increase of the people in the action/maintenance stage in the intervention group vs. control group 3.The counselling based on TTM was effective in leading people to progress in the stages of physical activity behaviour
	Norris et al	2000	US	To carry out a randomized controlled trial to assess the impact of PACE (physician based assessment & counselling for exercise) on self-reported physical activity levels	812 patients with mean age of 50.4 mean	1.At 6 months follow up, there was not a significant difference between the intervention and the control group regarding energy expenditure and physical activity change 2. One time PACE counselling is not effective in increasing physical activity

Models	Authors	Year	Country	Aims	Sample	Main findings
Mixed theories	Rosen	2000	US	Combines concepts from TTM, TPB and Elaboration Likelihood Model(ELM) to help understand the readiness for exercise	134 White/Asia American undergraduate and graduate students who were not exercising regularly but many of whom had been active exercisers before	1.Students in the preparation stage reported more regular exercises than those in the precomtemplation/contemplation stage at the follow up period 2. Students with positive attitude towards exercise portrayed strong processing of exercise messages on the measures of elaboration. There is however no difference among people in different stages on information processing 3.Intent has a strong impact on later behaviour of students in the preparation stage than those in the contemplation stage 4.Combination of TTM, ELM & TPB provided a thorough understanding of exercise readiness
	Sevick et al	2000	US	To evaluate the effectiveness of the exercise consultation in increasing the physical activity levels of a small group of patients with type 1 diabetes	235 sedentary men and women aged between 35 and 60 years	1.The intervention group had significant improvements in physical activity and cardio respiratory fitness between the baseline and 24 months 2.At 6 months and 24 months, the lifestyle intervention arm (subjects were taught behavioural skills to improve physical activity in their daily lives) was more cost effective than the structured exercise program (physical activity was supervised, and centre based)
	Pinto et al	2001	US	To investigate the effects of PAL(a medical office based activity counselling based on TTM for adults patients) intervention on the hypothesised mediators of behaviour change at 6 weeks and 8 months	34 GP's , 355 patients on routine visits with mean age of 65.6	1.The intervention group had a significant change in their decisional balance to exercise and exercise self efficacy after 6 weeks 2.There was a significant improvement in the application of behaviour processes by the intervention group at the end of 6 weeks 3. At the end of 8 months, the intervention group had experienced a significant improvement in the application of behaviour process (i.e. stimulus control). There was no significant changes in the other constructs like self efficacy and decisional balance 4.Decisional balance and behavioural processes had mediating effects on physical activity behaviour after 6 weeks 5.Self-efficacy, decisional balance and behavioural processes were only influenced by the intervention (based on TTM) after 6 weeks follow up

Appendix 2.3.4 Detailed description of psychological models

Theory of Reasoned Action (TRA) / Theory of Planned Behaviour (TPB)

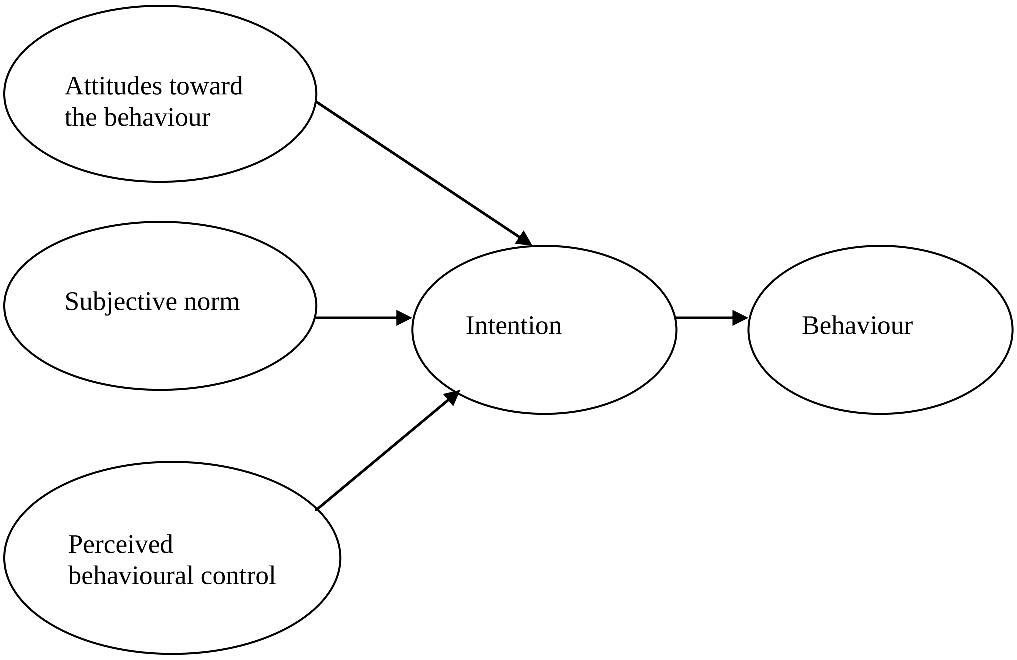
Propounded by Ajzen and Fishbein (1980), the TRA aims at explaining and predicting volitional behaviour. The general assumption of TRA is that human behaviour is under volitional control. This theory offers a systematic explanation to human behaviour and states that a persons' behaviour is first determined by his intention to perform that behaviour. For example if one is willing to engage in physical activity three times a week, one is likely to do it. The intention in turn is a function of a person's attitude towards that behaviour as well as the expectations, people important to that person hold about the behaviour in question. The latter construct is referred to as subjective norms.

The attitudes towards behaviour are determined by an individual's belief that behaviour will lead to certain outcomes, and the evaluation of those outcomes (i.e. benefits or costs). If the individual thinks the perceived benefits outweigh the perceived costs related to that behaviour then he is likely to have positive attitudes towards that behaviour and vice versa. Subjective norms are also a function of the beliefs an individual has about what the 'significant people' to him think about his intended behaviour. Hence if a person believes that people important to him do not favour his performance of certain behaviour, he is unlikely to perform that behaviour.

Applying the TRA to physical activity, we can surmise that a person is likely to do physical activity if he is willing (i.e. intends) to do it. However, he will only be willing (i.e. intend) to do physical activity, if he perceives that doing physical activity will give him benefits that outweigh the associated costs (i.e. positive attitudes), or/and if people important to him favours his intended physical activity behaviour. The perceived benefits related to physical activity participation may include *'to stay fit and in shape'; 'to improve skills'; 'to enhance physical appearance'; 'to enhance health'; 'to lose weight'; 'to have fun' 'pleasurable positive experiences of nature and fresh air'; 'to improve skills'; 'psychological stimulation'* (Martilla and Nupponen 2000; Hagger et. al 2000; Mummery et al. 1999; Norman et al. 2000).

The framework of TRA has a limitation as it only applies to volitional behaviour (Ajzen and Madden, 1986). This drawback led to the introduction of the theory of planned behaviour (TPB). TPB is the same as TRA but with an additional construct known as ‘perceived behaviour control’. This construct indicates that the intention to perform certain behaviour is further determined by the individuals’ belief in his ability to do the activity amidst potential barriers to that behaviour. Thus the TPB postulates that individual behaviour is determined by the intention to perform that behaviour, which is a function of his attitudes towards that behaviour, what his ‘significant others’ think about the intended behaviour (i.e. subjective norms), and his belief in his ability to do that activity (i.e. perceived behavourial control). We consider a diagrammatic representation of the framework of TPB below in figure 2.3.4.1:

Fig. 2.3.4.1 Theory of Planned Behaviour



Source: Sport England (2005)

The Transtheoretical Model (TTM)

The TTM explains human behaviour by describing the decision making process undertaken by individuals to acquire new behaviour (Proschaka and Di Clemente

1982). This theory assumes that the decision to undertake a new behaviour evolves 6 main stages:

- *Stage 1: Precontemplation*: This stage indicates when the individual is unaware that his current behaviour is a problem or has not considered a change in behaviour. For example when an inactive person has not realised that his lack of physical activity has bad consequences or he does not intend to do physical activity.
- *Stage 2: Contemplation:* The individual is now aware of the potential benefits of his intended behaviour and therefore considering modifying his behaviour. For example the inactive person is now aware that his physical inactivity is an unhealthy behaviour and that doing physical activity can help him to stay healthy and is therefore considering engaging in physical activity.
- *Stage 3: Preparation:* The individual is at the latter stages of modifying his behaviour and thus finalising plans to commence a new behaviour. For example the inactive person inquires about gym fees and places to engage in physical activity.
- *Stage 4: Action*: The individual commences his new behaviour. For example the inactive person starts going to the gym to engage in physical activity.
- *Stage 5*: *Maintenance*: The individual continues with his new behaviour. For example the 'inactive person' is regularly going to the gym to engage in physical activity.
- *Stage 6*: *Termination:* This is final stage of behaviour change or adoption and it describes when the individual can defy any potential relapses in his new behaviour. For example the 'inactive person' is able to overcome barriers to his participation in physical activity

The movement through the stages of behavioural changes is not stationary. An individual can move from say precontemplation to contemplation; backslide to precontemplation before progressing or vice versa. The TTM further postulates that the movement through the stages of behaviour change is mediated by three factors:

1. *Decisional balance*: This involves the comparison of perceived costs and perceived benefits of the intended behavourial change. A progressive movement is often contrived when the perceived benefits outweigh the perceived cons of the intended behavourial change. The decisional balance construct is most critical at the contemplation stage (i.e. when the individual is considering making the decision to engage in physical activity).
2. *Self efficacy*: This describes the ability of the individual to sustain his/her behavourial change in spite of the barriers that can lead to regression to another stage of behaviour change.
3. *Processes of change*: The processes of change explain how the transition through the stages of behaviour change occurs. It involves the techniques individuals employ to change thoughts, feelings and behaviour. In all, 10 processes of change assumed to be undertaken to ensure transition thorough the stages of behaviour change. These 10 processes of change are divided into *experiential processes* and *behavourial processes*. The *experiential processes* of change include:
    - *Consciousness raising*: Increasing the awareness and knowledge about the current ‘risky behaviour’
    - *Dramatic relief*: The arousal of emotions about the current ‘risky behaviour’. Usually this involves experiencing the negative emotions (e.g. worry and sadness) associated with the current ‘risky behaviour’.
    - *Environmental revaluation*: Assessing the consequences of the current ‘risky behaviour’ on the individual’s social and physical environment.
    - *Self revaluation*: Assessing the emotions associated with the intended behavourial change from the current ‘risky behaviour’. These are usually positive emotions (e.g. joy and happiness)

- *Self liberation*: The choice and maintenance of an activity to modify the current 'risky behaviour'.

The *behavourial processes* of change are:

- *Reinforcement management*: Rewarding positive behavourial changes
- *Helping relationship*: Soliciting for social support by engaging in discussions about the current 'risky behaviour' , with other people who tend to provide support for the intended behavioural change
- *Counter conditioning*: The substitution of the current 'risky behaviour' with an alternative positive behaviour.
- *Stimulus control:* Employing measures (i.e. removing or avoiding it) to manage a reminder that is capable of leading to a relapse in behaviour
- *Social liberation:* Becoming aware of societal efforts to eradicate the current 'risky behaviour' in society.

Figure 2.3.4.2 provides a schematic presentation of how the transition between the stages of behaviour is facilitated by the processes of change, indicating the particular transitions between stages of behaviour where particular processes are likely to occur.

Fig. 2.3.4.2 Stages of behaviour and processes of change: Transtheoretical Model

Precontemplation – Contemplation – Preparation – Action – Maintenance

Consciousness raising;
Dramatic relief;
Environmental
re-evaluation;

Self-revaluation

Self-liberation

Counter conditioning;
Helping relationships;
Reinforcement management;
Stimulus control;

Source: Prochaska (1985)

Elaboration Likelihood Model (ELM): The elaboration likelihood model explains human behaviour by describing how attitudes towards an intended behaviour change are formed. The underlying assumption is that behavourial change is determined by attitudes towards that behaviour, and that these attitudes are formed through *persuasion.* For example, for a sedentary person to start physical activity he/she should possess positive attitudes towards physical activity, and that these attitudes can be formed if he is persuaded. According to the theory, there are two main ways of persuasion: *central route and peripheral route.*

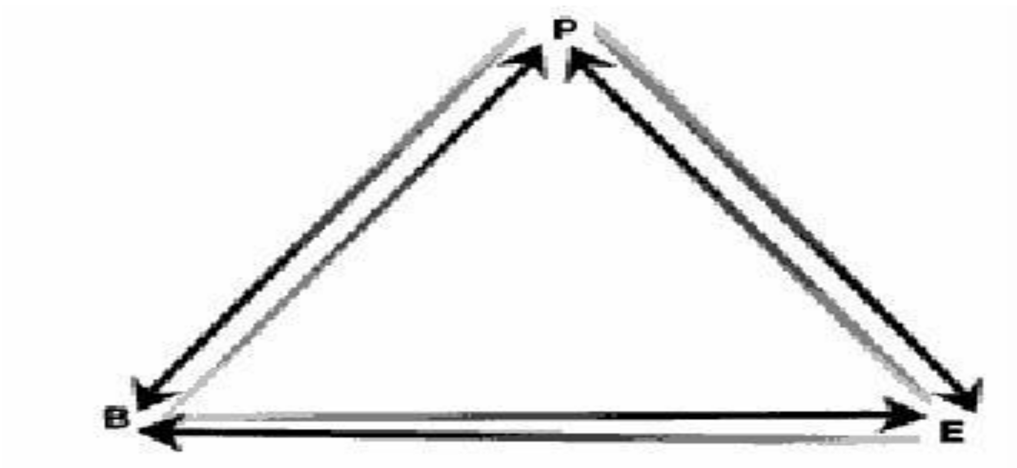
- *Central route:* This occurs when the individual is interested in the message being preached to persuade him to have positive attitudes towards say physical activity and be active, and therefore pays attention and listens well.

- *Peripheral route:* This occurs when the individual does not focus on the message but rather on the other 'unrelated' things such as say his dislike or like for the person who preached the message.

The basic conclusion of this model is that a behaviour change that is acquired through the central route of persuasion is likely to be permanent whereas that behaviour change is likely to be temporary if it was facilitated via the peripheral route of persuasion (Petty and Cacciopo, 1986). Therefore, say public health campaigns to improve physical activity behaviour ought to strategise to capture the full attention and interest (i.e. central route) of the audience.

Social Cognitive Theory (SCG): This theory was propounded by Bandura (1977) to offer a comprehensive framework of understanding human behaviour. The theory explains human behaviour primarily from a triadic interaction of the individual (i.e. personal factors), behaviour and environmental influences. The triadic interaction as shown in Figure 2.3.4.3 is bi-directional and facilitates the uptake of behavioural change.

Fig.2.3.4.3 Triadic interaction of personal factors, behaviour, and environmental influences



B: behavior, P: personal factors, E: environmental influences
Source: Bandura (1986)

The assumption is that individuals learn to uptake behavourial change through personal experiences, observation of the behaviour of others as well as the expected outcomes of that behaviour. According to the theory the following constructs (as described in Table 2.3.4.1) entailing personal and environmental factors determine behaviour change:

Table 2.3.4.1 Constructs of SCG

Construct	**Description**	**Example**
Reciprocal Determinism	An intended behaviour change is formed via the aforesaid triadic interaction which is dynamic and bi-directional	An individual works together with people close to him (social environment) to change his sedentary behaviour
Behavioral Capability	Requisite knowledge and skills are needed by an individual to facilitate behaviour change	An individuals has information about how to do physical activity
Expectations	Awareness about the expected outcomes (i.e. perceived benefits and cons) of the intended behaviour	An individuals is aware of the expected outcomes of physical activity participation
Emotional coping responses	The ability to cope with the arousal of emotions related to the behavioural change	An individual is able to cope with say the stress associated with doing physical activity
Self-Efficacy	Ability of the individual to sustain his/her behavourial change in spite of the barriers	An individual is confident he can do physical activity in spite the potential barriers such as 'fear of injury'.
Observational Learning	Formation of beliefs about an intended behaviour based on observation of others performing that behaviour	An individual is aware of the benefits that another person had obtained from doing physical activity
Expectancies	The values individuals place on the expected outcomes of the intended behaviour	An individual values the expected outcomes of the physical activity participation
Reinforcement	Rewards or punishment that are triggered anytime the intended behaviour is performed or not, tend to facilitate a relapse or maintenance	An individual is rewarded by others or others whenever he/she say goes to the gym.

Appendix 2.4.1 Search terms

Database	Search terms	Titles/ abstracts screened	Selected papers
SCOPUS	("physical activit*" OR sport OR "keep-fit" OR "keep fit" walking OR walk OR swimming OR swim OR cycle OR cycling OR aerobic OR jogging OR jog OR running OR dancing OR dance OR gym* OR fitness OR exercise OR exercising) AND (benefit OR utility OR outcome OR valu*)	8652	26
SPORTS DISCUSS	("physical activit*" OR sport OR "keep-fit" OR "keep fit" walking OR walk OR swimming OR swim OR cycle OR cycling OR aerobic OR jogging OR jog OR running OR dancing OR dance OR gym* OR fitness OR exercise OR exercising) AND (benefit OR utility OR outcome OR valu*)	796	18
Other sources	N/A	3	0
Total		9451	44

Appendix 2.4.2 Review questions

Headings	Review questions
Background information	1. Authors 2. Year 3. Aim
Identified perceived benefits	4. Which perceived benefits were found? 5. How were they specified in practice? 6. Which population were they sourced from
Description of techniques	7. How was physical activity specified in practice? 8. What population group/groups is the model focused on? 9. What is the sample size? 10. Any statistical basis for sample size used? 11. What is the sampling method used? 12. Source of data 13. Type of data analysis used 14. Type of statistical model used (if quantitative analysis) 15. Any tests of statistical model used?
Correlates of physical activity behaviour	17. Main findings 18. Strengths(Author stated) 16. Weaknesses (Author stated)

Appendix 2.4.3 List of selected studies

CHINN, D.J., WHITE, M., HOWEL, D., HARLAND, J.O. and DRINKWATER, C.K., 2006. Factors associated with non-participation in a physical activity promotion trial. *Public Health,* **120**(4), 309-19.

FLINTOFF, A. and SCRATON, S., 2001. Stepping into Active Leisure? Young women's perceptions of active lifestyles and their experiences of school physical education. *Sport, Education and Society,* **6**(1), 5-21.

GILLISON, F.B., STANDAGE, M. and SKEVINGTON, S.M., 2006. Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: A self-determination theory approach. *Health Education Research,* **21**(6), 836-847.

JONES, F., HARRIS, P. and WALLER, H., 1998. Expectations of an exercise prescription scheme: an exploratory study using repertory grids. *British Journal of Health Psychology,* **3**(3), 277-289.

JONES, F., HARRIS, P., WALLER, H. and COGGINS, A., 2005. Adherence to an exercise prescription scheme: the role of expectations, self-efficacy, stage of change and psychological well-being. *British Journal of Health Psychology,* **10**, 359-378.

MULLINEAUX, D.R., BARNES, C.A. and BARNES, E.F., 2001. Factors affecting the likelihood to engage in adequate physical activity to promote health. *Journal of Sports Science,* **19**(4), 279-88.

MULVIHILL, C., RIVERS, K. and AGGLETON, P., 2000. Views of young people towards physical activity: determinants and barriers to involvement. *Health Education,* **100**(5), 190-199.

ROBERTSON, S., 2003. 'If I let a goal in, I'll get beat up': Contradictions in masculinity, sport and health. *Health Education Research,* **18**(6), 706-716.

STATHI, A., MCKENNA, J. and FOX, K.R., 2004. The experiences of older people participating in exercise referral schemes. *Journal of Royal Society Promotion Health,* **124**(1), 18-23.

USSHER, M., STANBURY, L., CHEESEMAN, V. and FAULKNER, G., 2007. Physical activity preferences and perceived barriers to activity among persons with severe mental illness in the United Kingdom. *Psychiatric Services,* **58**(3), 405-408.

ZUNFT, H.J., FRIEBE, D., SEPPELT, B., WIDHALM, K., REMAUT DE WINTER, A.M., VAZ DE ALMEIDA, M.D., KEARNEY, J.M. and GIBNEY, M., 1999. Perceived benefits and barriers to physical activity in a nationally representative sample in the European Union. *Public Health Nutrition,* **2**(1A), 153-60.

Appendix 2.4.4 Summary of reviewed papers

Author (s)	Year	Aim(s)	Description of sample	Main findings
Gillison et al.	2006	To assess the prevalence of extrinsic exercise goals in an adolescent sample and examine a model of psychological processes aligned with self determined theory, linking these to leisure time exercise and quality of life	580 participants (300 boys with mean age of 14.06 years) from south west England.	(1) Boys tend to engage in more physical activity than girls (2) Girls are more likely to report extrinsic benefits (e.g. weight control, body tone, to be attractive) of physical activity participation than boys. (3)The perceived benefit content of physical activity have an influence on leisure time physical activity behaviour
Mullineaux et. al.	2001	To assess the likelihood of individuals to participate in enough physical activity to promote fitness and more conservatively to accrue only health benefits.	4316 representative adult English sample (mean age of 44 years (SD: 16))	(1) Age had the greatest influence on physical activity participation (2)Having a high recognition of the benefits accruable from physical activity participation was positively related to physical activity participation (3)High educational level is positively related to physical activity participation
Fiona et al.	2005	To clarify the role of expectations, self efficacy and stress as predictors of adherence to an exercise scheme	152 participants (aged between 34 and 55 years and above ; 64 males) from the south of England	(1) Participants made extravagant claims about their current levels of physical activity even when they had acknowledged it was inadequate (2)Participants had high expectations about the amount of change they expected from participating in the exercise scheme. (3)Though there was no statistical difference between completers of the exercise scheme vs. non completers with respect to their expectations about health and fitness benefits of the exercise scheme, the non completers were found to have higher expectations about feeling independent, and self confident (4)Those aged 55 years or above were more likely to complete all the 24 sessions of the exercise scheme as compared to relatively younger people
Stathi et al.	2004	To offer insights into how physical activity is situated in notions of successful ageing of people participating in exercise referral schemes and to highlight points for achieving client-based targets through exercise referral schemes	13 participants(aged between 63-79 years; 5 females; retired) from south west England	(1)Some participants recognised professional help and psychological support of the exercise specialist as facilitating factors for progression (2)Most of the participants enjoyed exercising in a secure environments with exercise specialist taking care of them though some did not like the structured type of exercise (3)The participants perceived both health and non health benefits related to physical activity participation
Mulvihill et al.	2000	To provide using qualitative methods; new data on the reported	103 participants (aged 11-15 years; 51 males) and 10 parents of these children. All	(1)The males tended to be actively involved in after and during school physical activity and were also likely to be

Author (s)	Year	Aim(s)	Description of sample	Main findings
		drivers and barriers to physical activity among young people	participants from north; midlands and south of England	members of sports clubs (2) The participants expected psychological benefits; social and physical health benefits from physical activity participation (3) The influence of parents in physical activity levels of their children was low, as their children tend to do physical activity on their own initiative (4) The social aspects of physical activity participation was important to the children as they would rather engage in physical activity with friends (5) Barriers to physical activity participation were identified as: cost of participation (including travel cost); feeling embarrassed and self conscious about their body(especially female); lack of time
Ussher et al.	2007	To assess physical activity interests among psychiatric patients	120 psychiatric patients (mean age of 42 years; 58% males; 68% white; 82% unemployed; 58% smokers) from southwest London	(1)The most cited reasons for not exercising were fatigue, illness, and bad weather (2)Majority of respondents perceived physical activity as having physical and mental health benefits (3)Gender(male) was positively related to self efficacy for exercise (4)The participants were highly motivated to do regular physical activity but self efficacy was low
Robertson	2003	To present a critical exploration of the relationship between masculinity, sports and health by reporting findings from a wider qualitative study on lay men's and health professionals beliefs about masculinity and preventive health care	20 men (aged between 27 and 43 years; comprised of straight, gay and disabled men) from north west England	(1)Sports was seen as having 'social benefits' of fostering companionship (2) For disabled men; sports provide chance to become involved in politics by knowing the lack of access to facilities provided to disabled men and then further discuss this with the politicians (3)Participants provide 'stress relief' (4) Barriers to doing sports is 'I am never good at them' mostly cited by some men who were not doing any sports (5) Also that sports is surrounded with 'macho' characteristics deters some men to do it (6)Sports participation was seen as leading to 'health injuries' (7)'Macho culture' of sports affected men's decision to do sports or not and what type of sports to do. For gay men who participated in sports avoiding team sports was a means to avoid potentially abusive or dangerous situations
Flintoff et al.	2001	To explain why women often opt out of physical education but tend to participate more in activity out of	21 participants(15 year old women) from north eastern England	(1)Young women tend to engage in physical activity for short term benefits (e.g. to meet friends; to learn new skills; weight loss) rather than longer term health benefits

Author (s)	Year	Aim(s)	Description of sample	Main findings
		school, and specifically to explore the perceptions of women towards physical activity		(2)The participants were found to be involved in physical activity both in and out of school (3)The participants are involved in a wider range of physical activity (4)Participants were influenced by their gender in their choice of type of physical activity; where participation is undertaken , and with whom
Zunft et al.	1999	To examine the attitudes of consumers in particular their perceived benefits and barriers to physical activity from all the members states of the European Union, and having a measure of prevailing levels	1250 adults(15 year plus) from UK	(1)Participants expected both health and non health benefits of physical activity participation (2)Women were more inclined to expect ‘to maintain good health’; younger people educated to tertiary level tended to expect ‘to get fit’, and ‘to release tension’ were likely to be cited by ‘younger and middle aged’ (3)Higher educated people were more likely to choose ‘to release tension’ (4)Age had a positive influence on physical activity participation
Fiona et al.	1998	To explore participants exercise-related constructs, their expectations of change on these constructs and the extent to which this predicts adherence	15 participants (11 women)	(1) Participants with modest expectations about exercise scheme were more likely to complete the entire session of the scheme (2)Participants with high outcome expectations were less likely to complete the exercise scheme
Chinn et al.	2006	To compare characteristics, knowledge and attitudes to physical activity participation in participants and non participants of a physical activity intervention trial in primary	353 participants (mean age of 51.4 years (SD: 7.0); 995 white; 40%men; 36% smokers) from Newcastle upon Tyne.	(1) Non participants were more likely to be smokers and live in deprived area, and likely to have low education (2) Far fewer non participants expected health and non health benefits of physical activity participation (3) The most cited barriers to physical activity participation were: time constraints, self image

Appendix 3.1 List of organisations and individuals contacted

National Centre for Social Research (NATCEN) (*runs the Health Survey for England*)

British Market Research Bureau (BMRB) (*runs the Taking Part Survey*)

Sports England (*runs the Active Life Survey*)

Peter Taylor, *Professor of Sport Economics, Co-Director of Sport Industry Research Centre, and Consultant on the economics of sport and leisure markets Sheffield Hallam University, England*

Nick Rowe, *Head of Research, Sport England*

Laura Clayton, *Research Manager , Sport England*

Emmanuel Stamatakis, *Senior Research Fellow, Department of Epidemiology and Public Health, University College of London, England*

Charlie Foster, *Senior researcher, British Heart Foundation Health Promotion Research Group, University of Oxford, England*

Steven Allender, *Senior researcher, British Heart Foundation Health Promotion Research Group, University of Oxford*

Catherine Musgrave, *Data & Support Services Assistant ,UK Data Archive*

Nick Cavill, *Principal Consultant, Cavill Associates, Health Promotion Consultants, England*

Themis Kokalakis, *Research Fellow, Sheffield Hallam University, England*

Paul Downward, *Senior lecturer in Sports Economics, Institute of Sport and Leisure Policy, Loughborough University, England*

Brad Humphreys, *Chair in the Economics of Gaming, University of Alberta, Canada*

Marijke Taks, *Associate Professor of Sport Management, University of Windsor, Canada*

Fernando Lera-Lopez, *Department of Economics, Public University of Navarra, Spain*

Appendix 3.2 Content of questionnaire (TPS 2008)

Content	Main question areas
Sports	1. Identification of the type of sports or exercise the respondent does? 2. Frequency of participation: how many days per month 3. Duration of participation: How long did you usually do it for? 4. Intensity of participation: Pace of participation enough to take your breath away? 5. Received tuition on participation? 6. Member of a health/fitness club? 7. Reasons for doing sports? 8. Barriers to sports participation 9. Availability of sports facility in neighbourhood? 10. Intend to do more sports /exercise? 11. What will encourage you to do more? 12. Do you have influence on the quality of sports facilities in your area? 13. Have done anything to improve the sports facilities? 14. Have you ever been asked to express your views about the quality of sports facilities in your area? 15. Has UK's success in winning the bid to host 2012 Olympics encouraged you to do more sports?
Walking	1. Frequency of participation: how many days per month 2. How many days did you walk for the purpose of health or recreation in the last month? 3. Intensity: how would you describe your walking pace? 4. Intend to do more walking? 5. What will encourage you to do more?
Cycling	1. Frequency of participation: how many days per month 2. How many days did you cycle for the purpose of health or recreation in the last month
Others	1. Participation in volunteering activities 2. Encouraged to do/visit (when aged 12-15 years) sports; museum; heritage places; music; read books e.t.c 3.Frequency of present participation with regards to royal parks; museum; theatre; historic places; crafts & drama; play musical instruments 4. spectatorship of sport
Demographics/health	Age ; Personal income; Number of adults in household; gender; education; employment status; type of tenureship of accommodation; car ownership in household; self report of health status; smoking status; drinking status; ethnicity; ethnicity;
Social capital	General questions about self assessment of area of residence

Appendix 3.3 Content of questionnaire (HSE 2008)

Content	Main question areas
Sports	1. Identification of the type of sports or exercise the respondent does? 2.Frequency of participation: how many days (with each occasion lasting at least 10 minutes) per month 3. Duration of participation: How long did you usually do it for? 4. Intensity of participation: Pace of participation enough to take your breath away or sweaty?
Walking	1. Frequency of participation: (a).How many days (with each occasion lasting at least 10 minutes) per month? (b) On the days you did it for 10 minutes, how many times did you do it? (c) How many days did you do more than one bout of walking? (d) How many days (with each occasion lasting at least 30 minutes) per month? 2. Duration of participation: How long did you usually do it for? 3. Intensity: Pace of participation enough to take your breath away or sweaty?
Occupational activity	1. Duration (recall period is 4 weeks): (a) On the average day at work; how much time do you spend sitting down or standing up? (b) On the average day at work; how much time do you spend walking at work? (c) On the average day at work; how much time do you spend climbing stairs or ladders? (d) On the average day at work; how much time do you spend lifting, carrying or moving heavy loads? 2. Perceived level of physical activity of job
Domestic activity	HEAVY HOUSEWORK 1. Frequency of participation: how many days per month? 2. Duration of participation: How long did you usually do it for? GARDENING/DIY/MANUAL WORK 1. Frequency of participation: how many days per month? 2. Duration of participation: How long did you usually do it for?
Swimming/Work out/keep fit	SWIMMING (to those who do swimming) 1. Was the swimming a social activity or swimming lags & lengths? WORK OUT/KEEP FIT (to those who do work outs/keep fit) 1. What type of specific work out did you do? 2. Frequency of participation: how many days (with each occasion lasting at least 10 minutes) per month? 3. Duration of participation: How long did you usually do it for? 4. Intensity of participation: Pace of participation enough to take your breath away or sweaty? N/B: Same questions were repeated for those who did keep fit
Sedentary time	1. How much time did you usually spent sitting down watching TV? 2. How much time did you usually spent sitting down doing any other activity?
Others	Perceived overall physical activity level for the last month?

Appendix 4.1 Descriptive statistics of control variables (adjusted for missing observations)

Control variables	Whole sample (n=2453)		Vig. active sample (n=519)		Not vig. active sample (n=1921)		Vig active vs. Not vig. active
	Obs.	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Comparison means / % (p value)** [a]
Socio demographic variables							
Age	2453	42.2 (14.9)	519	34.1 (13.0)	1921	44.3 (14.6)	<0.001***
Own accom'tion (income proxy)							
High	1928	78.6	398	76.7	1520	79.1	0.23
Low	508	20.7	118	22.7	387	20.1	
Gender							
Male	1162	47.4	330	63.6	827	43.1	<0.001***
Female	1291	52.6	189	36.4	1094	56.9	
Educated							
Yes	1597	65.1	413	79.6	1179	61.4	<0.001***
No	850	34.7	106	20.4	736	38.3	
Educational qualification							
CSE grade 2-5	103	4.2	41	7.9	62	3.2	<0.001***
GSCE	470	19.2	126	24.3	343	17.9	
A level	153	6.2	31	6.0	122	6.4	
Overseas school leaving cert.	9	0.4	-		9	0.5	
OND/City &Guilds advanced	126	5.1	37	7.1	89	4.6	
HND/City&Guilds tech. cert.	86	3.5	29	5.6	56	2.9	
RSA	114	4.6	17	3.3	97	5.0	
Teachers training	42	1.7	9	1.7	32	1.7	
Professional	92	3.8	28	5.4	64	3.3	
Degree	181	7.4	54	10.4	127	6.6	
Work related certificate	118	4.8	26	5.0	91	4.7	
Other	46	1.9	9	1.7	36	1.9	
Ethnicity							
White	2350	95.8	506	97.5	1837	95.6	0.066*
Black Caribbean	11	0.4	1	0.2	10	0.5	
Black African	4	0.2	1	0.2	2	0.1	
Black Other	3	0.1	1	0.2	3	0.2	

Control variables	Whole sample (n=2453)		Vig. active sample (n=519)		Not vig. active sample (n=1921)		Vig active vs. Not vig. active
	Obs.	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Comparison means / % (p value)** [a]
Indian	39	1.6	-		35	1.8	
Pakistani	6	0.2	2	0.4	6	0.3	
Chinese	5	0.2	1	0.2	2	0.1	
Employment status							
Full time	1298	52.9	336	64.7	958	49.9	<0.001***
Part time	334	13.6	58	11.2	275	14.3	
Unemployed	820	33.4	124	23.9	688	35.8	
Marital status							
Married	1698	69.2	282	54.3	1406	73.2	<0.001***
Single	495	20.2	199	38.3	295	15.4	
Divorced/widowed/separated	258	10.5	38	7.3	218	11.3	
Subjective norms							
Discouraged	31	1.3	8	1.5	23	1.2	<0.001***
Neither	1575	64.2	277	53.4	1296	67.5	
Encouraged	837	34.1	234	45.1	601	31.3	
Adult care responsibilities							
Yes	300	12.2	66	12.7	233	12.1	0.70
No	2145	87.4	450	87.7	1673	87.6	
Access to vehicle							
Yes	2037	83.0	446	85.9	1583	82.4	0.06*
No	406	16.6	72	13.9	329	17.1	
Driver's license							
Yes	1785	72.8	406	78.2	1371	71.4	0.002***
No	664	27.1	113	21.8	546	28.4	
Barriers to PA (Yes)							
Not sporty							
Applies	724	29.5	76	14.6	640	33.3	<0.001***
Does not apply	1709	69.7	441	85.0	1263	65.7	
No time							
Applies	1016	41.4	195	37.6	819	42.6	0.04**

Control variables	Whole sample (n=2453)		Vig. active sample (n=519)		Not vig. active sample (n=1921)		Vig active vs. Not vig. active
	Obs.	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Comparison means / % (p value)** [a]
Does not apply	1419	57.8	321	61.8	1093	56.9	
Young child to care for							
Applies	380	15.5	68	13.1	311	16.2	0.09*
Does not apply	2053	83.7	447	86.1	1600	83.3	
Too shy							
Applies	145	5.9	22	4.2	123	6.4	0.07*
Does not apply	2286	93.2	493	95.0	1786	93.0	
No sports partner							
Applies	372	15.2	64	12.3	307	16.0	0.04**
Does not apply	2059	83.9	450	86.7	1603	83.4	
Too old							
Applies	154	6.3	17	3.3	137	7.1	<0.001***
Does not apply	2276	92.8	498	96.0	1771	92.2	
Injured							
Applies	416	17.0	51	9.8	363	18.9	<0.001***
Does not apply	2016	82.2	465	89.6	1546	80.5	
Health not good enough							
Applies	253	10.3	19	3.7	232	12.1	<0.001***
Does not apply	2176	88.7	497	95.8	1674	87.1	
No facilities nearby							
Applies	230	9.4	48	9.2	180	9.4	0.94
Does not apply	2196	89.5	466	89.8	1725	89.8	
Time to relax							
Applies	551	22.5	83	15.9	468	24.4	<0.001***
Does not apply	1879	76.6	432	82.9	1440	75.0	
No time due to work							
Applies	650	26.5	142	27.4	507	26.4	0.70
Does not apply	1779	72.5	375	72.3	1398	72.8	
Fear of injury							
Applies	110	4.5	23	4.4	87	4.5	0.93

Control variables	Whole sample (n=2453)		Vig. active sample (n=519)		Not vig. active sample (n=1921)		Vig active vs. Not vig. active
	Obs.	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Comparison means / % (p value)** [a]
Does not apply	2320	94.6	492	94.8	1821	94.8	
Have not got right clothes							
Applies	119	4.9	15	2.9	104	5.4	0.02**
Does not apply	2310	94.2	500	96.3	1803	93.9	
Can never keep it up							
Applies	287	11.7	35	6.7	252	13.1	<0.001***
Does not apply	2142	87.3	481	92.7	1654	86.1	
Too fat							
Applies	204	8.3	23	4.4	180	9.4	<0.001***
Does not apply	2223	90.6	492	94.8	1725	89.8	
No energy							
Applies	354	14.4	42	8.1	312	16.3	<0.001***
Does not apply	2076	84.6	473	91.1	1596	83.1	
Cannot afford							
Applies	281	11.5	66	12.7	215	11.2	0.35
Does not apply	2146	87.5	450	86.7	1689	87.9	
Do not enjoy							
Applies	258	10.5	23	4.4	235	12.2	<0.001***
Does not apply	2173	88.6	493	95.0	1673	87.1	
Health variables							
BMI	2453	28.5 (5.6)	519	28.2 (5.4)	1921	28.6 (5.6)	0.25
Health status							
Good	1364	55.6	321	61.8	1039	54.1	<0.001***
Fair	672	27.4	100	19.3	569	29.6	
Poor	101	4.1	3	0.6	96	5.0	
Excellent	303	12.4	93	17.9	209	10.9	
Smoking status							
Smoker	738	30.1	149	28.7	585	30.5	0.75
Ex smoker	505	20.6	111	21.4	392	20.4	
Non smoker	1210	49.3	259	49.9	944	49.1	

Control variables	Whole sample (n=2453)		Vig. active sample (n=519)		Not vig. active sample (n=1921)		Vig active vs. Not vig. active
	Obs.	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Obs.**	**Mean (SD) / %**	**Comparison means / % (p value)** [a]
Drinking status							
Drinkers	2234	91.1	486	93.6	1740	90.6	0.03**
Non drinkers	213	8.7	32	6.2	177	92	
Current health problems affect PA							
No	1900	77.5	451	86.9	1441	75.0	<0.001***
Does not apply	197	8.0	14	2.7	181	9.4	
Yes	334	13.6	51	9.8	281	14.6	
Others							
Adequate level of PA							
Yes	1341	54.7	390	75.1	947	49.3	<0.001***
Don't know	1060	43.2	126	24.3	932	48.5	
No	41	1.7	2	0.4	39	2.0	
Level of PA compared to peers							
Active	1878	76.6	484	93.3	1388	72.2	<0.001***
Not active	568	23.2	35	6.7	532	27.7	
Seasonal effect							
Summer	368	15.0	80	15.4	285	14.8	0.74
Spring	2082	84.9	439	84.6	1633	85.0	

[a]The asterisks show significance level of 1%(***), 5%(**), 10%(*) (Chi square test, Kendall rank correlation; t test; Mann Whitney U test; Kruskall Wallis test)

Appendix 4.2 Missing observations of independent variables

Independent variables	Whole sample		Vig. active sample		Not vig. active sample		Vig. Active vs. Not vig. Active
	Obs.	**%**	**Obs.**	**%**	**Obs.**	**%**	**Comparison of % (p value)** [a]
PB							
To relax, forget about your cares	17	0.7	1	0.2	5	0.3	1.04
To get together and meet other people	20	0.8	1	0.2	8	0.4	0.69
To have fun	24	1	1	0.2	12	0.6	0.32
To get out of doors	24	1	2	0.4	11	0.6	1.01
To feel a sense of achievement	31	1.2	3	0.6	17	0.9	0.83
To feel mentally alert	37	1.6	2	0.4	24	1.3	0.10*
To feel in good shape physically	25	1	1	0.2	13	0.7	0.33
To learn new things	27	1	2	0.4	14	0.7	0.55
To look good	29	1.2	1	0.2	17	0.9	0.15
To control or lose weight	29	1.2	1	0.2	17	0.9	0.15
To seek adventure and excitement	26	1.1	1	0.2	14	0.7	0.22
To improve or maintain your health	26	1.1	1	0.2	14	0.7	0.22
To feel independent	37	1.6	2	0.4	24	1.3	0.11
RIB							
To relax, forget about your cares	23	1	6	1.2	12	0.6	0.21
To get together and meet other people	22	1	5	1	12	0.6	0.38
To have fun	25	1	7	1.4	13	0.7	0.13
To get out of doors	24	1	6	1.2	13	0.7	0.27
To feel a sense of achievement	24	1	5	1	14	0.7	0.58
To feel mentally alert	24	1	5	1	14	0.7	0.58
To feel in good shape physically	24	1	5	1	14	0.7	0.58
To learn new things	24	1	5	1	14	0.7	0.58
To look good	25	1	6	1.2	14	0.7	0.41
To control or lose weight	23	1	5	1	13	0.7	0.56
To seek adventure and excitement	24	1	5	1	14	0.7	0.58
To improve or maintain your health	24	1	5	1	14	0.7	0.58
To feel independent	22	1	5	1	12	0.6	0.38

Independent variables	Whole sample Obs.	%	Vig. active sample Obs.	%	Not vig. active sample Obs.	%	Vig. Active vs. Not vig. Active Comparison of % (p value) [a]
Socio demographic variables							
Own accommodation (income proxy)	17	0.7	3	0.6	14	0.7	0.71
Age	-						
Gender	-						
Educated	6	0.2	-		6	0.3	0.35
Educational qualification	913	37	112	22	793	41	<0.001***
Ethnicity	32	1.3	5	1	26	1.4	0.66
Employment status	1	0.04	1	0.2	-		0.21
Marital status	2	0.08	-		2	0.2	1.03
Subjective norms	10	0.4	-		1	0.1	1.01
Adult care responsibilities	8	0.3	3	0.6	5	0.3	0.3
Access to vehicle	10	0.4	1	0.2	9	0.5	0.70
Driving license	4	0.2	-		4	0.2	0.58
Barriers to PA							
Not sporty	20	0.8	2	0.4	12	0.6	0.75
No time	18	0.7	3	0.6	9	0.5	0.73
Young child to care for	20	0.8	4	0.8	10	0.5	0.51
Too shy	22	0.9	4	0.8	12	0.6	0.76
No sports partner	22	0.9	5	1	11	0.6	0.76
Too old	23	0.9	4	0.7	13	0.7	0.77
Injured	21	0.9	3	0.6	12	0.6	1.04
Health not good enough	24	1	3	0.6	15	0.8	0.78
No facilities nearby	27	1	5	1	16	0.8	0.79
Time to relax	23	0.9	4	0.8	13	0.7	0.77
No time due to work	24	1	2	0.4	16	0.8	0.39
Fear of injury	23	0.9	4	0.8	13	0.7	0.77
Have not got right clothes	24	1	4	0.8	14	0.7	1.02
Can never keep it up	24	1	3	0.6	15	0.8	0.78
Too fat	26	1.1	4	0.8	16	0.8	1.05
No energy	23	0.9	4	0.8	13	0.7	0.77
Cannot afford	26	1	3	0.6	17	0.9	0.78
Do not enjoy	22	1	3	0.6	13	0.7	1.07

Independent variables	Whole sample Obs.	%	Vig. active sample Obs.	%	Not vig. active sample Obs.	%	Vig. Active vs. Not vig. Active Comparison of % (p value) [a]
Health variables							
Health status	13	0.5	2	0.4	8	0.4	1.03
Smoking status	-						
Drinking status	6	0.2	1	0.2	4	0.2	0.71
Current health problems affect PA	22	1	3	0.6	18	0.9	0.62
BMI	464	19	84	16	376	20	0.08*
Others							
Adequate level of PA	11	0.5	1	0.2	3	0.2	1.01
Level of PA compared to peers	7	0.3	-		1	0.01	1.04
Seasonal effect	3	0.1	-		3	0.2	1.00

[a] The asterisks beside the correlation coefficient show significance level of 1%(***), 5%(**), 10%(*)

Appendix 4.3 Distribution of scores of PB for whole sample (n=2453); vigorously active sample (n=519); not vigorously active sample (n=1921)

Items (PB)	Scores – Frequency (%)					
	1	2	3	4	5	6
To relax, forget about your cares						
Whole sample	487(20%)	289(12%)	529(22%)	492(20%)	607(25%)	32(1%)
Vigorously active	49(9%)	29(6%)	100(19%)	135(26%)	203(39%)	2(0.4%)
Not vigorously active	437(23%)	260(14%)	429(22%)	357(19%)	403 (21%)	30(2%)
To get together and meet other people						
Whole sample	439(18%)	311(13%)	529(22%)	502(21%)	617(25%)	35(1%)
Vigorously active	61(12%)	65(13%)	113(22%)	103(20%)	174(34%)	2(0.4%)
Not vigorously active	378(20%)	246(13%)	416(22%)	397(21%)	443(23%)	33(2%)
To have fun						
Whole sample	352(15%)	249(10%)	503(21%)	554(23%)	738(30%)	33(1%)
Vigorously active	24(5%)	37(7%)	83(16%)	142(27%)	231(45%)	1(0.2%)
Not vigorously active	328(18%)	212(11%)	420(22%)	410(22%)	507(27%)	32(2%)
To get out of doors						
Whole sample	302(12%)	173(7%)	389(16%)	585(24%)	960(39%)	20(1%)
Vigorously active	20(4%)	27(5%)	74(14%)	130(25%)	266(52%)	-
Not vigorously active	282(15%)	146(8%)	313(16%)	455(24%)	694(36%)	20(1%)
To feel a sense of achievement						
Whole sample	263(11%)	157(7%)	376(16%)	633(26%)	964(40%)	29(1%)
Vigorously active	10(2%)	12(2%)	62(12%)	144(28%)	286(55%)	2(0.4%)
Not vigorously active	253(13%)	145(8%)	314(17%)	487(26%)	678(36%)	27(1%)
To feel mentally alert						
Whole sample	288(12%)	195(8%)	414(17%)	649(27%)	837(35%)	33(1%)
Vigorously active	20(4%)	22(4%)	82(16%)	141(27%)	248(48%)	4(1%)
Not vigorously active	268(14%)	173(9%)	332(18%)	507(27%)	588(31%)	29(2%)
To feel in good shape physically						
Whole sample	162(7%)	97(4%)	287(12%)	558(23%)	1298(54%)	26(1%)
Vigorously active	5(1%)	4(1%)	34(7%)	103(20%)	370(71%)	2(0.4%)
Not vigorously active	157(8%)	93(5%)	253(13%)	455(24%)	926(49%)	24(1%)

Items (PB)	Scores – Frequency (%)					
	1	2	3	4	5	6
To learn new things						
Whole sample	396(16%)	393(16%)	660(27%)	488(20%)	446(18%)	43(2%)
Vigorously active	45(9%)	88(17%)	143(28%)	122(24%)	116(22%)	3(0.5%)
Not vigorously active	351(18%)	305(16%)	515(27%)	366(19%)	330 (17%)	40 (2%)
To look good						
Whole sample	273(11%)	209(9%)	470(19%)	603(25%)	835(35%)	34(1%)
Vigorously active	25(5%)	29(6%)	95(18%)	138(27%)	229(44%)	2(0.4%)
Not vigorously active	248(13%)	180(10%)	375(20%)	464(24%)	605(32%)	32(2%)
To control or lose weight						
Whole sample	296(12%)	191(8%)	359(15%)	551(23%)	997(41%)	30(1%)
Vigorously active	35(7%)	36(7%)	72(14%)	116(22%)	257(50%)	2(0.4%)
Not vigorously active	261(14%)	155(8%)	287(15%)	434(23%)	739(39%)	28(2%)
To seek adventure and excitement						
Whole sample	571(24%)	443(18%)	604(25%)	390(16%)	377(16%)	42(2%)
Vigorously active	78(16%)	84(16%)	134(26%)	99(19%)	120(23%)	3(1%)
Not vigorously active	493(26%)	358(19%)	470(25%)	290(15%)	257(14%)	39(2%)
To improve or maintain your health						
Whole sample	175(7%)	115(5%)	293(12%)	636(26%)	1719(49%)	29(1%)
Vigorously active	5(1%)	13(3%)	38(7%)	118(23%)	341(66%)	3(0.5%)
Not vigorously active	170(9%)	102(5%)	255(13%)	518(27%)	836(44%)	26(1%)
To feel independent						
Whole sample	515(21%)	341(14%)	505(21%)	433(18%)	585(24%)	41(2%)
Vigorously active	63(12%)	56(11%)	108(21%)	116(23%)	171(33%)	1(0.2%)
Not vigorously active	452(24%)	285(15%)	396(21%)	316(17%)	414(22%0	40(2%)

Appendix 4.4 Distribution of scores of RIB for whole sample (n=2453); vigorously active sample (n=519); not vigorously active sample (n=1921)

Items (RIPB)	Scores-Frequency (%) 1	2	3	4	5	6
To relax, forget about your cares						
Whole sample	29(2%)	74(3%)	259(11%)	651(27%)	1414(58%)	3(0.1%)
Vigorously active	9(2%)	21(4%)	45(9%)	150(29%)	288(56%)	-
Not vigorously active	20(1%)	52(3%)	213(11%)	500(26%)	1121(59%)	3(0.2%)
To get together and meet other people						
Whole sample	63(3%)	143(6%)	536(22%)	741(31%)	945(39%)	3(0.1%)
Vigorously active	15(3%)	31(6%)	96(19%)	159(31%)	213(41%)	-
Not vigorously active	47(3%)	112(6%)	440(23%)	580(30%)	727(38%)	3(0.2%)
To have fun						
Whole sample	42(2%)	100(4%)	403(17%)	695(29%)	1179(49%)	9(0.4%)
Vigorously active	7(1%)	8(2%)	52(10%)	132(26%)	312(61%)	1(0.2%)
Not vigorously active	34(2%)	92(5%)	350(18%)	562(30%)	862(45%)	8(0.4%)
To get out of doors						
Whole sample	12(1%)	54(2%)	328(14%)	756(31%)	1274(53%)	5(0.2%)
Vigorously active	2(0.4%)	9(2%)	58(11%)	154(30%)	290(57%)	-
Not vigorously active	10(1%)	44(2%)	269(14%)	600(32%)	980(51%)	5(0.3%)
To feel a sense of achievement						
Whole sample	27(1%)	68(3%)	387(16%)	810(33%)	1127(46%)	8(0.3%)
Vigorously active	4(1%)	8(2%)	61(12%)	178(35%)	263(51%)	-
Not vigorously active	23(1%)	60(3%)	326(17%)	632(33%)	858(45%)	8(0.4%)
To feel mentally alert						
Whole sample	8(0.3%)	25(1%)	202(8%)	697(29%)	1478(61%)	11(1%)
Vigorously active		5(1%)	41(8%)	150(29%)	318(62%)	-
Not vigorously active	8(0.4%)	20(1%)	161(8%)	547(29%)	1160(61%)	11(1%)
To feel in good shape physically						
Whole sample	6(0.3%)	25(1%)	211(9%)	708(29%)	1468(61%)	5(0.2%)
Vigorously active	1(0.2%)	1(0.2%)	27(5%)	134(26%)	351(68%)	-
Not vigorously active	5(0.3%)	24(1%)	183(10%)	573(30%)	1117(59%)	5(0.3%)
To learn new things						

Items (RIPB)	Scores-Frequency (%) 1	2	3	4	5	6
Whole sample	51(2%)	155(6%)	547(23%)	834(34%)	834(34%)	8(0.3%)
Vigorously active	6(1%)	20(4%)	96(19%)	197(38%)	194(38%)	1(0.2%)
Not vigorously active	44(2%)	134(7%)	450(24%)	635(33%)	637(33%)	7(0.4%)
To look good						
Whole sample	46(2%)	138(6%)	466(19%)	727(30%)	1046(43%)	5(0.2%)
Vigorously active	7(1%)	32(6%)	84(16%)	168(33%)	221(43%)	1(0.2%)
Not vigorously active	39(2%)	105(6%)	380(20%)	559(29%)	820(43%)	4(0.2%)
To control or lose weight						
Whole sample	215(9%)	178(7%)	514(21%)	600(25%)	911(38%)	7(0.3%)
Vigorously active	39(8%)	32(6%)	107(21%)	140(27%)	196(38%)	-
Not vigorously active	175(9%)	145(8%)	406(21%)	460(21%)	715(38%)	7(0.4%)
To seek adventure and excitement						
Whole sample	236(10%)	398(16%)	785(32%)	556(23%)	439(18%)	7(0.3%)
Vigorously active	27(5%)	46(9%)	166(32%)	148(29%)	126(25%)	1(0.2%)
Not vigorously active	209(11%)	352(19%)	619(33%)	408(21%)	313(16%)	6(0.3%)
To improve or maintain your health						
Whole sample	22(1%)	28(1%)	217(9%)	703(29%)	1452(60%)	5(0.2%)
Vigorously active	2(0.4%)	5(1%)	34(7%)	152(30%)	321(62%)	-
Not vigorously active	20(1%)	23(1%)	183(10%)	551(29%)	1125(59%)	5(0.3%)
To feel independent						
Whole sample	35(1%)	79(3%)	412(17%)	695(29%)	1203(50%)	7(0.3%)
Vigorously active	7(10%)	11(2%)	82(16%)	161(31%)	253(49%)	-
Not vigorously active	27(1%)	67(4%)	330(17%)	532(28%)	946(50%)	7(0.4%)

Appendix 4.5 Estimation results of regression model of 'vigorously active'

INDEPENDENT VARIABLES	DEPENDENT VARIABLE			
	Vigorously active			
	Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Perceived benefits related to PA				
To relax, forget about your cares	0.19	0.02		
To get together and meet other people	-0.29	-0.03		
To have fun	0.71**	0.06	0.66**	0.06
To get out of doors	0.57*	0.05	0.50*	0.05
To feel a sense of achievement	0.43	0.04		
To feel mentally alert	0.48	0.04	0.61**	0.06
To feel in good shape physically	-0.30	-0.03		
To learn new things	0.04	0.00		
To look good	0.13	0.01		
To control or lose weight	0.29	0.03		
To seek adventure and excitement	-0.25	-0.03		
To improve or maintain your health	0.34	0.03		
To feel independent	-0.03	-0.00		
Socio demographic variables				
Own accommodation (income proxy)	-0.22	-0.02		
Age	-0.05***	-0.01	-0.05***	-0.01
Gender (male)	0.72***	0.08	0.70***	0.08
Educated (yes)	-0.32	-0.03		
Educational qualification (high)	0.32**	0.03	0.41***	0.05
Ethnicity (white)	1.05**	0.07	0.81**	0.07
Employment status [d]				
Full time	0.01	0.00		
Part time	0.15	0.02		
Marital status [e]				
Single	0.38**	0.04	0.41**	0.05
Divorced/widowed/separated	0.26	0.03	0.35*	0.04
Subjective norms [f]				
Discouraged	0.17	0.02	0.19	0.02
Neither	-0.26**	-0.03	-0.27**	-0.03
Adult care responsibilities (yes)	0.34*	0.04	0.31*	0.04
Access to vehicle (yes)	0.01	0.00		
Driver's license (have)	0.19	0.02		
Barriers to PA (Yes)				
Not sporty	-0.25	-0.02	-0.33**	-0.04
No time	-0.16	-0.02		
Young child to care for	-0.13	-0.01		
Too shy	0.31	0.04		
No sports partner	-0.27	-0.03		
Too old	0.45	0.05		
Injured	-0.33	-0.03		
Health not good enough	-0.11	-0.01		
No facilities nearby	0.21	0.02		
Time to relax	-0.19	-0.02	-0.31**	-0.03
No time due to work	-0.15	-0.01		
Fear of injury	0.59*	0.07	0.56*	0.07

INDEPENDENT VARIABLES	DEPENDENT VARIABLE			
	Vigorously active			
	Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Have not got right clothes	-0.45	-0.04		
Can never keep it up	0.00	0.00		
Too fat	0.06	0.01		
No energy	0.05	0.01		
Cannot afford	0.11	0.01		
Do not enjoy	-0.15	-0.01		
Health variables				
Health status [g]				
Good	-0.40**	-0.04	-0.37***	-0.04
Fair	-0.45**	-0.04	-1.43**	-0.10
Poor	-1.41**	-0.09	-0.46**	-0.05
Smoking status [h]				
Smoker	0.02	0.00		
Ex smoker	0.01	0.00		
Drinking status (drinkers)	0.12	0.01		
Current health problems affect PA [i]				
No	-0.09	-0.01		
Does not apply	-0.56	-0.05		
BMI	0.02**	0.00	0.03**	0.00
Others				
Adequate level of PA [j]				
Yes	1.10***	0.11	1.09***	0.12
Don't know	-0.52	-0.04	-0.63	-0.06
Level of PA compared to peers (active)	1.11***	0.09	1.13***	0.10
Seasonal effect (summer) [k]	0.07	0.01		
No .of observations	2440			
Constant			-7.42	
Pseudo R2			0.24	
Link test			p=0.27	
Goodness of fit			p=0.12 [c]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*)
[b] Marginal effects [c] Chi-square(8)=12.76 [d] Omitted category: unemployed; [e] Omitted category: married; [f] Omitted category: encouraged [g] Omitted category: excellent health ; [h] Omitted category: non smoker; [i] Omitted category: yes; [j]Omitted category: no; [k] Omitted category: spring

Appendix 4.6 Estimation results of regression model of 'RIPB': to have fun' given varying perceptions about PB and 'not vigorously active behaviour'

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To have fun'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Socio demographic variables								
Own accommodation (income proxy)	1.07	0.00			0.18	0.00		
Age	-0.09	-0.00			-0.06**	-0.00	-0.05**	-0.00
Gender (male)	0.86	0.00			-0.18	-0.00		
Educated (yes)	-0.16	-0.00			-1.30	-0.04		
Educational qualification (high)	1.82	0.00			-0.77	-0.02		
Ethnicity (white)	1.16	0.00			1.03	0.04		
Employment status [e]								
Full time	-1.14	-0.00			0.09	0.00		
Part time	-1.04	-0.00			-0.38	-0.01		
Marital status [f]								
Single	0.63	0.00			-2.31***	-0.16	-1.57***	-0.17
Divorced/widowed/separated	-0.09	-0.00			-0.89	-0.03	-0.26	-0.02
Subjective norms [g]								
Discouraged	-2.88	-0.01			-5.06***	-0.77	-3.11***	-0.54
Neither	-1.46	-0.00			-1.87**	-0.03	-1.30*	-0.06
Adult care responsibilities (yes)	1.15	0.00			0.29	0.01		
Access to vehicle (yes)	0.10	0.00			-0.42	-0.01		
Driver's license (have)	-0.39	-0.00			-0.10	-0.00		
Barriers to PA (Yes)								
Not sporty	0.20	0.00			0.08	0.00		
No time	1.56	0.00			0.17	0.00		
Young child to care for	-0.69	-0.00			-2.05**	-0.12	-1.49***	-0.15
Too shy					-1.47	-0.07		

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To have fun'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
No sports partner	0.99	0.00			1.77	0.03		
Too old	0.63	0.00			-0.23	-0.01		
Injured	2.89**	0.00			1.14	0.02		
Health not good enough	1.74	0.00			-0.38	-0.01		
No facilities nearby					-1.79**	-0.10	-1.22**	-0.12
Time to relax	0.02	0.00			1.10	0.02		
No time due to work	-0.10	-0.00			0.60	0.01		
Fear of injury	-0.72	-4.91			0.32	0.01		
Have not got right clothes	1.42	0.00			-1.72	-0.10		
Can never keep it up	-0.96	-0.00			0.70	0.01		
Too fat	0.01	1.15			0.47	0.01		
No energy	-0.57	-0.00			-1.23*	-0.05		
Cannot afford	-2.17**	-0.00	-1.27**	-0.01	0.70	0.01		
Do not enjoy	0.32	0.00			0.21	0.01		
Health variables								
Health status [h]								
Good	-1.48	-0.00			0.64	0.02		
Fair	-1.96	-0.00			0.26	0.00		
Poor	-3.43	-0.01			2.60**	0.03		
Smoking status [i]								
Smoker	-1.47*	-0.00			-0.46	-0.01		
Ex smoker	-0.47	-0.00			-1.23*	-0.05		
Drinking status (drinkers)	1.20	0.00	1.59***	0.01	0.87	0.03		
Current health problems affect PA [j]								
No	2.31**	0.00	1.19**	0.01	1.02	0.03		
Does not apply	1.55	0.00	0.26	0.00	2.23**	0.04		
BMI	0.14**	0.00	0.14**	0.00	0.04	0.00		

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To have fun'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Others								
Adequate level of PA[k]								
Yes	0.78	0.00	0.17	0.00	0.69	0.02		
Don't know	-2.59**	-0.01	-2.38***	-0.04	2.05	0.02		
Level of PA compared to peers (active)	-0.10	-0.00			0.58	0.02		
Seasonal effect (summer) [k]	0.74	0.00			1.45	0.02		
No. of observations	1549				360			
Constant			-0.62				6.55	
Pseudo R2			0.23				0.13	
Link test			p=0.86				p=0.71	
Goodness of fit			p=0.74 [c]				p=0.68 [d]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*)
[b] Marginal effects [c] Chi-square(8)=7.78 [d] Chi-square(8)=5.20 [e] Omitted category: unemployed; [f] Omitted category: married; [g] Omitted category: encouraged
[h] Omitted category: excellent health ; [i] Omitted category: non smoker; [j] Omitted category: yes; [k]Omitted category: no; [k] Omitted category: spring
* Variables with no values in the base models were found to predict the dependent variable perfectly and thus dropped from the model as their retention tend to cause numerical instability in the estimation.
*1st quadrant(high RIPB and high PB); 2nd quadrant(high RIPB and low PB); 3rd quadrant(low RIPB and high PB); 4th quadrant(low RIPB and low PB)

Appendix 4.7 Estimation results of regression model of 'RIPB: to get outdoors' given varying perceptions about PB and 'not vigorously active behaviour'

INDEPENDENT VARIABLES	**DEPENDENT VARIABLE**							
	Place importance on 'To get outdoors'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Socio demographic variables								
Own accommodation (income proxy)	0.85	0.00			3.77**	0.01	1.43**	0.06
Age	0.00	0.00			-0.01	-0.00		
Gender (male)	0.46	0.00			-0.11	-0.00		
Educated (yes)	-0.01	-0.00			-1.49	-0.00		
Educational qualification (high)	1.35	0.00			4.04*	0.00		
Ethnicity (white)	1.82*	0.01			6.21**	0.26	2.22**	0.17
Employment status [e]								
Full time	-0.79	-0.00			-2.83	-0.01		
Part time	0.33	0.00			-0.91	-0.00		
Marital status [f]								
Single					2.32	0.00		
Divorced/widowed/separated					-2.09	-0.00		
Subjective norms [g]								
Discouraged								
Neither								
Adult care responsibilities (yes)	0.03	0.00			1.62	0.00		
Access to vehicle (yes)	-0.54	-0.00						
Driver's license (have)	0.00	0.00						
Barriers to PA (Yes)								
Not sporty	-0.12	-0.00			-0.19	-0.00		
No time	1.43	0.00			-0.66	-0.00		
Young child to care for	-0.76	-0.00			-1.41	-0.00		
Too shy					-2.60	-0.01		

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To get outdoors'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
No sports partner	0.04	0.00						
Too old					-3.29*	-0.02		
Injured	0.80	0.00			-0.08	-0.00		
Health not good enough					3.30*	0.00		
No facilities nearby					-0.65	-0.00		
Time to relax	-0.31	-0.00			2.32	0.00		
No time due to work	0.02	0.00			1.24	0.00		
Fear of injury					-2.31	-0.01		
Have not got right clothes					-3.74	-0.03		
Can never keep it up	0.11	0.00			0.95	0.00		
Too fat	-0.97	-0.00			-1.16	-0.00		
No energy	0.54	0.00			2.68	0.00		
Cannot afford	0.55	0.00			3.88	0.00		
Do not enjoy	0.28	0.00			-2.77*	-0.01	-1.26**	-0.05
Health variables [h]								
Health status								
Good					-2.17	-0.00		
Fair					0.85	0.00		
Poor					-1.36	-0.00		
Smoking status [i]								
Smoker	-1.79**	-0.00	-1.60*	-0.01	2.51*	0.00		
Ex smoker	-0.93	-0.00	-0.85	-0.00	0.72	0.00		
Drinking status (drinkers)	0.55	0.00						
Current health problems affect PA [j]								
No					2.20	0.00		
Does not apply					0.00	0.00		
BMI	0.10	0.00	0.11*	0.00	0.09	0.00		

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To get outdoors'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]	*Coef.* [a]	*ME* [b]
Others								
Adequate level of PA[k]								
Yes	-0.29	-0.00	-0.06	-0.00	1.28	0.00		
Don't know	-2.07	-0.01	-2.05*	-0.02	-2.22	-0.01		
Level of PA compared to peers (active)	0.13	0.00			1.72	0.00		
Seasonal effect (summer)[k]	1.67	0.00						
No. of observations	1608				302			
Constant			2.72				0.63	
Pseudo R2			0.05				0.13	
Link test			p=0.12				p=0.11	
Goodness of fit			p=0.39 [c]				p=0.32 [d]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*)
[b] Marginal effects [c] Chi-square(8)=8.45 [d] Chi-square(1)=0.99 [e] Omitted category: unemployed; [f] Omitted category: married; [g] Omitted category: encouraged
[h] Omitted category: excellent health ; [i] Omitted category: non smoker; [j] Omitted category: yes; [k]Omitted category: no; [k] Omitted category: spring
* Variables with no values in the base models were found to predict the dependent variable perfectly and thus dropped from the model as their retention tend to cause numerical instability in the estimation
*1st quadrant(high RIPB and high PB); 2nd quadrant(high RIPB and low PB); 3rd quadrant(low RIPB and high PB); 4th quadrant(low RIPB and low PB)

Appendix 4.8 Estimation results of regression model of 'RIPB: to feel mentally alert' given varying perceptions about PB and 'not vigorously active behaviour'

INDEPENDENT VARIABLES	DEPENDENT VARIABLE							
	Place importance on 'To feel mentally alert'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]
Socio demographic variables								
Own accommodation (income proxy)	1.09	0.00			-0.04	-0.00		
Age	-0.03	-0.00			-0.04	-0.00		
Gender (male)	-0.24	-0.00			-1.92	-0.00		
Educated (yes)	0.25	0.00			3.16*	0.00		
Educational qualification (high)	-0.96	-0.00						
Ethnicity (white)	2.95**	0.02			1.00	0.00		
Employment status [e]								
Full time	0.39	0.00						
Part time	1.25	0.00						
Marital status [f]								
Single					0.78	0.00		
Divorced/widowed/separated					-0.73	-0.00		
Subjective norms [g]								
Discouraged								
Neither								
Adult care responsibilities (yes)	-0.45	-0.00						
Access to vehicle (yes)	0.02	0.00			0.05	0.00		
Driver's license (have)	1.02	0.00	1.36**	0.01	1.92	0.00		
Barriers to PA (Yes)								
Not sporty	-0.52	-0.00			1.78	0.00		
No time	0.14	0.00			4.28**	0.00		
Young child to care for	-0.44	-0.00			-1.06	-0.00		
Too shy	0.63	0.00						

INDEPENDENT VARIABLES	**DEPENDENT VARIABLE**							
	Place importance on 'To feel mentally alert'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]
No sports partner	1.54	0.00						
Too old	0.08	0.00			0.69	0.00		
Injured	2.33*	0.00			0.64	0.00		
Health not good enough					0.71	0.00		
No facilities nearby					-3.54**	-0.02	-1.91***	-0.12
Time to relax	-0.05	-0.00			-1.94	-0.00		
No time due to work	-0.28	-0.00			-3.95**	-0.02		
Fear of injury					1.05	0.00		
Have not got right clothes	0.28	0.00						
Can never keep it up	1.78	0.00						
Too fat	-0.74	-0.00						
No energy	-0.27	-0.00			1.28	0.00		
Cannot afford	-1.15	-0.00						
Do not enjoy								
Health variables								
Health status [h]								
Good	1.62**	0.00			-2.17	-0.00		
Fair	1.86**	0.00			-0.48	-0.00		
Poor	1.82	0.00			0.22	0.00		
Smoking status [i]								
Smoker	-0.01	-0.00			1.75	0.00		
Ex smoker	-0.22	-0.00			-1.48	-0.00		
Drinking status (drinkers)	1.27*	0.00			2.16*	0.00	1.90***	0.11
Current health problems affect PA [j]								
No	1.51*	0.00			1.36	0.00		
Does not apply	0.91	0.00			-1.69	-0.00		
BMI	0.10	0.00	0.09**	0.00	0.16*	0.00		

INDEPENDENT VARIABLES	**DEPENDENT VARIABLE**							
	Place importance on 'To feel mentally alert'							
	1st quadrant & 3rd quadrant				2nd quadrant & 4th quadrant			
	Base		Reduced		Base		Reduced	
	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]	Coef. [a]	ME [b]
Others								
Adequate level of PA[k]								
Yes	1.85**	0.00			0.79	0.00		
Don't know	-1.90	-0.01			2.88	0.00		
Level of PA compared to peers (active)	0.18	0.00			2.49	0.00		
Seasonal effect (summer) [k]	0.99	0.00			-0.54	-0.00		
No. of observations	1600				297			
Constant			1.36				2.09	
Pseudo R2			0.07				0.15	
Link test			p=0.25				p=0.80	
Goodness of fit			p=0.67 [c]				p=0.87 [d]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*)
[b] Marginal effects [c] Chi-square(8)=5.79 [d] Chi-square(1)=0.03 [e] Omitted category: unemployed; [f] Omitted category: married; [g] Omitted category: encouraged
[h] Omitted category: excellent health ; [i] Omitted category: non smoker; [j] Omitted category: yes; [k]Omitted category: no; [k] Omitted category: spring
* Variables with no values in the base models were found to predict the dependent variable perfectly and thus dropped from the model as their retention tend to cause numerical instability in the estimation
*1st quadrant(high RIPB and high PB); 2nd quadrant(high RIPB and low PB); 3rd quadrant(low RIB and high PB); 4th quadrant(low RIPB and low PB

Appendix 5.1 Mathematical description of bivariate probit model with selectivity correction

In practice, the bivariate probit model with selectivity correction is estimated using first, a probit equation of the probability that an individual participates in physical activity or not:

$$Y_p = \beta_1 X_1 + e_1, \quad Y_p = 1 \text{ if } Y_p > 0; \text{ otherwise } Y_p = 0 \qquad (1)$$

where $\beta_{1=}$ a vector of variables affecting the decision to participate in physical activity
$e_{1\,=}$ the error term

And second, a probit equation indicating that the individual meet the recommended level of participation given participation or not is estimated as:

$$Y_a = \beta_2 X_2 + e_2, \quad Y_a = 1 \text{ if } Y_a > 0; \text{ otherwise } Y_a = 0; \quad Y_a \neq \text{missing if } Y_p = 1 \qquad (2)$$

where $\beta_{2=}$ a vector of variables affecting the decision to become physically active
$e_{2\,=}$ the error term

It is assumed that the two errors terms for both above-stated probit equations are jointly normally distributed and hence the selection model is estimated as:

$$E\,[Y_a|Y_p>0, X] = \beta_2 X_2 + \rho\sigma E\,[\varphi(\beta_1 X_1)/\Phi(\beta_1 X_1)|X] \qquad (3)$$

where $\Phi(.)$=the cumulative distribution of the standard normal distribution
$\varphi\,(.)$=the corresponding density
σ^2=the variance of e_2
ρ=the parameter of correlation between e_1 and e_2

To test and correct for selectivity bias, the second term on the right hand side of equation 3 enters the probit equation of probability of meeting the recommended level of participation as an extra variable, which is then estimated as:

$$Y_a = \beta_2 X_2 + \theta\lambda + \varepsilon \qquad (4)$$

where λ=the selection term on the right hand side of equation3
θ=the coefficient of the selection term

To identify the selection model, at least one or more explanatory variables that enter the first probit model (i.e. participation or not) should not enter the second probit model (i.e. meet recommended level of participation or not). This occurs when at least an element of vector β_1 is not included in vector $\beta_{2.}$ A problem of selection bias is suggested if the correlation coefficient between the two error terms of the two equations is found to be statistically significant (Jones 2007). In such a case of evidence of selection bias, the bivariate probit model with selectivity correction is considered the suitable model, otherwise, a 2 part model is considered. The 2 part model treats both probit equations as separate and unrelated models which are modelled separately.

Appendix 5.2 Descriptive statistics of variables (adjusted for missing observations)

Variables	Obs.	Mean(SD) / %	Variables	Obs.	Mean(SD) / %	Variables	Obs.	%
DEPENDENT VARIABLES			**Demographics**			**0ther variables**		
Participate in physical activity			*Marital status*			*Urban residence*		
Yes	6248	44.2	Other	2872	20.3	Yes	10979	77.6
No	7884	55.8	Married(living with partner)	7709	54.5	No	3163	22.4
missing	10	0.07	Single	3558	25.2	*Seasonal effect*		
Meeting recommended level			missing	3	0.01	Summer	3224	22.8
Yes	1343	21.5	Income[190]	14142	28358.6 (23751.9)	Spring	3535	25
No	4905	78.5	missing	2792	19.7	Autumn	3592	25.4
INDEPEND. VARIABLES			*Working hours*			Winter	3790	26.8
Opportunity cost of time			Fulltime	9412	66.6	*Region of residence*		
Have a degree (proxy 1)			Part time	3923	27.7	North east	738	5.2
Yes	2711	19.2	missing	807	5.7	North west	1918	13.6
No	11383	78.5	Number of children	14142	0.5(0.90)	Yorkshire	1429	10.1
missing	48	0.3	**0ther variables**			East Midlands	1238	8.8
Employed (proxy 2)			*Drinkers*			West Midlands	1498	10.6
Yes	7642	54.0	Yes	11295	79.9	East	1573	11.1
No	6460	45.7	No	2760	19.5	London	2011	14.2
missing	40	0.3	missing	87	0.6	South west	1440	10.2
CONTROL VARIABLES			*Smokers*			South east	2297	16.2
Demographics			Yes	3101	21.9	*Obese(BMI:30plus)*		
Age	14142	49.3(18.6)	No	10934	77.6	Yes	3010	21.3
Number of adults in household	14142	2.2(0.92)	missing	107	0.8	No	9017	63.7
Access to vehicle	11,532	81.5	*Voluntary activities*			missing	2115	15.0
Yes	11466	81.1	Yes	1539	10.9			
No	2672	18.9	No	11001	77.8			
missing	3	0.01	missing	1602	11.3			
Ethnicity			*Mem. of sports/social club*					
White	12834	89.1	Yes	3311	23.4			

[190] Missing observations for income were 2792, and the mean(SD) unadjusted for missing observations is 29112.2(2569.4).

Variables	**Obs.**	**Mean(SD) / %**	**Variables**	**Obs.**	**Mean(SD) / %**	**Variables**	**Obs.**	**%**
Mixed	123	1.0	No	9229	65.3			
Asian	831	5.9	missing	1602	11.3			
Black	395	2.8	*Health status*					
Chinese	158	1.1	Good health	10464	73.1			
missing	35	0.01	Fair health	2650	18.7			
Gender			Bad health	1025	7.3			
Male	6324	44.7	missing	3	0.01			
Female	7818	55.3						

Appendix 5.3 Correlation between item non response and 'decision to participate'

Item non response variables	By 'decision to participate' : (p value)
Working hours	0.853
Ethnicity	<0.001
Income	<0.001
Marital status	0.433
Health status	0.123
Obese	<0.001
Drinkers	0.107
Smokers	0.404
Voluntary activities	<0.001
Access to vehicle	0.705
Degree(proxy 1)	<0.001
Employed(proxy 2)	0.01
Member of sports/social club	<0.001

*Statistical tests used were: Fischer test and chi square test

Appendix 5.4 Estimation results of 2 part model for whole sample (proxies)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef [a].	ME	Coef [a].	ME	Coef [a] .	ME	Coef [a].	ME
Oppor. cost								
Proxy 1(educ[191].)	0.172***	0.069	0.175***	0.070	0.044	0.012	0.054***	0.016
Proxy 2 (employed)	-0.003	-0.001	0.006	0.003	0.041	0.011	0.087**	0.025
Demographics								
Age	-0.019***	-0.008	-0.020***	-0.008	-0.013***	-0.004		
No. of adults	-0.006	-0.002			-0.032	-0.009		
Access to vehic.	0.011	0.004			-0.072	-0.021		
Ethnicity [b]								
Mixed	-0.001	0.000	-0.003	-0.001	0.010	0.003	0.094	0.028
Asian	-0.199***	-0.078	-0.200***	-0.078	0.000	0.000	0.107	0.032
Black	-0.072	-0.029	-0.068	-0.027	-0.065	-0.018	0.047	0.014
Chinese	0.011	0.004	0.013	0.005	-0.506**	-0.113	-0.393**	-0.095
Female	-0.114***	-0.045	-0.111***	-0.044	-0.430***	-0.121	-0.436***	-0.124
Marital status [c]								
Other	-0.020	-0.008	-0.008	-0.003	0.058	0.017		
Married (living)	-0.103***	-0.041	-0.090**	-0.036	0.057	0.016		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.074**	-0.029	-0.067**	-0.027	0.004	0.001		
No. of children	0.020	0.008			-0.029	-0.008		
Other variables								
Drinkers	0.217***	0.085	0.223***	0.088	-0.074	-0.021		
Smokers	-0.196***	-0.078	-0.195***	-0.077	-0.193***	-0.052	-0.113***	-0.032
Voluntary activi.	0.087**	0.035	0.082**	0.033	-0.017	-0.005		
Club member	1.216***	0.447	1.210***	0.445	0.658***	0.189	0.694***	0.203
Health status [d]								
Good health	0.583***	0.223	0.585***	0.224	0.093	0.025		
Fair health	0.333***	0.132	0.335***	0.133	-0.290	-0.074		
Urban residence	-0.001	0.000			0.082*	0.023	0.145***	0.040
Obese	-0.126***	-0.050	-0.125***	-0.049	-0.210***	-0.056	-0.304***	-0.080
Seasonal effect [e]								
Summer	0.257***	0.102	0.257***	0.102	0.116**	0.034	0.096*	0.028
Spring	0.100***	0.040	0.100***	0.040	0.058	0.017	0.048	0.014
Autumn	0.104***	0.041	0.101***	0.040	0.104*	0.030	0.101*	0.030
Region of residence [f]								
North east	-0.247***	-0.096	-0.251***	-0.098	0.102	0.030		
North west	-0.223***	-0.088	-0.223***	-0.088	0.081	0.023		
Yorkshire	-0.155***	-0.061	-0.159***	-0.063	-0.006	-0.002		
East Midlands	-0.069	-0.028	-0.073	-0.029	-0.044	-0.012		
West Midlands	-0.109**	-0.043	-0.111**	-0.044	0.001	0.000		
East	-0.039	-0.015	-0.037	-0.015	-0.038	-0.011		
London	-0.213***	-0.084	-0.218***	-0.086	0.034	0.010		
South west	-0.066	-0.026	-0.065	-0.026	-0.020	-0.006		
Constant	0.028		0.018		-0.456**		-1.173***	
Observations	14142				6248			
Link test			*p*=0.132				*p*=0.363	

[191] Educational attainment was specified entirely as having a degree or not, as it provides better fit to the regression models.

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef [a].	ME	Coef [a].	ME	Coef [a] .	ME	Coef [a].	ME
Pseudo R^2	0.240		0.240		0.108		0.087	
Goodness of fit			p=0.534 [g]				p=0.470 [h]	

[a] The asterisks show significance level of 1%(***), 5%(**) and 10%(*) [b] Omitted category: white; [c] Omitted category: single ; [d] bad health; [e] winter; [f] south east. Rho: estimate of the correlation of the error terms [g] Chi-square (8)=7.02 [h] Chi-square(8)= 7.64

Appendix 5. 5 Estimation results of bivariate probit model with selectivity correction : female sample (proxies)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy 1	0.177***	0.069	0.196***	0.077	0.054	0.013	0.056	0.015
Proxy 2	0.038	0.015	0.049	0.020	0.171**	0.042	0.198***	0.054
Demographics								
Age	-0.018***	-0.007	-0.018***	-0.007	-0.004	-0.001		
No. of adults	-0.026	-0.010			-0.017	-0.004		
Access to vehic.	0.023	0.009			0.029	0.007		
Ethnicity [b]								
Mixed	0.109	0.045	0.105	0.046	-0.160	-0.036	-0.179	-0.045
Asian	-0.372***	-0.139	-0.422***	-0.155	0.361**	0.101	0.422***	0.133
Black	-0.040	-0.015	-0.046	-0.016	-0.054	-0.013	0.002	0.001
Chinese	0.049	0.019	0.036	0.015	-0.259	-0.055	-0.246	-0.060
Marital status [c]								
Other	-0.059	-0.024			0.025	0.006		
Married(living)	-0.072	-0.029			0.040	0.010		
Income	0.000	0.000			0.000*	0.000	0.000**	0.000
Full time work	-0.015	-0.006			0.062	0.015		
No. of children	0.002	0.000	-0.002	-0.001				
0ther variables								
Drinkers	0.300***	0.116	0.314***	0.123	-0.068	-0.017		
Smokers	-0.191***	-0.075	-0.195***	-0.075	-0.083	-0.020		
Voluntary activi.	0.117**	0.046	0.114**	0.046	-0.043	-0.010		
Club member	1.291***	0.476	1.295***	0.477	0.466*	0.127	0.373***	0.110
Health status [d]								
Good health	0.479***	0.179	0.487***	0.181				
Fair health	0.280***	0.111	0.280***	0.111				
Urban residence	-0.015	-0.006			0.164*	0.038	0.170**	0.044
Obese	-0.108**	-0.044	-0.107**	-0.045	-0.160*	-0.037	-0.163**	-0.042
Seasonal effect [e]								
Summer	0.204***	0.081	0.203***	0.081	0.161*	0.041	0.154**	0.043
Spring	0.063	0.025	0.061	0.024	0.023	0.006	0.017	0.005
Autumn	0.065	0.026	0.059	0.024	0.001	0.000	-0.002	-0.001
Region of residence [f]								
North east	-0.118	-0.047	-0.123	-0.050				
North west	-0.220***	-0.089	-0.214***	-0.089				
Yorkshire	-0.134**	-0.054	-0.133**	-0.054				
East Midlands	-0.037	-0.014	-0.037	-0.014				
West Midlands	-0.095	-0.040	-0.095	-0.040				
East	0.000	-0.003	0.010	0.000				
London	-0.192***	-0.080	-0.189***	-0.081				
South west	-0.024	-0.012	-0.018	-0.011				
Constant	-0.104		-0.201*		-1.217***		-1.328***	
Observations	7818				3349			
Rho	-0.268		-.0364		-0.268		-0.364	
	p=0.393		*p*=0.003		*p*=0.393		*p*=0.003	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.6 Estimation results of 2 part model for male sample (proxies)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy 1	0.166***	0.066	0.160***	0.064	0.039	0.013	0.081	0.027
Proxy 2	-0.066	-0.026	-0.080*	-0.032	-0.085	-0.028	-0.001	0.000
Demographics								
Age	-0.021***	-0.008	-0.021***	-0.009	-0.018***	-0.006	-0.015***	-0.005
No. of adults	0.003	0.001			-0.043	-0.014		
Access to vehic.	-0.006	-0.002			-0.169*	-0.057	-0.169*	-0.058
Ethnicity [b]								
Mixed	-0.180	-0.071			0.163	0.056	0.142	0.049
Asian	-0.046	-0.019			-0.149	-0.047	-0.120	-0.038
Black	-0.144	-0.057			-0.142	-0.045	-0.080	-0.026
Chinese	-0.100	-0.040			-0.712**	-0.177	-0.620**	-0.161
Marital status [c]								
Other	0.038	0.015	0.031	0.012	0.085	0.028		
Married (living)	-0.097*	-0.039	-0.103*	-0.041	0.109	0.036		
Income	0.000***	0.000	0.000***	0.000	0.000	0.000		
Full time work	-0.122**	-0.049	-0.139**	-0.055	-0.005	-0.002		
No. of children	0.049**	0.020	0.049**	0.019	-0.059*	-0.019	-0.053*	-0.017
0ther variables								
Drinkers	0.117**	0.047	0.130**	0.052	-0.121	-0.041		
Smokers	-0.213***	-0.085	-0.214***	-0.085	-0.266***	-0.083	-0.265***	-0.083
Voluntary activi.	0.026	0.010			-0.002	-0.001		
Club member	1.135***	0.415	1.126***	0.412	0.657***	0.218	0.634***	0.211
Health status [d]								
Good health	0.725***	0.278	0.719***	0.276	-0.062	-0.021	-0.087	-0.029
Fair health	0.421***	0.165	0.417***	0.163	-0.528**	-0.148	-0.549**	-0.153
Urban residence	0.014	0.006			0.032	0.010		
Obese	-0.128***	-0.051	-0.128***	-0.051	-0.249***	-0.077	-0.266***	-0.083
Seasonal effect [e]								
Summer	0.308***	0.122	0.307***	0.121	0.048	0.016	0.048	0.016
Spring	0.131***	0.052	0.130***	0.052	0.088	0.029	0.080	0.027
Autumn	0.135***	0.054	0.134***	0.053	0.172***	0.058	0.162***	0.054
Region of residence [f]								
North east	-0.407***	-0.159	-0.406***	-0.159	0.087	0.029	0.080	0.027
North west	-0.239***	-0.095	-0.240***	-0.095	0.019	0.006	0.013	0.004
Yorkshire	-0.180***	-0.071	-0.183***	-0.073	-0.071	-0.023	-0.075	-0.024
East Midlands	-0.130*	-0.052	-0.133*	-0.053	-0.084	-0.027	-0.096	-0.031
West Midlands	-0.131*	-0.052	-0.136*	-0.054	-0.068	-0.022	-0.079	-0.026
East	-0.083	-0.033	-0.084	-0.033	-0.183*	-0.057	-0.192*	-0.060
London	-0.244***	-0.097	-0.270***	-0.107	-0.050	-0.016	-0.032	-0.011
South west	-0.109	-0.043	-0.110	-0.044	-0.121	-0.039	-0.143	-0.045
Constant	0.088		0.146		0.272		0.059	
Observations	6324				2899			
Link test			p=0.885				p=123	
Pseudo R^2	0.238		0.237		0.108		0.103	
Goodness of fit			p=0.297 [g]				p=0.221 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. [g] Chi-square(8)=9.56 [h] Chi-square(8)= 10.67

Appendix 5.7 . Estimation results of 2 part model for whole sample (proxy index)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy index	0.066***	0.026	0.064***	0.025	0.010	0.003	0.035	0.010
Demographics								
Age	-0.019***	-0.008	-0.019***	-0.008	-0.013***	-0.004	-0.013***	-0.004
No. of adults	-0.008	-0.003			-0.034	-0.010		
Access to vehic.	-0.003	-0.001			-0.068	-0.019		
Ethnicity [b]								
Mixed	0.006	0.002	0.005	0.002	-0.006	-0.002	0.004	0.001
Asian	-0.190***	-0.075	-0.192***	-0.075	0.004	0.001	0.057	0.017
Black	-0.077	-0.031	-0.071	-0.028	-0.058	-0.016	0.033	0.010
Chinese	0.046	0.018	0.050	0.020	-0.502**	-0.112	-0.414**	-0.098
Female	-0.110***	-0.044	-0.111***	-0.044	-0.431***	-0.121	-0.422***	-0.120
Marital status [c]								
Other	-0.033	-0.013	-0.019	-0.008	0.061	0.017		
Married (living)	-0.113***	-0.045	-0.102***	-0.041	0.061	0.017		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.082***	-0.033	-0.087***	-0.035	0.012	0.003		
No. of children	0.020	0.008			-0.030	-0.008		
0ther variables								
Drinkers	0.212***	0.083	0.208***	0.082	-0.074	-0.021		
Smokers	-0.203***	-0.080	-0.198***	-0.078	-0.198***	-0.053	-0.173***	-0.047
Voluntary activi.	0.096**	0.038	0.089**	0.035	-0.018	-0.005		
Club member	1.218***	0.448	1.211***	0.445	0.658***	0.190	0.624***	0.182
Health status [d]								
Good health	0.569***	0.218	0.570***	0.219	0.104	0.028		
Fair health	0.324***	0.128	0.325***	0.129	-0.283	-0.072		
Urban residence	-0.005	-0.002			0.082	0.023		
Obese	-0.132***	-0.052	-0.131***	-0.052	-0.210	-0.056		
Seasonal effect [e]								
Summer	0.260***	0.103	0.261***	0.104	0.116**	0.034	0.117**	0.034
Spring	0.103***	0.041	0.104***	0.041	0.056	0.016	0.063	0.018
Autumn	0.103***	0.041	0.102***	0.041	0.102*	0.029	0.111**	0.033
Region of residence [f]								
North east	-0.243***	-0.095	-0.245***	-0.096	0.102	0.030		
North west	-0.221***	-0.087	-0.220***	-0.086	0.080	0.023		
Yorkshire	-0.159***	-0.063	-0.162***	-0.064	-0.007	-0.002		
East Midlands	-0.069	-0.027	-0.074	-0.029	-0.045	-0.012		
West Midlands	-0.10***	-0.043	-0.109***	-0.043	-0.001	0.000		
East	-0.038	-0.015	-0.037	-0.014	-0.039	-0.011		
London	-0.203***	-0.080	-0.205***	-0.081	0.041	0.012		
South west	-0.066	-0.026	-0.066	-0.026	-0.020	-0.006		
Constant	0.077		0.084		-0.430**		-0.516***	
Observations	14142				6248			
Link test			*p*=0.204				*p*=0.169	
Pseudo R^2	0.239		0.238		0.108		0.094	
Goodness of fit			*p*=0.524 [g]				*p*=0.255 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. [g] Chi-square(8)=7.11 [h] Chi-square(8)= 10.14

Appendix 5.8 Results of bivariate probit model (sele. corr.): female sample (proxy index)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy index	0.082***	0.032	0.087***	0.034	0.071*	0.018	0.088***	0.025
Demographics								
Age	-0.018***	-0.007	-0.019***	-0.007	-0.005	-0.001		
No. of adults	-0.027	-0.010			-0.017	-0.004		
Access to vehic.	0.011	0.004			0.038	0.009		
Ethnicity [b]								
Mixed	0.110	0.046	0.109	0.048	-0.172	-0.039	-0.188	-0.049
Asian	-0.361***	-0.136	-0.403***	-0.148	0.354**	0.100	0.424***	0.137
Black	-0.050	-0.019	-0.052	-0.018	-0.020	-0.005	0.006	0.002
Chinese	0.076	0.030	0.076	0.031	-0.289	-0.061	-0.279	-0.070
Marital status [c]								
Other	-0.065	-0.026			0.039	0.010		
Married(living)	-0.076	-0.030			0.049	0.012		
Income	0.000	0.000			0.000**	0.000	0.000**	0.000
Full time work	-0.022	-0.008			0.063	0.015		
No. of children	0.002	0.001	-0.002	-0.001				
0ther variables								
Drinkers	0.295***	0.114	0.301***	0.118	-0.078	-0.019		
Smokers	-0.196***	-0.077	-0.197***	-0.077	-0.061	-0.015		
Voluntary activi.	0.121**	0.048	0.116**	0.048	-0.051	-0.012		
Club member	1.292***	0.476	1.295***	0.477	0.455*	0.125	0.340***	0.103
Health status [d]								
Good health	0.467***	0.174	0.474***	0.176				
Fair health	0.269***	0.107	0.272***	0.108				
Urban residence	-0.019	-0.007			0.160***	0.038	0.164**	0.044
Obese	-0.112***	-0.045	-0.113***	-0.047	-0.154*	-0.036	-0.154**	-0.042
Seasonal effect [e]								
Summer	0.207***	0.082	0.206***	0.082	0.163*	0.042	0.149*	0.044
Spring	0.064	0.025	0.063	0.025	0.018	0.005	0.010	0.003
Autumn	0.062	0.025	0.060	0.024	0.006	0.001	0.000	0.000
Region of residence [f]								
North east	-0.114	-0.045	-0.116	-0.047				
North west	-0.218***	-0.088	-0.210***	-0.088				
Yorkshire	-0.136**	-0.055	-0.134**	-0.055				
East Midlands	-0.035	-0.014	-0.037	-0.015				
West Midlands	-0.096	-0.040	-0.093	-0.040				
East	0.001	-0.002	0.010	0.000				
London	-0.180**	-0.076	-0.173**	-0.076				
South west	-0.024	-0.012	-0.017	-0.011				
Constant	-0.017		-0.104		-1.081***		-1.155***	
Observations	7818				3349			
Rho	-0.276		-0.394		-0.276		-0.394	
	p=0.375		*p*=0.001		*p*=0.375		*p*=0.001	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.9 Estimation results of 2 part model for male sample (proxy index)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef [a].	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy index	0.045	0.018	0.028	0.011	-0.030	-0.010	-0.005	-0.002
Demographics								
Age	-0.020***	-0.008	-0.020***	-0.008	-0.018***	-0.006	-0.015***	-0.005
No.of adults	0.000	0.000			-0.045	-0.015		
Access to vehic.	-0.026	-0.010			-0.172*	-0.058	-0.182**	-0.062
Ethnicity [b]								
Mixed	-0.167	-0.066			0.150	0.051	0.132	0.045
Asian	-0.034	-0.014			-0.133	-0.042	-0.088	-0.028
Black	-0.142	-0.056			-0.143	-0.045	-0.047	-0.015
Chinese	-0.052	-0.021			-0.688**	-0.173	-0.615**	-0.161
Marital status [c]								
Other	0.017	0.007	0.010	0.004	0.076	0.025		
Married (living)	-0.114**	-0.046	-0.121**	-0.048	0.105	0.035		
Income	0.000***	0.000	0.000***	0.000	0.000*	0.000	0.000***	0.000
Full time work	-0.142**	-0.057	-0.184***	-0.073	-0.013	-0.004		
No. of children	0.047**	0.019	0.048**	0.019	-0.063	-0.021		
0ther variables								
Drinkers	0.116**	0.046	0.111**	0.044	-0.117	-0.039		
Smokers	-0.222***	-0.088	-0.219***	-0.087	-0.276***	-0.086	-0.267***	-0.084
Voluntary activi.	0.038	0.015			0.003	0.001		
Club member	1.139***	0.416	1.129***	0.414	0.659***	0.219	0.635***	0.212
Health status [d]								
Good health	0.701***	0.269	0.692***	0.266	-0.075	-0.025		
Fair health	0.405***	0.159	0.396***	0.155	-0.535	-0.150		
Urban residence	0.013	0.005			0.030	0.010		
Obese	-0.136***	-0.054	-0.136***	-0.054	-0.254***	-0.079	-0.287***	-0.089
Seasonal effect [e]								
Summer	0.311***	0.123	0.310***	0.123	0.052	0.017	0.051	0.017
Spring	0.134***	0.054	0.137***	0.055	0.090	0.030	0.087	0.029
Autumn	0.133***	0.053	0.132***	0.053	0.170**	0.057	0.164**	0.056
Region of residence [f]								
North east	-0.402***	-0.157	-0.398***	-0.155	0.094	0.032	0.090	0.031
North west	-0.236***	-0.094	-0.235***	-0.093	0.020	0.006	0.023	0.008
Yorkshire	-0.186***	-0.074	-0.187***	-0.074	-0.076	-0.024	-0.063	-0.021
East Midlands	-0.129*	-0.051	-0.134*	-0.053	-0.081	-0.026	-0.091	-0.029
West Midlands	-0.130*	-0.052	-0.132*	-0.053	-0.068	-0.022	-0.062	-0.020
East	-0.082	-0.033	-0.085	-0.034	-0.184*	-0.058	-0.189*	-0.060
London	-0.237***	-0.094	-0.256***	-0.102	-0.038	-0.012	-0.043	-0.014
South west	-0.107	-0.043	-0.111	-0.044	-0.125	-0.040	-0.134	-0.043
Constant	0.089		0.154		0.226		-0.172	
Observations	6324				2899			
Link test			p=0.680				p=0.186	
Pseudo R^2	0.237		0.236		0.108		0.097	
Goodness of fit			p=0.897 [g]				p=0.346 [h]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. [g] Chi-square(8)=3.53 [h] Chi-square(8)= 8.99

Appendix 5.10 Estimation results of bivariate probit model (select. corre.): whole sample (proxies)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef [a].	ME	Coef [a].	ME	Coef [a].	ME	Coef [a].	ME
Proxies								
Proxy 1	0.172***	0.072	0.173***	0.073	0.058	0.013	0.078	0.016
Proxy 2	-0.003	0.007	0.006	0.012	0.060	0.013	0.073	0.014
Demographics								
Age	-0.019***	-0.008	-0.019***	-0.007	-0.013***	-0.003	-0.013***	-0.003
No. of adults	-0.006	-0.006			-0.027	-0.006		
Access to vehic.	0.011	0.007			-0.071	-0.016		
Ethnicity [b]								
Mixed	0.000	0.010	0.001	0.009	0.005	0.001	0.001	0.000
Asian	-0.199***	-0.081	-0.204***	-0.086	0.009	0.002	0.000	0.000
Black	-0.072	-0.018	-0.069	-0.017	-0.063	-0.014	-0.024	-0.005
Chinese	0.011	0.027	0.016	0.026	-0.488**	-0.082	-0.457**	-0.067
Female	-0.114***	-0.033	-0.112***	-0.031	-0.429***	-0.096	-0.426***	-0.084
Marital status [c]								
Other	-0.020	-0.007	-0.020	-0.005	0.041	0.009		
Married (living)	-0.103***	-0.033	-0.104***	-0.034	0.038	0.009		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.074***	-0.019	-0.064**	-0.013	0.008	0.002		
No. of children	0.020	0.004	0.022	0.005				
0ther variables								
Drinkers	0.217***	0.084	0.227***	0.087	-0.062	-0.014		
Smokers	-0.196***	-0.079	-0.196***	-0.078	-0.216***	-0.045	-0.199***	-0.036
Voluntary activi.	0.087**	0.033	0.083**	0.032	-0.017	-0.004		
Club member	1.217***	0.453	1.211***	0.452	0.675***	0.178	0.747***	0.180
Health status [d]								
Good health	0.583***	0.218	0.579***	0.217				
Fair health	0.334***	0.130	0.338***	0.130				
Urban residence	-0.001	0.004			0.104	0.022	0.110	0.021
Obese	-0.126***	-0.050	-0.127***	-0.050	-0.242***	-0.050	-0.257***	-0.046
Seasonal effect [e]								
Summer	0.257***	0.093	0.258***	0.094	0.112*	0.026	0.128**	0.026
Spring	0.100***	0.028	0.100***	0.028	0.058	0.013	0.062	0.012
Autumn	0.104***	0.038	0.102***	0.037	0.108*	0.025	0.117**	0.024
Region of residence [f]								
North east	-0.247***	-0.090	-0.248***	-0.089				
North west	-0.223***	-0.093	-0.226***	-0.093				
Yorkshire	-0.155***	-0.070	-0.157***	-0.070				
East Midlands	-0.069	-0.032	-0.070	-0.033				
West Midlands	-0.109**	-0.052	-0.110**	-0.051				
East	-0.039	-0.016	-0.035	-0.015				
London	-0.214***	-0.081	-0.220***	-0.082				
South west	-0.066	-0.026	-0.064	-0.026				
Constant	0.028		-0.009		-0.478***		-0.769***	
Observations	14142				6248			
Rho	0.014		0.151		0.014		0.151	
	p=0.933		*p*=0.354		p=0.933		p=0.354	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] single ; [d] bad health; [e] winter; [f] south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.11 Estimation results of bivariate probit model (select. corre.): male sample (proxies)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy 1	0.165***	0.066	0.159***	0.064	0.056	0.015	0.078	0.019
Proxy 2	-0.067	-0.026	-0.081*	-0.032	-0.068	-0.018	-0.021	-0.005
Demographics								
Age	-0.021***	-0.008	-0.022***	-0.009	-0.018***	-0.005	-0.017***	-0.004
No. of adults	0.003	0.001			-0.039	-0.010		
Access to vehic.	-0.006	-0.002			-0.166*	-0.047	-0.184**	-0.047
Ethnicity [b]								
Mixed	-0.178	-0.071			0.151	0.043	0.130	0.033
Asian	-0.047	-0.019			-0.130	-0.033	-0.080	-0.018
Black	-0.144	-0.057			-0.124	-0.031	-0.042	-0.010
Chinese	-0.101	-0.040			-0.702**	-0.131	-0.611**	-0.104
Marital status [c]								
Other	0.038	0.015	0.028	0.012	0.067	0.018		
Married(living)	-0.097*	-0.039	-0.106**	-0.041	0.069	0.018		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.122**	-0.049	-0.139**	-0.055	0.001	0.000		
No. of children	0.050***	0.020	0.050	0.019***				
0ther variables								
Drinkers	0.118**	0.047	0.135**	0.052	-0.095	-0.026		
Smokers	-0.213***	-0.085	-0.215***	-0.085	-0.299***	-0.074	-0.302***	-0.067
Voluntary activi.	0.026	0.010			-0.003	-0.001		
Club member	1.136***	0.415	1.128***	0.412	0.695***	0.211	0.745***	0.208
Health status [d]								
Good health	0.726***	0.278	0.717***	0.276				
Fair health	0.426***	0.165	0.431***	0.163				
Urban residence	0.015	0.006			0.067	0.018		
Obese	-0.129***	-0.051	-0.131***	-0.051	-0.281***	-0.069	-0.301***	-0.065
Seasonal effect [e]								
Summer	0.309***	0.122	0.309***	0.121	0.044	0.012	0.070	0.017
Spring	0.131**	0.052	0.131**	0.052	0.093	0.025	0.101	0.025
Autumn	0.135***	0.054	0.135***	0.053	0.176**	0.049	0.177**	0.044
Region of residence [f]								
North east	-0.407***	-0.159	-0.405***	-0.159				
North west	-0.240***	-0.095	-0.239***	-0.095				
Yorkshire	-0.179**	-0.071	-0.179**	-0.073				
East Midlands	-0.129*	-0.052	-0.128*	-0.053				
West Midlands	-0.130*	-0.052	-0.132*	-0.054				
East	-0.080	-0.033	-0.074	-0.033				
London	-0.244***	-0.097	-0.268***	-0.107				
South west	-0.107	-0.043	-0.102	-0.044				
Constant	0.087		0.139		-0.049		-0.288	
Observations	6324				2899			
Rho	0.060 p=0.794		0.219 p=0.390		0.060 p=0.794		0.219 p=0.390	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.12 Estimation results of bivariate probit model (select. cor.): whole sample (proxy index)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy index	0.066***	0.031	0.063***	0.031	0.021	0.005	0.039	0.008
Demographics								
Age	-0.019***	-0.008	-0.019***	-0.007	-0.013***	-0.003	-0.013***	-0.003
No. of adults	-0.008	-0.007			-0.029	-0.007		
Access to vehic.	-0.003	0.002			-0.068	-0.016		
Ethnicity [b]								
Mixed	0.006	0.012	0.008	0.011	-0.008	-0.002	0.003	0.001
Asian	-0.190***	-0.077	-0.196***	-0.082	0.015	0.004	-0.001	0.000
Black	-0.077	-0.019	-0.071	-0.017	-0.053	-0.012	-0.021	-0.004
Chinese	0.046	0.041	0.053	0.042	-0.484**	-0.084	-0.454**	-0.066
Female	-0.110***	-0.032	-0.112***	-0.032	-0.430***	-0.098	-0.429***	-0.084
Marital status [c]								
Other	-0.033	-0.011	-0.031	-0.009	0.044	0.010		
Married (living)	-0.113***	-0.036	-0.117***	-0.038	0.043	0.010		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.082***	-0.022	-0.084***	-0.021	0.017	0.004		
No. of children	0.020	0.005	0.023	0.006				
0ther variables								
Drinkers	0.212***	0.082	0.212***	0.082	-0.064	-0.015		
Smokers	-0.203***	-0.081	-0.200***	-0.079	-0.219***	-0.047	-0.201***	-0.037
Voluntary activi.	0.096**	0.036	0.090**	0.034	-0.018	-0.004		
Club member	1.218***	0.454	1.212***	0.452	0.666***	0.178	0.756***	0.181
Health status [d]								
Good health	0.569***	0.213	0.564***	0.213				
Fair health	0.323***	0.126	0.328***	0.126				
Urban residence	-0.005	0.002			0.105***	0.023	0.110***	0.021
Obese	-0.132***	-0.052	-0.134***	-0.052	-0.242***	-0.051	-0.259***	-0.046
Seasonal effect [e]								
Summer	0.260***	0.094	0.261***	0.095	0.110*	0.026	0.131**	0.027
Spring	0.103***	0.029	0.104***	0.029	0.055	0.013	0.060	0.012
Autumn	0.103***	0.038	0.103***	0.038	0.105*	0.024	0.117**	0.023
Region of residence [f]								
North east	-0.243***	-0.089	-0.242***	-0.088				
North west	-0.221***	-0.092	-0.223***	-0.091				
Yorkshire	-0.159***	-0.071	-0.160***	-0.071				
East Midlands	-0.069	-0.032	-0.071	-0.034				
West Midlands	-0.109**	-0.052	-0.108**	-0.051				
East	-0.038	-0.015	-0.035	-0.015				
London	-0.203***	-0.077	-0.208***	-0.078				
South west	-0.066	-0.026	-0.064	-0.026				
Constant	0.077		0.056		-0.415**		-0.711***	
Observations	14142				6248			
Rho	-0.002		0.166		-0.002		0.166	
	p=0.9916		*p*=0.315		*p*=0.9916		*p*=0.315	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.13 Estimation results of bivariate probit model (select. corr.): male sample (proxy index)

	Decision to participate				Decision to meet recommended level			
	Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost								
Proxy index	0.045	0.018	0.028	0.011	-0.020	-0.005	0.007	0.002
Demographics								
Age	-0.020***	-0.008	-0.020***	-0.008	-0.018***	-0.005	-0.017***	-0.004
No. of adults	0.000	0.000			-0.041	-0.011		
Access to vehic.	-0.026	-0.010			-0.173*	-0.048	-0.186**	-0.047
Ethnicity [b]								
Mixed	-0.165	-0.066			0.139	0.039	0.129	0.033
Asian	-0.035	-0.014			-0.111	-0.028	-0.088	-0.020
Black	-0.141	-0.056			-0.121	-0.030	-0.053	-0.012
Chinese	-0.053	-0.021			-0.675**	-0.126	-0.618**	-0.105
Marital status [c]								
Other	0.017	0.007	0.007	0.004	0.056	0.015		
Married(living)	-0.115**	-0.046	-0.124**	-0.048	0.063	0.017		
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Full time work	-0.142**	-0.057	-0.184***	-0.073	-0.004	-0.001		
No. of children	0.048**	0.019	0.049**	0.019				
0ther variables								
Drinkers	0.117**	0.046	0.116**	0.044	-0.090	-0.024		
Smokers	-0.222***	-0.088	-0.220***	-0.087	-0.311***	-0.076	-0.314***	-0.069
Voluntary activi	0.039	0.015			0.003	0.001		
Club member	1.140***	0.416	1.131***	0.414	0.708***	0.213	0.750***	0.210
Health status [d]								
Good health	0.701***	0.269	0.690***	0.266				
Fair health	0.411***	0.159	0.410***	0.155				
Urban residence	0.014	0.005			0.068	0.018		
Obese	-0.137***	-0.054	-0.140***	-0.054	-0.287***	-0.070	-0.300***	-0.065
Seasonal effect [e]								
Summer	0.312***	0.123	0.312***	0.123	0.050	0.013	0.074	0.018
Spring	0.135***	0.054	0.137***	0.055	0.096	0.026	0.101	0.025
Autumn	0.134***	0.053	0.134***	0.053	0.175**	0.048	0.177**	0.044
Region of residence [f]								
North east	-0.403***	-0.157	-0.398***	-0.155				
North west	-0.236***	-0.094	-0.234***	-0.093				
Yorkshire	-0.185***	-0.074	-0.183***	-0.074				
East Midlands	-0.127***	-0.051	-0.128*	-0.053				
West Midlands	-0.129*	-0.052	-0.129*	-0.053				
East	-0.079*	-0.033	-0.076	-0.034				
London	-0.237***	-0.094	-0.254***	-0.102				
South west	-0.104	-0.043	-0.103	-0.044				
Constant	0.087		0.147		-0.105		-0.330*	
Observations	6324				2899			
Rho	0.081		0.220		0.081		0.220	
	p=0.734		*p*=0.395		*p*=0.734		*p*=0.395	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health;
[e] Omitted category: winter; [f] Omitted category: south east. Rho is the estimate of the correlation of the error terms of the 'decision to participate' and 'decision to become physically active' equations

Appendix 5.14 Estimation results of the 'decision to meet recommended level of participation' in different types of physical activities: probit models (proxies)

	Low time intensive				Mod. time intensive				High time intensive			
	Base model		Reduced model		Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost												
Proxy 1	-0.061	-0.022	-0.023	-0.008	0.017	0.006	0.043	0.015	0.301***	0.110	0.322***	0.119
Proxy 2	0.006	0.002	0.112**	0.040	0.156**	0.053	0.159***	0.054	-0.224*	-0.081	-0.124	-0.045
Demographics												
Age	-0.013***	-0.005	-0.012***	-0.004	-0.011***	-0.004			-0.024***	-0.008	-0.016***	-0.006
No. of adults	-0.032	-0.011			-0.014	-0.005			-0.036	-0.013		
Access to vehic.	0.053	0.019			-0.201**	-0.073	-0.206**	-0.073	-0.060	-0.022		
Ethnicity [b]												
Mixed	0.218	0.081	0.276	0.105	0.068	0.041			-0.205	-0.069		
Asian	0.066	0.024	-0.003	-0.001	0.127	0.044			-0.064	-0.023		
Black	0.051	0.018	-0.095	-0.034	0.084	0.028			-0.021	-0.008		
Chinese	-0.496*	-0.154	-0.536**	-0.167	-0.472	-0.138			-0.476	-0.148		
Female	-0.489***	-0.175	-0.471***	-0.170	-0.539***	-0.180	-0.527***	-0.177	-0.398***	0.133	-0.397***	-0.133
Marital status [c]												
Other	0.094	0.034			0.063	0.021			0.211	0.078		
Married (living)	0.139	0.050			0.000	0.000			0.268	0.097		
Income	0.000**	0.000	0.000***	0.000	0.000	0.000			0.000	0.000		
Full time work	0.094	0.033			-0.050	-0.016			0.161	0.057		
No. of children	-0.002	-0.001			-0.043	-0.014			-0.064	-0.023		
0ther variables												
Drinkers	-0.035	-0.013			-0.112	-0.039			-0.129	-0.047		
Smokers	-0.165**	-0.058	-0.255***	-0.089	-0.164	-0.053			-0.425***	-0.142	-0.375***	-0.127
Voluntary activi.	-0.109	-0.038			0.072	0.024			0.090	0.033		
Club member	0.620	0.214			0.776***	0.265	0.835***	0.284	0.621***	0.213	0.608***	0.210
Health status [d]												
Good health	0.218	0.075			0.089	0.031			0.302	0.100		
Fair health	-0.199	-0.068			-0.301	-0.095			-0.136	-0.047		
Urban residence	0.140**	0.049	0.120**	0.043	0.049	0.017			0.000	0.000		

	Low time intensive				Mod. time intensive				High time intensive			
	Base model		Reduced model		Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Obese	-0.136*	-0.048	-0.201***	-0.070	-0.322***	-0.103	-0.417***	-0.131	-0.369***	-0.122	-0.349***	-0.117
Seasonal effect [e]												
Summer	0.147**	0.054	0.163**	0.060	0.037	0.014			0.143	0.052	0.125	0.046
Spring	0.109	0.040	0.114*	0.042	0.008	0.004			0.217*	0.079	0.192	0.070
Autumn	0.136*	0.049	0.120*	0.044	0.071	0.026			0.405***	0.151	0.416***	0.155
Region of residence [f]												
North east	0.188	0.070			0.042	0.014	0.071	0.025	0.131	0.048	0.114	0.042
North west	0.105	0.038			0.020	0.008	0.034	0.012	0.004	0.002	0.014	0.005
Yorkshire	0.042	0.015			0.085	0.029	0.128	0.045	-0.173	-0.060	-0.148	-0.051
East Midlands	-0.055	-0.020			0.007	0.002	0.002	0.001	0.086	0.031	0.080	0.029
West Midlands	0.059	0.021			0.202**	0.072	0.234**	0.084	-0.067	-0.024	-0.057	-0.020
East	0.023	0.008			-0.088	-0.029	-0.079	-0.027	-0.258*	-0.087	-0.260*	-0.089
London	-0.071	-0.025			0.059	0.020	0.131	0.046	-0.237	-0.081	-0.230	-0.079
South west	0.090	0.033			0.065	0.024	0.065	0.023	-0.469***	-0.150	-0.467***	-0.150
Constant	-0.645**		-0.048		-0.207		-0.678***		-0.055		-0.202	
Observations	3199				3370				1170			
Linktest			p=0.598				p=0.527				p=0.960	
Pseudo R^2	0.100		0.057		0.132		0.113		0.119		0.104	
Goodness of fit			p=0.767 [g]				p=0.690 [h]				p=0.608 [i]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*) [b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health; [e] Omitted category: winter; [f] Omitted category: south east [g] Chi-square(8)= 4.91 [h] Chi-square(8)= 5.62 [i] Chi-square(8)= 6.36

Appendix 5.15 Estimation results of the ‘decision to meet recommended level of participation’ in different types of physical activities: probit models (proxy index)

	Low time intensive				**Mod. time intensive**				**High time intensive**			
	Base model		Reduced model		Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Oppor. cost												
Proxy index	-0.030	-0.011	0.001	0.000	0.040	0.014	0.055**	0.019	0.039	0.014	0.050	0.014
Demographics												
Age	-0.013***	-0.005	-0.013***	-0.005	-0.011***	-0.004			-0.022***	-0.008	-0.015***	-0.006
No. of adults	-0.031	-0.011			-0.013	-0.004			-0.039	-0.014		
Access to vehic.	0.060	0.021			-0.195	-0.069			-0.089	-0.032		
Ethnicity [b]												
Mixed	0.201	0.075	0.204	0.076	0.079	0.028			-0.269	-0.090		
Asian	0.067	0.024	0.027	0.010	0.132	0.047			-0.040	-0.014		
Black	0.058	0.021	0.008	0.003	0.070	0.024			-0.041	-0.014		
Chinese	-0.496*	-0.154	-0.504*	-0.157	-0.493	-0.142			-0.391	-0.126		
Female	-0.489***	-0.175	-0.520***	-0.187	-0.542***	-0.181	-0.475***	-0.164	-0.379***	-0.127	-0.366***	-0.123
Marital status [c]												
Other	0.100	0.037	0.099	0.036	0.081	0.028			0.181	0.067		
Married(living)	0.144*	0.052	0.130*	0.047	0.011	0.004			0.256	0.093		
Income	0.000***	0.000	0.000***	0.000	0.000	0.000			0.000	0.000		
Full time work	0.101	0.036			-0.033	-0.011			0.069	0.025		
No. of children	-0.002	-0.001			-0.041	-0.014			-0.075	-0.027		
0ther variables												
Drinkers	-0.033	-0.012			-0.112	-0.039			-0.123	-0.045		
Smokers	-0.165**	-0.058	-0.162**	-0.057	-0.154	-0.051			-0.447***	-0.149	-0.458***	-0.137
Voluntary activi.	-0.113	-0.040			0.066	0.023			0.109	0.040		
Club member	0.620***	0.214	0.588***	0.204	0.776	0.264			0.618***	0.213	0.621***	0.210
Health status [d]												
Good health	0.229	0.078			0.119	0.039			0.289	0.097		
Fair health	-0.190	-0.066			-0.279	-0.089			-0.119	-0.042		
Urban residence	0.141**	0.050	0.135**	0.048	0.046	0.016			-0.020	-0.007		

	Low time intensive				Mod. time intensive				High time intensive			
	Base model		Reduced model		Base model		Reduced model		Base model		Reduced model	
Variables	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME	Coef. [a]	ME
Obese	-0.131*	-0.046	-0.166**	-0.058	-0.315***	-0.100	-0.445***	-0.142	-0.398***	-0.131	-0.386***	-0.129
Seasonal effect [e]												
Summer	0.143**	0.052	0.145**	0.053	0.041	0.014			0.173	0.063	0.153	0.056
Spring	0.107	0.039	0.101	0.037	0.009	0.003			0.223*	0.082	0.199*	0.075
Autumn	0.133*	0.048	0.131*	0.048	0.078	0.027			0.384***	0.143	0.406***	0.152
Region of residence [f]												
North east	0.186	0.069			0.036	0.012	0.152	0.055	0.144	0.053	0.144	0.046
North west	0.105	0.038			0.016	0.005	0.088	0.032	-0.007	-0.003	0.006	0.002
Yorkshire	0.045	0.016			0.085	0.030	0.189**	0.069	-0.171	-0.059	-0.149	-0.055
East Midlands	-0.054	-0.019			-0.001	0.000	0.026	0.009	0.102	0.037	0.092	0.030
West Midlands	0.058	0.021			0.198**	0.070	0.245**	0.090	-0.063	-0.022	-0.056	-0.021
East	0.026	0.009			-0.095	-0.032	-0.043	-0.015	-0.258*	-0.088	-0.261*	-0.091
London	-0.074	-0.026			0.054	0.019	0.181**	0.066	-0.187	-0.065	-0.172	-0.064
South west	0.090	0.033			0.067	0.023	0.045	0.016	-0.469***	-0.150	-0.469***	-0.150
Constant	-0.671**		-0.373***		-0.123		-0.313***		-0.075		-0.214	
Observations	3199				3370				1170			
Linktest			*p*=0.165				*p*=0.805				*p*=0.800	
Pseudo R^2	0.100		0.089		0.130		0.041		0.110		0.096	
Goodness of fit			*p*=0.224 [g]				*p*=0.944 [h]				*p*= 0.263 [i]	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*) [b] Omitted category: white; [c] Omitted category: single ; [d] Omitted category: bad health; [e] Omitted category: winter; [f] Omitted category: south east [g] Chi-square(8)= 10.62 [h] Chi-square(8)= 2.84 [i] Chi-square(8)= 10.03

Appendix 5.16 Groups of different physical activities

Groups	Types of physical activities	Mean(SD) time per session
Low time intensive	running/jogging	10.7(18.0)
	workout at gym/exercise bike/weight training	14.5(19.6)
	exercise(e.g. press ups, sits ups)	7.5(24.3)
Moderate time intensive	aerobics/keep fit/ gymnastics/dance for fitness	21.1(39.1)
	swimming	21.3(34.3)
	cycling	22.3(40.5)
High time intensive	squash	23.7(20.7)
	football/rugby	26.8(30.3)
	badminton/tennis	30.5(28.8)

Appendix 6.1 Description of questionnaire (developed by Taks and Kessenne 2000)

The purpose of the questionnaire was to collect data on expenditure related to sports participation in Flanders, Belgium. It consisted of three sections (a) sports expenditure (b) sports participation, and (c) demographic profile. It must be emphasised that only the sports expenditure questions were used in this thesis. The mode of administration of the questionnaire was face-to-face interviews. The questionnaire was originally in Dutch, not English, so it was translated, with translation undertaken by a native Dutch speaker (a health economist by profession) with excellent proficiency in English. The translated questionnaire was then reviewed and approved by the first author of the questionnaire, who also has excellent proficiency in English.

Appendix 6.2: Questionnaire on costs of participation in physical activity

QUESTIONNAIRE

Name of interviewer……
Interview date……..
Location of interview……
Number of interview…….

Dear Sir/Madam
We would like to express our sincere thanks for your participation in this study. The objective of this study is to determine costs on participation in sports and exercise activities. It will take approximately ……… It is important to the research that the

questionnaire is answered as accurately as you can. We encourage you to take your time and think about the answers. If any of the questions is not completely clear to you, please let me know, and I'll read again.

The first part of the questionnaire contains specific questions about your money expenditures and travel time related to participation in sports and exercise activities. The last part aims to identify your working hours.

All your answers will be treated anonymously and will solely be used for research purposes. Again, we are thanking you in advance for your kind cooperation.

1. COSTS ON SPORTS AND EXERCISE PARTICIPATION

SHOW CARD A
Now I am going to ask you about costs related your participation in sports and exercise activities during the last four weeks. By sports and exercise activities I mean activities defined on this card. Please include payments on all /any of these activities you have taken part in, but do not include those related to spectatoring of these activities. Please remember to include any payments you made online or had automatically deducted.

DIRECT EXPENSES
Membership
1. Did you pay membership fees to play/practice your sports and exercise activities?
[That is since (date four weeks ago)]

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|

License
2. Did you pay for license required to play/practice your sports and exercise activities?
[That is since (date four weeks ago)]

1 Yes	2 No

If yes, (a) how much did you usually pay per usage? |__||__||__|, |__||__|
(b) how much did you pay in total per month? |__||__||__|, |__||__|

Registration
3. Did you pay for registration fees for initial subscription to sports club? *(That is since: date four weeks ago)*

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|
Competitions
4. Did you pay for registration or entry fees for participation in tournaments and/or competitions related to sports and exercise (excl. membership fees)? *(That is since: date four weeks ago)*

1 Yes	2 No

If yes, (a) how much did you usually pay per practice? |__||__||__|, |__||__|
(b) how much did you pay in total per month? |__||__||__|, |__||__|

Entrance
5. Did you pay for entrance charges or rent for using sports infrastructures (e.g. sport halls, sport fields, tennis courts etc)? *[That is since: date four weeks ago]*

1 Yes	2 No

If yes, (a) how much did you usually pay per usage?
(b) how much did you pay in total per month?

Classes
6. Did you pay for your participation in sports classes, training sessions, inductions, etc ? *(That is since: date four weeks ago)*

1 Yes	2 No

If yes, (a) how much did you usually pay per practice?
(b) how much did you pay in total per month?

Camps
7. Did you pay for your participation in sports or training camps? *(That is since: date four weeks ago)*

1 Yes	2 No

If yes, (a) how much did you usually pay per practice?
(b) how much did you pay in total per month?

Holidays
8. Did you pay for your participation in sports holidays or vacation (i.e. organised holidays with the main objective to practice sport and exercise activities)? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, (a) how much did you usually pay per vacation?
(b) how much did you pay in total per month?

Rent
9. Did you pay rent or charges for using sports equipment, sports kits, sports clothing and sports shoes? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, (a) how much did you usually pay per usage?
(b) how much did you pay in total per month?

Facilities
10. Did you pay for maintenance of sports facilities and equipment you may own? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, (a) how much did you usually pay per maintenance?
(b) how much did you pay in total per month?

Kit
11. Did you pay for sports clothes, and kits to play/practice your sports and exercise activities? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, how much? ¦_¦¦_¦¦_¦, ¦_¦¦_¦

INDIRECT EXPENSES
Apart from your direct sports expenses, presumably, you incur some indirect costs related to practising sports and exercise activities

Travel
12. How did you usually travel to and from the location where you practice sports and exercise activities? *[That is since (date four weeks ago)]*

By foot	1
By own vehicle	2
By public transportation	3
By bicycle	4
Others	5

APPLIES TO ALL
Kilometre
How many kilometres did you usually travel, back and forth per practice? ¦_¦¦_¦¦_¦

Time
How much time did you usually spend travelling, back and forth per practice? ¦_¦¦_¦¦_¦

APPLIES If Travel=2
Parking
Did you pay for parking costs at the location where you practice sports and exercise? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, how much did you usually pay per practice? ¦_¦¦_¦¦_¦, ¦_¦¦_¦

APPLIES IF Travel=3
Ticket
How much did you usually pay, back and forth per practice? ¦_¦¦_¦¦_¦, ¦_¦¦_¦

Care
13. Did you pay for medical care related to your participation in sports and exercise activities? Please do not include medical care covered by insurance or paid for by the NHS. *[That is since (date four weeks ago/1year ago]*

1 Yes	2 No

If yes, how much? ¦_¦¦_¦¦_¦, ¦_¦¦_¦

Body
14. Did you pay to take care of your body or to buy special nutrition related to your participation in sports and exercise activities? *[That is since (date four weeks ago/1year ago]*

1 Yes	2 No

If yes, how much? ¦_¦¦_¦¦_¦, ¦_¦¦_¦

Insurance
15. Did you pay for insurance (if not included in membership fee) related to your participation in sports and exercise activities? *[That is since (date four weeks ago]*

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|

Nanny
16. Did you pay for the care of any dependents (including babies, partners or any other relatives) in order to participate in sports and exercise activities? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, (a) how much did you usually pay per practice? |__||__||__|, |__||__|
(b) how much did you pay in total per month? |__||__||__|, |__||__|

Books
17. Did you pay for documents (i.e. books, magazines, newspapers etc) related to your participation in sports and exercise activities? *[That is since (date four weeks ago)]*

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|

Club
18. Did you pay for club activities (i.e. fundraisers, dinner etc) related to your participation in sports and exercise activities? *[That is since (date four weeks ago/1year ago]*

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|

Other
19. Did you pay money related to your participation in sports and exercise activities that have not been mentioned yet? *[That is since (date four weeks ago/1year ago]*

1 Yes	2 No

If yes, how much? |__||__||__|, |__||__|

SHOW CARD A
Any activity that involves the exertion of force generated by skeletal muscle that result in energy expenditure above resting level[192]. For example[193] workout at the gym, motor sport, dancing for fitness, archery, fencing, walking, bowling, mountain climbing, rugby, windsurfing, and others.

INTERVIEWER INSTRUCTION: If necessary (i.e. if respondent is in doubt) show the list below

1. alpinism (trekking, altitude hiking, …)	40. lawn bowling
2. American football	41. parachute jumping
3. athletics	42. paragliding
4. motor / car sport	43. rafting
5. badminton	44. rowing
6. basketball	45. skating / roller skating / inline skating
7. biathlon	46. rugby
8. body-building / weight training / power training…	47. ice skating
9. boxing	48. fencing
10. ballgames	49. shooting
11. archery	50. snow-boarding
12. bowling	51. skiing
13. dance for fitness (jazz dance, ballet…)	52. speleology
14. scuba diving	53. squash
15. cycling, mountain biking	54. surfing
16. workout at gym, conditioning activities (aerobics, keep fit, callanetics, rope-skipping, aqua gym…)	55. table tennis
17. frisbee	56. tennis
18. martial arts (karate, taekwondo, tai chi, …)	57. triathlon / decathlon
19. golf	58. darts
20. gymnastics (acrobatics, tumbling, trampoline) / yoga	59. volleyball
21. handball	60. hiking
22. angling	61. water polo
23. hockey	62. waterskiing / jet skiing
24. baseball	63. bicycle racing
25. wall climbing (indoor/outdoor)	64. windsurfing
26. jogging/ running	65. wrestling
27. judo	66. football (indoor/outdoor)
28. cricket	67. sailing
29. canoeing / kayaking	68. boating / punting
30. play skittles (ninepins)	69. gliding
31. clay pigeon shooting	70. swimming / (springboard) diving
32. rock / mountain climbing	71. lacrosse
33. korfball	72.rounders
34. powerball	73.snooker
35. figure-skating	74. other type of sports
36. cross-country skiing (Nordic skiing)	75.walking
37. mini-golf	
38. orienteering	
39. horse riding /racing	

[192] Department of Health (2004): At least five a week - evidence on the impact of physical activity and its relationship to health - a report from the Chief Medical Officer.
[193] The activities were chosen to reflect high intensity and low intensity activities.

Appendix 6.3 Semi-structured interview schedule for experts review

Content validity
cvalid
Do you think this questionnaire includes all components of costs related to participation in physical activity?

(INTERVIEWER: If response to *cvalid* indicates incompleteness, proceed to *cmiss*. If not, skip to *cother*)
cmiss
Which components of costs are missing?

cother
Do you have any other comments on the cost components covered in this questionnaire?

Face validity
fvalid
Do you think the use of ‘usual payment per occasion’ to capture unit costs is correct?
Yes 1
No 2

(INTERVIEWER: If fvalid=1, proceed to *freason)*
freason
Could you please explain why?

Feasibility
SHOW CARD B
Looking at the information on show card, how do you assess the viability of a future national survey using this questionnaire?

Appropriateness
Would you say the content of this questionnaire matches the intended purpose of the study?

Appendix 6.4 Probing questions for cognitive interviews

Probes to check comprehension

- Can you tell me what this introduction says?
- What to you are ‘entrance charges’?
- What to you is a ‘tournament or competition’?
- Do you think participation fees for tournaments as asked in this question include payment made to watch tournament or competition? Yes 1 No 2 (either way) Why?
- Do you think parking fee include any fines incurred for wrongful parking? 1 Yes 2 No (If yes why?)
- I asked you about ‘any special nutritional supplement’ you may have bought to do sport or exercise activities’, were you unsure about including payments on some items. 1 Yes 2 No. If yes, what are those items?
- Was it hard or easy to answer this question? (either way) why?
- I asked you about ‘any body aids you may have bought to do sports or exercise activities’, were you unsure about including payments on some items? 1 Yes 2 No. if yes, what are those items?
- What to you is a ‘private vehicle’

Probes to check recall strategy/confidence of recall

- How did you arrive at the amount you usually pay food or drinks directly associated with your participation in sports or exercise activities at every occasion?
- How do you remember this?
- How did you arrive at ‘your usual mode of travel’?
- How do you remember this?
- How do you remember the miles you usually travel back and forth at every occasion to do sports or exercise activities?
- How do you remember this?
- How sure are you of your answer?

Appendix 6.5 Respondent debriefing questions

To assess face validity

- I asked you about your money expenditure related to your participation in sports or exercise activities. Do you think this include one-off payments[194]? 1 Yes 2 No

- Did you include any expenses you have made related to other peoples' participation in sports or exercise activities? Yes/No Why?(either way)

- Can you please tell me which reference period the questions were asking about?

- What 'usual payment' to you is as asked in this questionnaire?

- What do you think about the reference period used in the questionnaire?

- Do you find any questions/question not clear in meaning?
  1 Yes 2 No
  If yes, which ones/one?

- Do you recommend any changes to the language used in the questionnaire?
  1 Yes 2 No
  If yes, how?

To assess acceptability

- Can you think of any reasons why you would not like to answer this questionnaire?

- Can you tell me what you think about the time you spent to answer this questionnaire?

- Can you tell me what you think about the order of the questions?

- What would you want to be changed about this questionnaire?

- Did you find it difficult to answer any questions/questions? 1 Yes 2 No If yes, which one/ones?

Description of difficult questions	Reasons
1.	
2.	
3.	
4.	

- In general, how difficult or easy was it to answer this questionnaire?

code		Reasons
1	Very easy	
2	easy	
3	neither	
4	difficult	
5	Very difficult	

[194] We suspect that people might only include regular payments.

<u>**Appendix 6.6 Questionnaire with probes**</u>

QUESTIONNAIRE
On
Sports and Exercise Activities

Thank you for agreeing to participate in this study. The objective of this study is to understand how much people spend participating in sports and exercise activities. It will take approximately ……… minutes to complete the questionnaire. It is important for research purposes that the questionnaire is answered as accurately as possible. We encourage you to take time to think about the answers. Please note if any of the questions are not clear to you, please ask me to clarify.

The first part of the questionnaire contains specific questions about your participation in sports or exercise activities participation. The second part aims to identify the money and time expenditure you may have incurred doing sports or exercise activities.

All answers will be treated confidentially. Once again, thank you for your kind cooperation.

Name of Interviewer	
Interview Date	
Location of Interview	
Number of Interview	

1. Sports and Exercise Participation
I would like to ask you about the sports or exercise activities you have done in the past four weeks.

Sprts
SHOW CARD A
Can you tell me if you have done any activities on this card during the last four weeks, that is since (date four weeks ago)? Include teaching, coaching, training and practice sessions
Yes 1
No 2

If Sprts = 1 THEN,
Activi
Which have you done in the last four weeks? PROBE ‘Any others?
CODE ALL THAT APPLY
1 Swimming
2 Cycling
3 Workout at a gym/Exercise bike /Weight training
4 Aerobics/Keep fit/Gymnastics/Dance for fitness
5 Running/Jogging
6 Football/rugby
7 Badminton/tennis
8 Squash
9 Exercises (e.g. press-ups, sit ups)

FOR Activi: 10 TO 15 DO
Otheract
Have you done any other sport or exercise not listed on the card?
Yes 1
No 2

If Otheract=1 THEN
NameOtheract
INTERVIEWER: Probe for name/names of sport or exercise. Write.
Text:……………

FOR Activi: 1-15 DO
Qty
Can you tell me on how many separate days did you do (*activity*) during the past four weeks, that is since (date four weeks ago)?
|__||__|

Time
How much time did you usually spend doing (*activity*) on each day?
Text…………

Intensity
During the past four weeks, was the effort of the (*activity*) usually enough to make you out of breath and sweaty?
Yes 1
No 2

2. Money Expenditure on Sports and Exercise Participation

Now I am going to ask you about money expenditure on your participation in sports or exercise activities during the past four weeks. Please remember to include any payments you have made online and/or any subscriptions automatically charged to your account. Please do not include money spent spectating any events.

Probes (to check comprehension)
Can you tell me what this introduction says?

2a. **Direct Expenses**
Please answer the following questions separately for each of the activities you have done, and note that all questions relate to expenses incurred in the last four weeks, that is since (date four weeks ago)

2b. *Membership*

Activity	**Have you paid membership fees to do (*activity*) in the past four weeks?**	
	Yes 1 **No 2**	**If yes, how much?**

2c. *Joining*

Activity	Have you paid joining fees in addition to membership fees for an initial subscription to sports club to do (*activity*) during the past four weeks?	
	Yes 1 No 2	**If yes, how much?**

Probes (To check recall strategy)
How do you remember this?

2d. *Entrance*

	Activity	Yes 1 No 2	How much do you usually pay at every occasion during the past four weeks?	On how many occasions have you paid?	How much have you paid in total for the past four weeks
Have you paid entrance charges for using sports or exercise facilities (e.g. sport halls, sport fields, tennis courts, swimming pools etc) to do *(activity)* during the past four weeks? (if not included in membership fees)					

Probe (to check comprehension)
What to you are 'entrance charges'?

2e. *Competitions*

	Activity	Yes 1 No 2	How much do you usually pay for each day of tournament or competition during the past four weeks?	How many days have you paid to participate in tournament or competition?	How much have you paid in total for the past four weeks
Have you paid participation fees for tournaments or competitions related to *(activity)* during the past four weeks?					

Probes (to check comprehension)
What to you is a 'tournament or competition'?
Do you think participation fees for tournaments as asked in this question include payment made to watch tournament or competition? Yes 1 No 2 (either way) Why?

2f. *Classes*

	Activity	Yes 1 No 2	How much do you usually pay for each day of attendance during the past four weeks?	How many days have you paid to attend?	How much have you paid in total for the past four weeks
Have you paid for attendance in any classes, training sessions, inductions etc, related to (*activity*) in the past four weeks? (if not included in membership fee)					

2g. *License*

Activity	Have you paid license to do (*activity*) in the past four weeks?	
	Yes 1 **No 2**	**If yes, how much?**

2h. *Refreshment*

	Activity	Yes 1 No 2	How much do you **usually** pay at every occasion during the past four weeks?	On how **many occasions** have you paid?	How much have you paid in **total** for the past four weeks
Have you paid for drinks or food directly associated with participating in (*activity*) during the past four weeks?					

Probes (To check recall strategy)

How did you arrive at the amount you usually pay for food or drinks directly associated with your participation in sports or exercise activities at every occasion?

2i. *Apparel (Hire)*

	Activity	Yes 1 No 2	Which **items** do you usually hire?	How much do you **usually** pay to hire **each item** at every occasion during the past four weeks?	On how **many occasions** have you hired **each item**?	How much have you paid in **total** for the past four weeks
Have you paid to hire sports equipment, kit, clothing, or shoes, to do (*activity*) in the past four weeks?						

2j. *Apparel (Bought)*

Activity	Have you bought any sports equipment, kit, clothing, or shoes, to do (*activity*) in the past four weeks?	
	Yes 1 **No 2**	**If yes, how much?**

Probes (To check recall strategy)

How do you remember this?

3. Indirect Expenses

Apart from your direct sports expenses you may have incurred some indirect expenses related to sports or exercise activities.

3a. *Travel*

What was your <u>usual</u> mode of travel to and from the location where you did (*activity*) during the past four weeks?

Activity	**Mode of travel**				
	On foot 1	**By private vehicle 2**	**By public transportation 3**	**By bicycle 4**	**Others 5**

<u>Probe (to test recall strategy)</u>

How did you arrive at 'your usual mode of travel'?

Probe (to test comprehension)

What to you is a 'private vehicle'? (we will like to capture lifts by gym buddies as well, and motor cycle)

3b. *Time*

How much <u>time</u> do you usually spend travelling, back and forth at every occasion to do (*activity*), during the past four weeks? …………….Hours…………..Minutes

<u>Probes (To check recall strategy)</u>

How do you remember this?

3c. *Distance*

How <u>many miles</u> do you usually travel, back and forth at every occasion to do (*activity*), during the past four weeks?

Activity	**Distance**				
	Less than 5 miles: 1	**5-10 miles: 2**	**10-15 miles: 3**	**15-20 miles: 4**	**20 miles or more: 5**

<u>Probe (to test recall strategy)</u>

How do you remember the miles you 'usually travel back and forth at every occasion' to do sports or exercise activities?

<u>Probe (to check confidence of recall)</u>

How sure are you of your answer?

APPLIES If Travel=2

3a (i). *Parking*

	Activity	Yes 1 No 2	How much do you <u>usually</u> pay at every occasion during the past four weeks?	On how <u>many occasions</u> have you paid?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid parking fee at the location where you did (*activity*) during the past four weeks?					

<u>*Probe (to test comprehension)*</u>

Do you think 'parking fee' include any fines incurred for wrongful parking?

1 Yes 2 No

If yes, why?

APPLIES IF Travel=3

3a (ii). *Transport*

	Activity	Yes 1 No 2	How much do you <u>usually</u> pay to travel back and forth at every occasion during the past four weeks?	On how <u>many occasions</u> have you paid?	How much have you paid in <u>total</u> for the last four weeks
Have you paid for transport ticket to travel to do (*activity*) during the past four weeks?					

3d. *Nutrition*

Activity	Have you bought any special nutritional supplements such as dietary supplements related to your participation in (*activity*) during the past four weeks?	
	Yes 1 No 2	If yes, how much?

<u>*Probe (To check comprehension)*</u>

I asked you about 'any special nutritional supplement' you may have bought to do sports or exercise activities', were you unsure about including payments on some items 1 Yes 2 No.

If yes, what are those items?

3d. *Insurance*

Activity	Have you paid insurance related to your participation in (*activity*) during the past four weeks? (if not included in membership fee)	
	Yes 1 No 2	If yes, how much?

3e. *Care*

Activity	Have you paid for medical care such as seeking treatment for injury obtained while doing (*activity*) in the past four weeks? Please do not include medical care covered by insurance or paid for by the NHS.	
	Yes 1 **No 2**	**If yes, how much?**

<u>*Probe (to test comprehension)*</u>
Was it hard or easy to answer this question? (either way) why?

3f. *Aids*

Activity	Have you bought any body aids (e.g. elastic limb support) to do (*activity*) during the past four weeks?	
	Yes 1 **No 2**	**If yes, how much?**

<u>Probe (to test comprehension)</u>
I asked you about 'any body aids you may have bought to do sports or exercise activities', were you unsure about including payments on some items? 1 Yes 2 No.
If yes, what are those items?

3g. *Maintenance*

Activity	Have you paid for maintenance of personal sports equipment such as dry cleaning, repair etc, during the past four weeks?	
	Yes 1 **No 2**	**If yes, how much?**

3h. *Dependents*

	Activity	Yes 1 No 2	How much do you <u>usually</u> pay at every occasion during the past four weeks?	On how <u>many</u> <u>occasions</u> have you paid?	How much have you paid in <u>total</u> for the past four weeks
Have you paid for the care of any dependents (including babies, partners or any other relatives) in order to participate in (*activity*) during the past four weeks?					

3i. *Other*

Activity	Have you spent any money in the last four weeks as a result of participating in (*activity*) that have not been mentioned above?	
	Yes 1 **No 2**	**If yes, how much?**

CARD A

1 Swimming 2 Cycling 3 Workout at a gym/Exercise bike /Weight training 4 Aerobics/Keep fit/Gymnastics/Dance for fitness 5 Running/Jogging 6 Football/rugby 7 Badminton/tennis 8 Squash 9 Exercises(e.g. press-ups, sit ups)

Appendix 6.7 Questionnaire appraisal form for expert review

Instruction: Now I'd like to check what you think about the questionnaire. Can you please fill the questionnaire appraisal form below:

	Yes No	Comments(if yes)
Inaccurate instructions		
Inaccurate introductions(including show card), or explanations		
Any question or questions lengthy, awkward, ungrammatical		
Technical terms are undefined, unclear, or complex		
Any vague question/questions		
Reference periods are missing, not well specified , or in conflict		
Any negative question/questions		
Any general comments		

Appendix 6.8 SHOWCARD B (for expert review)

The PHD is focussed on understanding the choices that individuals make about the extent to which they engage in physical activity, from an economic perspective. A specified output of this work has indicated the importance of accounting for both money and time costs in specifying the demand for physical activity. However, there is dearth of research on this issue to date, in part due to data inadequacy on these costs. A search for data that incorporates both time and money costs alongside indicators of physical activity found that no such surveys exist in the England. Thus, the aim is to conduct a follow-up survey to the Health Survey for England (HSE) 2008 and ask about time and money costs on physical activity using this questionnaire, for which potential cost estimates are shown below.

Potential cost estimates of a future national survey

Type interview	Approx costs* VAT not included
1000 10 min telephone follow-up interviews from national probability sample	£52,000
1000 15 min telephone follow-up interviews from national probability sample	£58,000
150 30 min face to face interviews	£52,000-58,000

* Cost estimates were collected from market research organisations

Appendix 6.9 Expert recommendations that were not considered

Differing views on reference period

- There were differing expert opinions on the reference period used in the questionnaire. Though the experts in general thought the reference period was adequate, one of them suggested that replacement of the reference period of 'last four weeks' with 'last two weeks' to aid recall and retrieval of information. This suggestion was however not carried forward due to the following reasons: (a) using a reference period of 'last two weeks' is likely to be inconsistent with the reference period (i.e. last four weeks) generally used by national surveys on participation in sports or exercise activities, which any future survey using this questionnaire intends to follow-up (b) to capture potential seasonal variation in expenditure on physical activity participation, any future national survey using the questionnaire may be carried out throughout the year. Thus, using a 'last two weeks' as the reference period is likely to warrant the collection of data each fortnight throughout the year, a practice which may inflate the resources needed, and tend to affect the feasibility of such a survey.

Specification of unit costs

- Although likely to aid recall, the use of 'payment made the last time' was not preferred to 'usual payment made'. It was considered that the former may not reflect the true cost per unit this study aims to capture as it may be a 'one off payment'. For example, in situations of promotions or sales, capturing 'payment made the last time' may not tend to reflect the true cost per unit during the reference period under consideration. It must be said however that there was a consideration to capture both alternatives in the questionnaire, but this was not implemented due to the burden it may create for respondents.

Appendix 6.10 Findings not considered in revising questionnaire (first set of cognitive interviewing)

Time spent to answer questionnaire

One respondent indicated that that time involved was relatively long. Further probing revealed that this respondent did not differentiate between the cognitive interview probes and the main questions in his/her assessment of the time spent answering the questionnaire. This is unsurprising since one demerit related to the use of probing technique in cognitive interviews is that respondents often tend to confuse probes with survey questions (Willis 2005).

Reference period

Suggestions to broaden the reference period in order to capture 'periodic costs' was not addressed because that may lead to recall problems and would be inconsistent with the reference period used by the survey to be followed on (i.e. HSE). Notwithstanding, future national surveys may need to collect data across the whole year to account for such periodic costs.

Appendix 6.11 Finding not considered in revising questionnaire (second set of cognitive interviewing)

Potential reasons for non-response

The sensitive nature of the questionnaire in terms of expenditure questions was also noted to be potential reason for non–response. This may, however, not be classified as evidence of specific problems with the questionnaire per se, but likely general problem with questionnaire on physical activity participation and expenditure. Nonetheless, it is hoped the response rate and the extent of 'missingness' in data to be collected from future survey may provide further insights.

Appendix 6.12 Revised questionnaire after the whole pre-testing

QUESTIONNAIRE
On
Sports and Exercise Activities

Thank you for agreeing to participate in this study. The objective of this study is to understand how much people spend participating in sports and exercise activities. It will take approximately ……… minutes to complete the questionnaire. It is important for research purposes that the questionnaire is answered as accurately as possible. We encourage you to take time to think about the answers. Please note if any of the questions are not clear to you, please ask me to clarify.

The first part of the questionnaire contains specific questions about money expenditures and travel times. The second part aims to identify general information, background data about you and benefits expected or gained from participation in sports or exercise activities.

All answers will be treated confidentially. Once again, thank you for your kind cooperation.

Name of Interviewer	
Interview Date	
Location of Interview	
Number of Interview	

4. Sports and Exercise Participation

I would like to ask you about the sports or exercise activities you have done in the past four weeks.

Sprts
SHOW CARD A
Can you tell me if you have done any activities on this card during the last four weeks, that is since (date four weeks ago)? Include teaching, coaching, training and practice sessions
Yes 1
No 2

If Sprts = 1 THEN,
Activi
Which have you done in the last four weeks? PROBE ‘Any others?
CODE ALL THAT APPLY
1 Swimming
2 Cycling
3 Workout at a gym/Exercise bike /Weight training
4 Aerobics/Keep fit/Gymnastics/Dance for fitness
5 Running/Jogging
6 Football/rugby
7 Badminton/tennis
8 Squash
9 Exercises (e.g. press-ups, sit ups)

FOR Activi: 10 TO 15 DO
Otheract
Have you done any other sport or exercise not listed on the card?
Yes 1
No 2

If Otheract=1 THEN
NameOtheract
INTERVIEWER: Probe for name/names of sport or exercise. Write.
Text:……………

FOR Activi: 1-15 DO
Qty
Can you tell me on how many separate days did you do (*activity*) during the past four weeks, that is since (date four weeks ago)?
|__||__|

Time
How much time did you usually spend doing (*activity*) on each day?
Text…………

Intensity
During the past four weeks, was the effort of the (*activity*) usually enough to make you out of breath and sweaty?
Yes 1
No 2

5. Money Expenditure on Sports and Exercise Participation

Now I am going to ask you about money expenditure on your participation in sports or exercise activities during the past four weeks. Please remember to include any payments you have made online and/or any subscriptions automatically charged to your account. Please do not include money spent watching any events.

2a. **Direct Expenses**
Please answer the following questions separately for each of the activities you have done, and note that all questions relate to expenses incurred during the past four weeks, that is since (*date four weeks ago)*

2b. *Membership*

Activity	**Have you paid membership fees to do (*activity*) in the past four weeks?**	
	Yes 1 **No 2**	**If yes, how much?**

2c. *Joining*

Activity	**Have you paid joining fees in addition to membership fees for an initial subscription to sports club to do (*activity*) during the past four weeks?**	
	Yes 1 **No 2**	**If yes, how much?**

2d. *Entrance*

	Activity	Yes 1 No 2	**How much did you <u>usually</u> pay at every occasion during the past four weeks?**	**On how <u>many</u> <u>occasions</u> have you paid during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid entrance charges for using sports or exercise facilities (e.g. sport halls, sport fields, tennis courts, swimming pools etc) to do (*activity)* during the past four weeks? (if not included in membership fees)					

2e. *Competitions*

	Activity	Yes 1 No 2	**How much did you <u>usually</u> pay for each day of tournament or competition during the past four weeks?**	**How <u>many days</u> have you paid to participate in tournament or competition during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid participation fees for tournaments or competitions related to *(activity)* during the past four weeks? (if not included in membership fees)					

2f. *Classes*

	Activity	Yes 1 No 2	**How much did you <u>usually</u> pay for each day of attendance during the past four weeks?**	**How <u>many days</u> have you paid to attend during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid for attendance in any classes, training sessions, inductions etc, related to (*activity*) in the past four weeks? (if not included in membership fee)					

2g. *License*

Activity	**Have you paid license to do (*activity*) in the past four weeks?**	
	Yes 1 No 2	**If yes, how much?**

2h. *Refreshment*

	Activity	Yes 1 No 2	How much do you <u>usually</u> pay at every occasion during the past four weeks?	On how <u>many</u> <u>occasions</u> have you paid during the past four weeks ?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid for drinks or food such as energy drinks directly associated with participating in (*activity*) during the past four weeks?					

2i. *Apparel (Hire)*

	Activity	Yes 1 No 2	Which <u>items</u> did you usually hire during the past four weeks?	How much did you <u>usually</u> pay to hire <u>each item</u> at every occasion during the past four weeks?	On how <u>many</u> <u>occasions</u> have you paid to hire <u>each item</u> during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid to hire sports clothes or shoes to do (*activity*) during the past four weeks?						

2j. *Apparel (Bought)*

Activity	Have you bought any sports clothes or shoes to do (*activity*) during the past four weeks?	
	Yes 1 No 2	If yes, how much?

2k. *Equipment (Hire)*
SHOW CARD B

	Activity	Yes 1 No 2	Which <u>items</u> did you usually hire during the past four weeks?	How much did you <u>usually</u> pay to hire <u>each item</u> at every occasion during the past four weeks?	On how <u>many</u> <u>occasions</u> have you paid to hire <u>each item</u> during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid to hire sports equipment such as those on this card to do (*activity*) in the past four weeks?						

2l. *Equipment (Bought)*

SHOW CARD B

Activity	**Have you bought any sports equipment such as those on this card to do (*activity*) in the past four weeks?**	
	Yes 1 **No 2**	**If yes, how much?**

2m. *Maintenance*

Activity	**Have you paid for maintenance of personal sports equipment such as dry cleaning, repair etc, during the past four weeks?**	
	Yes 1 **No 2**	**If yes, how much?**

6. Indirect Expenses

Apart from your direct sports expenses you may have incurred some indirect expenses related to sports or exercise activities.

3a. *Travel*

What was your <u>usual</u> mode of travel to and from the location where you did (*activity*) during the past four weeks?

Activity	**Mode of travel**				
	On foot 1	**By private vehicle 2**	**By public transportation 3**	**By bicycle 4**	**Others 5**

3b. *Time*

How much <u>time</u> do you usually spend travelling, back and forth at every occasion to do (*activity*), during the past four weeks?

…………….Hours…………..Minutes

3c. *Distance*

How <u>many miles</u> do you usually travel, back and forth at every occasion to do (*activity*), during the past four weeks?

Activity	**Distance**				
	Less than 5 miles: 1	**5-10 miles: 2**	**10-15 miles: 3**	**15-20 miles: 4**	**20 miles or more: 5**

APPLIES If Travel=2

3a (i). *Parking*

	Activity	Yes 1 No 2	How much did you __usually__ pay at every occasion during the past four weeks?	On how __many occasions__ have you paid during the past four weeks?	How much have you paid in __total__ for the past four weeks?
Have you paid a parking fee at the location where you did (*activity*) during the past four weeks?					

APPLIES IF Travel=3

3a (ii). *Transport*

	Activity	Yes 1 No 2	How much did you __usually__ pay to travel back and forth at every occasion during the past four weeks?	On how __many occasions__ have you paid during the past four weeks?	How much have you paid in __total__ for the last four weeks?
Have you paid for a transport ticket to travel to do (*activity*) during the past four weeks?					

3d. *Nutrition*

Activity	Have you bought any special nutritional supplements such as vitamins or protein supplements etc., related to your participation in (*activity*) during the past four weeks?	
	Yes 1 No 2	If yes, how much?

3d. *Insurance*

Activity	Have you paid insurance related to your participation in (*activity*) during the past four weeks? (if not included in membership fee)	
	Yes 1 No 2	If yes, how much?

3e. *Care*

Activity	**Have you paid for medical care such as seeking treatment for injury obtained while doing (*activity*) during the past four weeks? Please do not include medical care covered by insurance or paid for by the NHS.**	
	Yes 1 **No 2**	**If yes, how much?**

3f. *Dependents*

	Activity	**Yes 1** **No 2**	**How much did you <u>usually</u> pay at every occasion during the past four weeks?**	**On how <u>many occasions</u> have you paid during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid for the care of any dependents (including babies, partners or any other relatives) in order to participate in (*activity*) during the past four weeks?					

3g. *Other*

Activity	**Have you spent any money during the past four weeks as a result of participating in (*activity*), that have not been mentioned above?**	
	Yes 1 **No 2**	**If yes, how much?**

CARD A

1 Swimming 2 Cycling 3 Workout at a gym/Exercise bike /Weight training 4 Aerobics/Keep fit/Gymnastics/Dance for fitness 5 Running/Jogging 6 Football/rugby 7 Badminton/tennis 8 Squash 9 Exercises(e.g. press-ups, sit ups)

CARD B

1 Helmets/Goggles/Gloves 2 Bicycles 3 Treadmills 4 Bats/Rackets/Nets 5 Balls 6 Knee support/Shin guards/Wrists guards….

Appendix 7.1 Questionnaire used for survey

QUESTIONNAIRE
On
Sports and Exercise Activities

Thank you for agreeing to participate in this study. The objective of this study is to understand how much people spend participating in sports and exercise activities. It will take approximately ……… minutes to complete the questionnaire. It is important for research purposes that the questionnaire is answered as accurately as possible. We encourage you to take time to think about the answers. Please note if any of the questions are not clear to you, please ask me to clarify.

The first part of the questionnaire contains specific questions about money expenditures and travel times. The second part aims to identify general information, background data about you and benefits expected or gained from participation in sports or exercise activities.

All answers will be treated confidentially. Once again, thank you for your kind cooperation.

Name of Interviewer	
Interview Date	
Location of Interview	
Number of Interview	

1. Sports and Exercise Participation
I would like to ask you about the sports or exercise activities you have done in the past four weeks.

Sprts
SHOW CARD A
Can you tell me if you have done any activities on this card during the last four weeks, that is since (date four weeks ago)? Include teaching, coaching, training and practice sessions
Yes 1
No 2

If Sprts = 1 THEN,
Activi
Which have you done in the last four weeks? PROBE ‘Any others?
CODE ALL THAT APPLY
1 Swimming
2 Cycling
3 Workout at a gym/Exercise bike /Weight training
4 Aerobics/Keep fit/Gymnastics/Dance for fitness
5 Running/Jogging
6 Football/rugby
7 Badminton/tennis
8 Squash
9 Exercises (e.g. press-ups, sit ups)

FOR Activi: 10 TO 15 DO
Otheract
Have you done any other sport or exercise not listed on the card?
Yes 1
No 2

If Otheract=1 THEN
NameOtheract
INTERVIEWER: Probe for name/names of sport or exercise. Write.
Text:……………

FOR Activi: 1-15 DO
Qty
Can you tell me on how many separate days did you do (*activity*) during the past four weeks, that is since (date four weeks ago)?
|__||__|

Time
How much time did you usually spend doing (*activity*) on each day?
Text…………

Intensity
During the past four weeks, was the effort of the (*activity*) usually enough to make you out of breath and sweaty?
Yes 1
No 2

2. Money Expenditure on Sports and Exercise Participation

Now I am going to ask you about money expenditure on your participation in sports or exercise activities during the past four weeks. Please remember to include any payments you have made online and/or any subscriptions automatically charged to your account. Please do not include money spent watching any events.

2a. Direct Expenses

Please answer the following questions separately for each of the activities you have done, and note that all questions relate to expenses incurred during the past four weeks, that is since (*date four weeks ago)*

2b. *Membership*

Activity	**Have you paid membership fees to do (*activity*) in the past four weeks?**	
	Yes 1 No 2	**If yes, how much?**

2c. *Joining*

Activity	**Have you paid joining fees in addition to membership fees for an initial subscription to sports club to do (*activity*) during the past four weeks?**	
	Yes 1 No 2	**If yes, how much?**

2d. *Entrance*

	Activity	Yes 1 No 2	How much did you <u>usually</u> pay at every occasion during the past four weeks?	On how <u>many occasions</u> have you paid during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid entrance charges for using sports or exercise facilities (e.g. sport halls, sport fields, tennis courts, swimming pools etc) to do (*activity)* during the past four weeks? (if not included in membership fees)					

2e. *Competitions*

	Activity	Yes 1 No 2	How much did you <u>usually</u> pay for each day of tournament or competition during the past four weeks?	How <u>many days</u> have you paid to participate in tournament or competition during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid participation fees for tournaments or competitions related to *(activity)* during the past four weeks? (if not included in membership fees)					

2f. *Classes*

	Activity	Yes 1 No 2	How much did you <u>usually</u> pay for each day of attendance during the past four weeks?	How <u>many days</u> have you paid to attend during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid for attendance in any classes, training sessions, inductions etc, related to (*activity*) in the past four weeks? (if not included in membership fee)					

2g. *License*

Activity	Have you paid license to do (*activity*) in the past four weeks?	
	Yes 1 No 2	If yes, how much?

2h. *Refreshment*

	Activity	Yes 1 No 2	**How much do you <u>usually</u> pay at every occasion during the past four weeks?**	**On how <u>many</u> <u>occasions</u> have you paid during the past four weeks ?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid for drinks or food such as energy drinks directly associated with participating in (*activity*) during the past four weeks?					

2i. *Apparel (Hire)*

	Activity	Yes 1 No 2	**Which <u>items</u> did you usually hire during the past four weeks?**	**How much did you <u>usually</u> pay to hire <u>each item</u> at every occasion during the past four weeks?**	**On how <u>many</u> <u>occasions</u> have you paid to hire <u>each item</u> during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid to hire sports clothes or shoes to do (*activity*) during the past four weeks?						

2j. *Apparel (Bought)*

Activity	**Have you bought any sports clothes or shoes to do (*activity*) during the past four weeks?**	
	Yes 1 No 2	**If yes, how much?**

2k. *Equipment (Hire)*

SHOW CARD B

	Activity	Yes 1 No 2	**Which <u>items</u> did you usually hire during the past four weeks?**	**How much did you <u>usually</u> pay to hire <u>each item</u> at every occasion during the past four weeks?**	**On how <u>many</u> <u>occasions</u> have you paid to hire <u>each item</u> during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid to hire sports equipment such as those on this card to do (*activity*) in the past four weeks?						

2l. *Equipment (Bought)*

SHOW CARD B

Activity	Have you bought any sports equipment such as those on this card to do (*activity*) in the past four weeks?	
	Yes 1 No 2	If yes, how much?

2m. *Maintenance*

Activity	Have you paid for maintenance of personal sports equipment such as dry cleaning, repair etc, during the past four weeks?	
	Yes 1 No 2	If yes, how much?

7. Indirect Expenses

Apart from your direct sports expenses you may have incurred some indirect expenses related to sports or exercise activities.

3a. *Travel*

What was your <u>usual</u> mode of travel to and from the location where you did (*activity*) during the past four weeks?

Activity	Mode of travel				
	On foot 1	By private vehicle 2	By public transportation 3	By bicycle 4	Others 5

3b. *Time*

How much <u>time</u> do you usually spend travelling, back and forth at every occasion to do (*activity*), during the past four weeks?

…………….Hours…………..Minutes

3c. *Distance*

How <u>many miles</u> do you usually travel, back and forth at every occasion to do (*activity*), during the past four weeks?

Activity	Distance				
	Less than 5 miles: 1	5-10 miles: 2	10-15 miles: 3	15-20 miles: 4	20 miles or more: 5

APPLIES If Travel=2
3a (i). *Parking*

	Activity	Yes 1 No 2	How much did you <u>usually</u> pay at every occasion during the past four weeks?	On how <u>many occasions</u> have you paid during the past four weeks?	How much have you paid in <u>total</u> for the past four weeks?
Have you paid a parking fee at the location where you did (*activity*) during the past four weeks?					

APPLIES IF Travel=3
3a (ii). *Transport*

	Activity	Yes 1 No 2	How much did you <u>usually</u> pay to travel back and forth at every occasion during the past four weeks?	On how <u>many occasions</u> have you paid during the past four weeks?	How much have you paid in <u>total</u> for the last four weeks?
Have you paid for a transport ticket to travel to do (*activity*) during the past four weeks?					

3d. *Nutrition*

Activity	Have you bought any special nutritional supplements such as vitamins or protein supplements etc., related to your participation in (*activity*) during the past four weeks?	
	Yes 1 No 2	If yes, how much?

3d. *Insurance*

Activity	Have you paid insurance related to your participation in (*activity*) during the past four weeks? (if not included in membership fee)	
	Yes 1 No 2	If yes, how much?

3e. *Care*

Activity	**Have you paid for medical care such as seeking treatment for injury obtained while doing (*activity*) during the past four weeks? Please do not include medical care covered by insurance or paid for by the NHS.**	
	Yes 1 No 2	**If yes, how much?**

3f. *Dependents*

	Activity	**Yes 1 No 2**	**How much did you <u>usually</u> pay at every occasion during the past four weeks?**	**On how <u>many occasions</u> have you paid during the past four weeks?**	**How much have you paid in <u>total</u> for the past four weeks?**
Have you paid for the care of any dependents (including babies, partners or any other relatives) in order to participate in (*activity*) during the past four weeks?					

3g. *Other*

Activity	**Have you spent any money during the past four weeks as a result of participating in (*activity*), that have not been mentioned above?**	
	Yes 1 No 2	**If yes, how much?**

The following information is important for the research project in order to be able to link your costs on sports of exercise activities participation to the benefits you expect from participation, and background information about you

Perceived benefits (HEANSAH 1991)

SHOW CARD C

3a Could you look at this card and tell me how much you would say sports or exercise activities could help you in the following things. Please give me a number from 1 to 5, '1' means you would say it could not help at all and '5' means you think it could help a great deal

What number on the card would you choose to show how much you think participation in sports or exercise activities could help you	Not at all				Great deal	Don't know
To relax , forget about your cares	1	2	3	4	5	6
To get together and meet other people	1	2	3	4	5	6
To have fun	1	2	3	4	5	6
To get out of doors	1	2	3	4	5	6
To feel a sense of achievement	1	2	3	4	5	6
To feel mentally alert	1	2	3	4	5	6
To feel in good shape physically	1	2	3	4	5	6
To learn new things	1	2	3	4	5	6
To look good	1	2	3	4	5	6
To control or lose weight	1	2	3	4	5	6
To seek adventure and excitement	1	2	3	4	5	6
To improve or maintain your health	1	2	3	4	5	6
To feel independent	1	2	3	4	5	6

Extra perceived benefits

3b. Are/is there any other benefit(s) not mentioned on the card that you think participation in sports or exercise activities could help you gain

1 Yes

2 No

If yes, list

Gender (HSE 2006)

3c. Interviewer: CODE gender

1 Male

2 Female

Age (HSE 2006)

3d. Can you tell me your age last birthday? (Interviewer instruction: IF NECESSARY, What do you estimate your age to be?)

Education (OMNIBUS 2005)
SHOW CARD D

3e. Could you please look at this card and tell me which number represents the highest level of qualification that you have received from school, college or connected with work?

Degree level qualification (or equivalent)	1
Higher educational qualification below degree level	2
A-levels or Highers	3
ONC/National level BTEC	4
O Level or GCSE equivalent(Grade A-C) or O Grade/CSE equivalent(Grade 1) or Standard	5
GCSE grade D-G or CSE grade 2-5 or Standard Grade level 4-6	6
Other qualifications(including foreign qualifications below degree level)	7
No formal qualifications	8

Work (TPS 2005)

3f. Did you do any paid work in the seven days ending last Sunday, either as an employee or as self employed?
1 Yes
2 No

APPLIES If Work=1 (EFS 2003)
How many hours per week do you usually work in your main job/business? Please exclude meal breaks (and overtime)
|_||_|

3g. *Relative importance on perceived benefits (HEANSAH 1991)*
SHOW CARD E
Could you look at this card and tell me how important are the following things to you by giving me a number from '1' which means it is not at all important, through 2, 3, 4 to 5 which means it is very important.

What number on the card would choose to show how important you think the followings things are to you	Not at all important				Very important	Don't know
To relax , forget about your cares	1	2	3	4	5	6
To get together and meet other people	1	2	3	4	5	6
To have fun	1	2	3	4	5	6
To get out of doors	1	2	3	4	5	6
To feel a sense of achievement	1	2	3	4	5	6
To feel mentally alert	1	2	3	4	5	6
To feel in good shape physically	1	2	3	4	5	6
To learn new things	1	2	3	4	5	6
To look good	1	2	3	4	5	6
To control or lose weight	1	2	3	4	5	6
To seek adventure and excitement	1	2	3	4	5	6
To improve or maintain your health	1	2	3	4	5	6
To feel independent	1	2	3	4	5	6

3h. *Income (TPS 2005)*

SHOW CARD F

I would like to know about your overall personal income from all sources in the last four weeks that is since (date four weeks ago). This includes earnings from employment or self-employment, income from sponsors, income from benefits and pensions, and income from other sources such as interest from savings.

Please look at this card and tell me which letter represents your personal earnings in the last four weeks after tax and other deductions

Under £200	A
£200 - £399	B
£400 - £829	C
£830 - £1,249	D
£1,250 - £1,649	E
£1,650 - £2,099	F
£2,100 - £2,499	G
£2,500 - £2,899	H
£2,900 - £3,349	I
£3,350 - £3,749	J
£3,750 - £4,149	K
£4,150 or more	L

4i. *Income (HSE2006 &TPS 2005)*

SHOW CARD G & CARD H

Thinking of the income of your household as a whole, which of the letters on this card represents the total income of the whole household in the last four weeks after tax and other deductions.

Under £200	A
£200 - £399	B
£400 - £829	C
£830 - £1,249	D
£1,250 - £1,649	E
£1,650 - £2,099	F
£2,100 - £2,499	G
£2,500 - £2,899	H
£2,900 - £3,349	I
£3,350 - £3,749	J
£3,750 - £4,149	K
£4,150 or more	L
Don't know[195]	M

Size of household (HSE 2006)

Numhh

4j. Can I just check, how many people do you live with in your household?

|__||__|

APPLIES IF Numhh # 0

Numadult

4j (i). How many of them are aged under 16 years?

|__||__|

[195] Looking at the target sample, which mainly includes student population, there is a possibility that some of them may not know the income of members in their household, the 'don't know' response was therefore provided to account for that.

CARD C

What number on the card would you choose to show how much you think participation in sports and exercise activities could help you	Not at all				Great deal	Don't know
To relax , forget about your cares	1	2	3	4	5	6
To get together and meet other people	1	2	3	4	5	6
To have fun	1	2	3	4	5	6
To get out of doors	1	2	3	4	5	6
To feel a sense of achievement	1	2	3	4	5	6
To feel mentally alert	1	2	3	4	5	6
To feel in good shape physically	1	2	3	4	5	6
To learn new things	1	2	3	4	5	6
To look good	1	2	3	4	5	6
To control or lose weight	1	2	3	4	5	6
To seek adventure and excitement	1	2	3	4	5	6
To improve or maintain your health	1	2	3	4	5	6
To feel independent	1	2	3	4	5	6

CARD D

Degree level qualification (or equivalent)	1
Higher educational qualification below degree level	2
A-levels or Highers	3
ONC/National level BTEC	4
O Level or GCSE equivalent(Grade A-C) or O Grade/CSE equivalent(Grade 1) or Standard	5
GCSE grade D-G or CSE grade 2-5 or Standard Grade level 4-6	6
Other qualifications(including foreign qualifications below degree level)	7
No formal qualifications	8

CARD E

What number on the card would choose to show how important you think the followings things are to you	Not at all important				Very important	Don't know
To relax , forget about your cares	1	2	3	4	5	6
To get together and meet other people	1	2	3	4	5	6
To have fun	1	2	3	4	5	6
To get out of doors	1	2	3	4	5	6
To feel a sense of achievement	1	2	3	4	5	6
To feel mentally alert	1	2	3	4	5	6
To feel in good shape physically	1	2	3	4	5	6
To learn new things	1	2	3	4	5	6
To look good	1	2	3	4	5	6
To control or lose weight	1	2	3	4	5	6
To seek adventure and excitement	1	2	3	4	5	6
To improve or maintain your health	1	2	3	4	5	6
To feel independent	1	2	3	4	5	6

CARD F

Under £200	A
£200 - £399	B
£400 - £829	C
£830 - £1,249	D
£1,250 - £1,649	E
£1,650 - £2,099	F
£2,100 - £2,499	G
£2,500 - £2,899	H
£2,900 - £3,349	I
£3,350 - £3,749	J
£3,750 - £4,149	K
£4,150 or more	L
Don't know	M

CARD G

A household comprises either one person living alone or a group of people, who may or may not be related, living (or staying temporarily) at the same address, with common housekeeping, who either share at least one meal a day or share common living accommodation (i.e. a living room or sitting room). Resident domestic servants are included. Members of a household are not necessarily related by blood or marriage[196].

CARD H

Under £200	A
£200 - £399	B
£400 - £829	C
£830 - £1,249	D
£1,250 - £1,649	E
£1,650 - £2,099	F
£2,100 - £2,499	G
£2,500 - £2,899	H
£2,900 - £3,349	I
£3,350 - £3,749	J
£3,750 - £4,149	K
£4,150 or more	L
Don't know	M

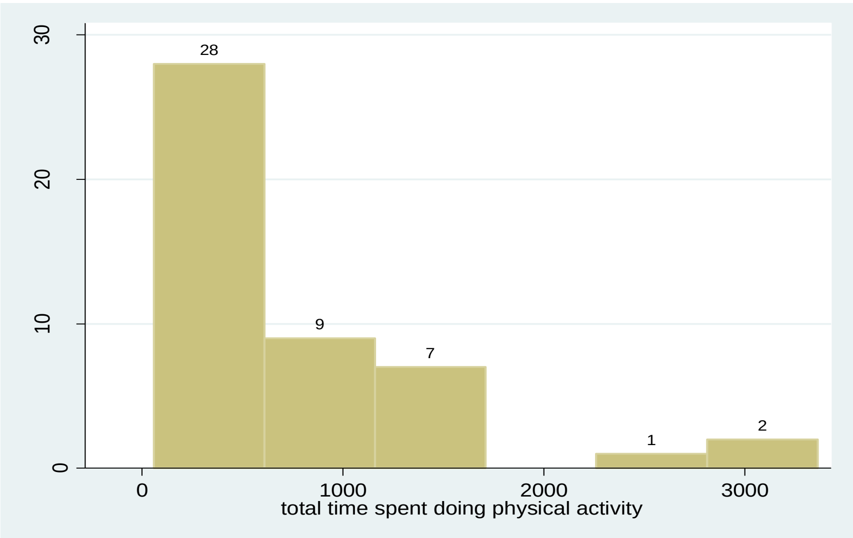
196 Crispin Jenkinson, 'Measuring Health Status and Quality of Life' 1998, Question Bank Topic Commentary on Health, http://qb.soc.surrey.ac.uk/topics/health/jenkinson.htm [The Question Bank is an ESRC funded Internet social survey resource based in the Department of Sociology, University of Surrey.] Accessed 14/11/2008.

Appendix 7.2 Sports and exercise activities intensity classification

Vigorous: a)All occurrences of running/jogging, squash, boxing, kick boxing, skipping, trampolining b)Sports were coded as vigorous intensity if they had made the informant out of breath or sweaty, but were otherwise coded as moderate intensity: cycling, aerobics, keep fit, gymnastics, dance for fitness, weight training, football, rugby, swimming, tennis, badminton Moderate: a) See ‘vigorous’ category b) b) All occasions of a large number of activities including: basketball, canoeing, fencing, field athletics, hockey, ice skating, lacrosse, netball, roller skating, rowing, skiing, volleyball. c) Sports were coded as moderate intensity if they had made informant out of breath or sweaty, but were otherwise coded as light intensity, including: exercise (press-ups, sit ups etc), dancing. Light: a)See ‘moderate’ category c) b) All occasions of a large number of activities including: abseiling, baseball, bowls, cricket, croquet, darts, fishing, golf, riding, rounders, sailing, shooting, snooker, snorkelling, softball, table tennis, yoga.

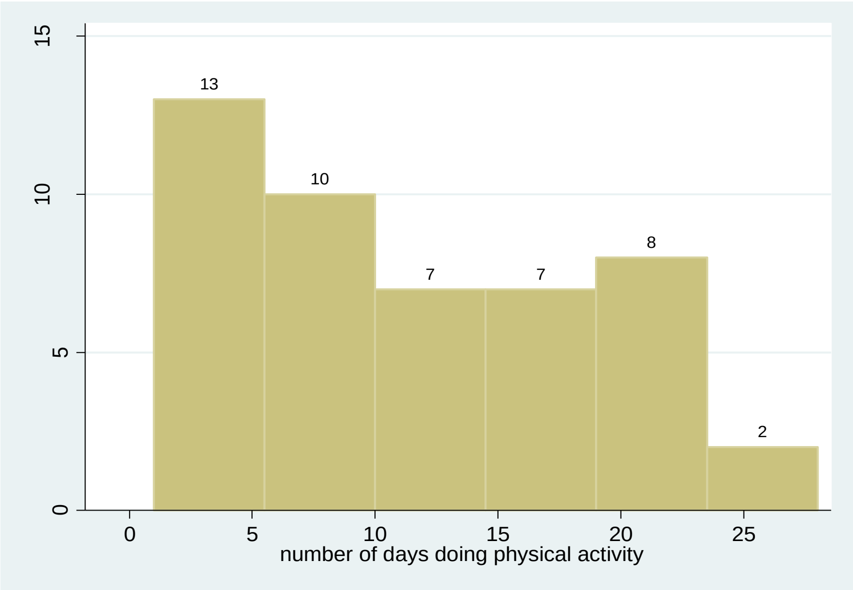
Source: Health Survey for England (2006): Cardiovascular disease and risk factors in adults. Volume 1. pg. 122 www.ic.nhs.uk/webfiles/publications/HSE06 (accessed 15/12/2008)

Appendix 7.3 Distribution of total time (mins) spent on physical activity

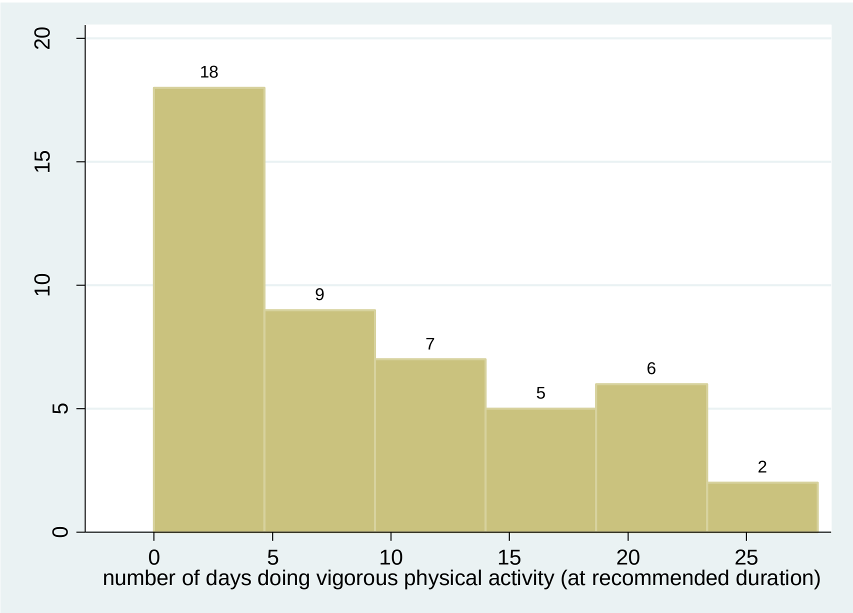


*It was log-transformed prior to analysis

Appendix 7.4 Distribution of number of days doing physical activity



Appendix 7.5 Distribution of number of days doing vigorous physical activity (at recommended duration)



Appendix 7.6 Descriptive statistics of control variables by participation or not in physical activity

Variables	Participants in PA (n=47)					Non-participants in PA (n=13)					Participants vs. Non-participants
	Obs.	**Mean(SD) / %**	**Median (IQR)**	**min**	**max**	**Obs.**	**Mean(SD) / %**	**Median (IQR)**	**min**	**max**	**p value** [a]
Age	47	26.5(6.0)	24(22,29)	18	44	13	29.8(7.6)	26(25,35)	22	46	0.103
Working hours	23	24.7(13.2)	22.5(15,38)	6	45	7	19.7(13.2)	19(7,35)	6.5	37.5	0.403
Size of household	47	3.8(2.9)	3(2,5)	1	15	13	2.8(2.0)	2(2,4)	1	8	0.227
No. of children in h'hold	47	0.4(0.7)	0(0,1)	0	2	13	0.5(1.2)	0(0,0)	0	4	0.777
No. of adults in h'hold	47	3.4(3.0)	2(2,4)	1	15	13	2.2(1.3)	2(1,2)	1	5	0.186
Personal income											
Under £200-£399	14	29.8				3	23.1				0.447
£400-£1,249	23	48.9				5	38.5				
£1,250-£2,899	10	21.3				5	38.5				
Household income[197]											
Under £200-£1,249	16	38.1				7	58.3				0.46
£1,250-£2,899	13	30.9				2	16.7				
£2,900-£4,150 or more	13	30.9				3	25				
Gender											
Male	31	66				5	38.5				0.073*****
Female	16	34				8	61.5				
Employment status											
Employed	23	49				7	53.9				0.754
Not employed	24	51				6	46.2				
Educational qualification											
Degree level	35	74.5				10	76.9				0.856
Below degree level	12	25.5				3	23.1				

[a] The asterisks show significance level of 10%(*)

[197] There were 6 don't know responses to household income, which were excluded from the analyses. Thus the number of observations for the participants sample is 42, and that of the non participants sample is 12.

Appendix 7.7 Expenditure (£) per month on physical activity given participation by demographic variables (n=47 unless otherwise stated)

Variables	Expenditure (£)per month						
		Total		Fixed		Variable	
	Obs.	Mean(SD)	Median (IQR)	Mean(SD)	Median (IQR)	Mean(SD)	Median (IQR)
Personal income							
Under £200-£399 (low)	14	31.1(30.7)	21(10,66)	25.7(29.6)	11(0, 62)	5.4(8.6)	0.5(0, 6.3)
£400-£1,249 (middle)	23	20.6(19.7)	13(9.2, 30)	11.7(17.2)	0(0, 20)	8.8(12.4)	7.2(0, 11.3)
£1,250-£2,899 (high)	10	38.1(27.3)	44.5(8, 64)	35.7(28.4)	42.5(1, 64)	2.4(2.6)	1.8(0, 4)
Household income (n=42)							
Under £200-£1,249 (low)	16	26.7(26.5)	18.3(9.6, 37.5)	17.9(25.5)	5(0, 30.5)	8.8(12.6)	1.5(0,13.3)
£1,250-£2,899 (middle)	13	35.7(21.5)	35(14, 50)	27.4(24.1)	20(0,43)	8.3(12.1)	4(0, 11)
£2,900-£4,150 or more (high)	13	23(25.1)	18.3(4, 21)	19.5(24.6)	10(0,20)	3.6(3.9)	2(0, 6.3)
Gender							
Male	31	27.1(26.7)	18.3(4, 44)	19.1(26.2)	10(0, 31)	8.0(11.9)	4(0, 12)
Female	16	28.1(23.9)	20.5(10.3,49.5)	24.7(24.1)	20(0, 46.5)	3.4(4.2)	1.5(0, 6)
Employment status[198]							
Employed	23	23.7(22.1)	13(9.2, 42)	17.5(24)	10(0, 31)	6.2(9.6)	3(0, 10.5)
Not employed	24	31(28.4)	22.9(7, 55.9)	24.4(26.7)	14.5(0, 46.5)	6.6(10.8)	1.3(0, 9.2)
Educational qualification							
Degree level	35	26.4(25.7)	18.3(8, 47)	22(25.7)	10(0, 42)	4.4(8.2)	1(0, 8)
Below degree level	12	30.3(25.9)	24.2(12.5, 47)	18.1(25.3)	5(0, 35)	12.2(13.2)	10.1(1.5, 18.2)
Age							
18-24 years	24	27(26.3)	18.9(9.6, 45.5)	19.3(26.3)	10(0, 31.5)	7.8(10.6)	3.5(0, 12)
25-46 years	23	27.8(25.2)	20(8, 52)	22.8(24.8)	17(0, 42)	5.0(9.7)	1(0, 8)
Working hours (n=23)							
6-22.5 hours	12	28.9(25.4)	17(10, 54)	20.7(28.3)	10(0, 41.5)	8.2(12.5)	3(0, 12.2)
23-45 hours	11	18.0(17.2)	11(4, 31)	13.9(19.0)	0(0, 31)	4.1(4.7)	2(0, 9.5)
No. of adults in h'hold							
0 child	33	29.1(26.3)	19.5(10, 44)	22.3(26.7)	10(0, 42)	6.8(9.4)	4(0, 11)
1-2 child(ren)	14	23.4(23.9)	16.5(3, 50)	17.9(22.5)	8.5(0, 30)	5.5(12.0)	0.5(0, 4)

[198] All 'not employed' respondents were students but not all students were 'not employed'.

Variables	Obs.	Expenditure (£)per month					
		Total		Fixed		Variable	
		Mean(SD)	**Median (IQR)**	**Mean(SD)**	**Median (IQR)**	**Mean(SD)**	**Median (IQR)**
No. of adults in h'hold							
1-2 adults	25	33.2(26.9)	24.8(10.5,61.8)	24.8(26.7)	17(0, 50)	8.5(13)	2(0, 11.2)
3-15 adults	22	20.8(22.6)	12.5(4, 27.2)	16.7(23.7)	10(0, 20)	4(4.7)	2.3(0, 7.2)
Size of household							
1-3 persons	24	33.2(26.8)	27.9(10.3, 58)	26(27.4)	15(0, 54)	7.1(10.7)	2.5(0, 11.1)
4-15 persons	23	21.4(23.1)	13(4, 27.2)	15.7(22.4)	10(0, 20)	5.7(9.7)	1.5(0, 9.2)

*Presenting the continuous variables (i.e. age, working hours, number of adults, number of children, and size of household) in groups was intended for clarity in presentation.
The correlation coefficients (where the variables are kept as continuous) showed a similar pattern as presented on the table, with total expenditure having a positive correlation with age (0.002), and negative correlations with working hours(-0.065), number of adults (-0.120), number of children(-0.083) and size of the household (-0.102). Total fixed cost showed a positive correlation with age (0.105) but a negative correlation with working hours(-0.121), number of adults (-0.016), number of children(-0.064) and size of the household (-0.014). Total variable costs also showed a positive correlation with working hours (0.022), but negative correlations with age(-0.23), number of adults(-0.020), number of children (-0.106), and size of household(-0.024).
Overall, the correlation was only significant for total variable cost and age; at 5% level of significance.

Appendix 7.8 Association between total expenditure by demographics

Variables	Obs.	p value
Personal income		0.31
Under £200-£399 (low)	14	
£400-£1,249 (middle)	23	
£1,250-£2,899 (high)	10	
Household income (n=42)		0.21
Under £200-£1,249 (low)	16	
£1,250-£2,899 (middle)	13	
£2,900-£4,150 or more (high)	13	
Gender		0.75
Male	31	
Female	16	
Employment status		0.44
Employed	23	
Not employed	24	
Educational qualification		0.40
Degree level	35	
Below degree level	12	
Age	47	0.35
Working hours	23	0.69
No. of adults in h'hold	47	0.28
No. of children in h'hold	47	0.49
Size of household	47	0.15

Appendix 7.9 Association between dependent variables and independent variables[199] (n=47 unless otherwise stated)

INDEPENDENT VARIABLES	***DEPENDENT VARIABLES***			
	No. of days	**Total time**	**Meet recom'dation**	**No. of days (rec. duration)**
	p value [a]	*p value* [a]	*p value* [a]	*p value* [a]
Cost(unit) related to PA				
Fixed cost	++	++	++	++
Variable cost	--	--	0	--
Travel time (mins)	---	---	--	--
Perceived benefits				
To relax, forget about your cares	++	++	++	++
To get together & meet people	0	0	0	0
To have fun	0	0	0	0
To get out of doors	0	0	0	0
To feel a sense of achievement	+	+	0	++
To feel mentally alert	0	0	0	0
To feel in good shape physically	0	0	0	0
To learn new things	++	++	0	0
To look good (n=46)	0	0	0	++
To control or lose weight	0	0	++	++
To seek adventure & excitement	0	0	0	0
To improve/maintain your health	0	0	0	0
To feel independent	0	0	0	0
Control variables				
Age	0	0	0	0
Gender (male)	0	+	0	+
Employment status (employed)	0	0	0	0
Working hours (n=23)	0	0	0	0
Size of household	0	0	0	0
No. of children in h'hold	0	0	0	0
No. of adults in h'hold	0	0	0	0

[199] Appendix 6.3 shows the real figures of the p values.

INDEPENDENT VARIABLES	*DEPENDENT VARIABLES*			
	No. of days	**Total time**	**Meet recom'dation**	**No. of days (rec. duration)**
	p value [a]	*p value* [a]	*p value* [a]	*p value* [a]
Education (degree)	0	0	0	0
Existence of other PB (Yes)	+	+	0	0
Personal income	0	0	0	0
Household income	0	0	0	0

[a] +++ / --- (positive/negative association at 1% significant level), ++ / -- (positive/negative association at 5% significant level),
+ / - (positive/negative association at 10% significant level), 0 (not significant)

Appendix 7.10 Estimation results of regression models of dependent variables

INDEPENDENT VARIABLES	DEPENDENT VARIABLES											
	Number of days				**Total time**				**Meet recommended level**			
	Base		*Reduced*		*Base*		*Reduced*		*Base*		*Reduced*	
	Coef. [a]	***ME*** [b]	***Coef.*** [a]	***ME*** [b]	***Coef.*** [a]	***ME*** [b]	***Coef.*** [a]	***ME*** [b]	***Coef.*** [a]	***ME*** [b]	***Coef.*** [a]	***ME*** [b]
Unit cost related to PA												
Fixed cost	0.00	0.04	0.00	0.04	0.01**	0.01	0.01**	0.01	0.03**	0.01	0.03**	0.01
Variable cost	-0.13***	-1.14	-0.13***	-1.14	-0.05	-0.05	-0.05	-0.05	-0.01	-0.00	-0.01	-0.00
Time cost (travel time)	-0.02***	-0.21	-0.02***	-0.21	-0.03***	-0.03	-0.03***	-0.03	-0.06**	-0.02	-0.06**	-0.02
Perceived benefits												
To relax, forget about your cares	0.44**	3.41	0.44**	3.41	0.37	0.37	0.40	0.40	0.83	0.18	0.83	0.18
To feel a sense of achievement	-0.48	-5.29	-0.48	-5.29	-0.17	-0.17	-0.19	-0.19				
To learn new things	-0.11	-0.98	-0.11	-0.98	0.15	0.15	0.13	0.13				
To control or lose weight									-0.64	-0.21	-0.64	-0.21
Control variables												
Personal income (high)	0.30*	2.76	0.30*	2.76			0.19	0.19				
Age	-0.06***	-0.54	-0.06***	-0.54								
Gender (male)					0.58*	0.58	0.69**	0.69				
Existence of other PB (Yes)	0.29**	2.78	0.29**	2.78	0.22	0.22	0.19	0.19				
No. of observations	47		47		47		47		47		47	
Constant			3.75				5.75				-2.02	
Linktest			*p*=0.20				*p*=0.95				*p*=0.36	
Goodness of fit											*p*=0.66 [d]	
Test for heteroskedasticity							*p*=0.95					
Normality test							*p*=0.95					
R squared							0.39					
Pseudo R squared			0.18								0.34	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) , 10%(*) [b] Marginal effects) [c]Chi-square(1)=0.58 [d]Chi-square(8)=5.90
*Variables indicating the equivalent values placed on perceived benefits were accounted for in the regression models. They are not reported here since the their relationship with the dependent variables are not of specific interest in the context of this study **The base model and reduced models for 'number of days' and 'meet recommended level' models are the same, as no statistically insignificant 'variables' were found in the base model (see analysis section for details of the criteria for selecting a reduced model) ***The average VIF for the variables was 1.5, and average tolerance levels were 0.7.

Appendix 7.11 Estimation results of regression on 'No. of days doing vigorous activity (rec.)'

INDEPENDENT VARIABLES	'No. of days doing vigorous activity (rec.)'			
	Base		*Reduced*	
	Coef.[a]	***ME***[b]	***Coef.***[a]	*ME*[b]
Unit cost related to PA				
Fixed cost	0.01**	0.07	0.01**	0.07
Variable costs	-0.00	-0.03	-0.00	-0.03
Time cost (travel time)	-0.02**	-0.13	-0.02**	-0.13
Perceived benefits				
To relax, forget about your cares	0.15	1.02	0.15	1.02
To feel a sense of achievement	-0.71	-7.05	-0.71	-7.05
To look good	0.35	2.27	0.35	2.27
To control or lose weight	1.40**	6.71	1.40**	6.71
Control variables				
Personal income(high)	0.03	0.20	0.03	0.20
Gender(male)	0.65**	4.33	0.65**	4.33
No. of observations	47			
Constant			1.55	
Linktest			p=0.39	
Pseudo R squared			0.14	

[a] The estimated parameters and asterisks show significance level of 1%(***), 5%(**) and 10%(*)
[b] Marginal effects *****The base and reduced model are the same as no statistically insignificant variables were found In the base model (see analysis section for criteria in selecting a reduced model)

Appendix 7.12 Estimation results of regression on 'workout' (workout at gym/exercise bike/weight training)

INDEPENDENT VARIABLES	Workout (no. of days)			
	Base		*Reduced*	
	Coef.[a]	***ME***[b]	***Coef.***[a]	***ME (Elas'ty)***[b]
Unit cost related to PA				
Fixed cost	0.01	0.06	0.01	0.06 (0.15)
Variable costs	-0.15*	-1.34	-0.15*	-1.34 (-0.12)
Time cost (travel time)	-0.03**	-0.28	-0.03**	-0.28 (-0.60)
No. of observations	23			
Constant			2.93	
Linktest			p=0.43	
Pseudo R squared			0.10	

The estimated parameters and asterisks show significance level of 1% (***), 5%(**) and 10%(*)
[b] Marginal effects (Elasticity) *Variables such as income, and perceived benefit: 'To improve or maintain your health' and its equivalent RIB were controlled for the regression

Appendix 7.13 Inputs for revision of questionnaire after illustrative survey

1. Either the sub-questions on ‘number of occasions paid’ or ‘total paid in a month’ in the case of variable costs items would have to be removed, as the former when multiplied by the average cost tended to equal the latter (in the illustrative survey).
2. The categorical responses for question on ‘distance travelled to do physical activity’ may have to be removed because it is difficult deriving averages using such responses. Hence, that question ought to be an open question though a possible consequence may be issues with recall.
3. Future work may have to decide whether data on those with seasonal transport ticket should be indicated as zero cost or not. In this study, one such case occurred but it was recorded as zero as it may be difficult to isolate this cost because the seasonal ticket may have been bought not specifically for physical activity.