Exercising Choice: The Economic Determinants of Physical Activity Behaviour

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August 2010

Abstract

Poor diet and a lack of physical activity are major factors to the worldwide obesity epidemic, and make a significant contribution to the overall burden of disease. The determinants of individual participation in physical activity are not well understood. This paper uses a modified time allocation framework to explore how economic and demographic factors influence participation in physical activity. We use data from the first six waves of the Household Income and Labour Dynamics of Australia survey. The analysis examines frequency of participation in physical activity using both standard and generalised random effects ordered probit model. We control for individual heterogeneity as well as exploring differences across gender and employment status. The results indicate that a rising opportunity cost of participating in physical activity significantly impacts on participation. Economic and demographic factors have a stronger impact on employed individuals' participation. This suggests that policies which make exercise more convenient, and hence decrease the opportunity cost of exercise, will help to encourage more people to participate in physical activity.

JEL Classification: L83; J10; I18; I10; R20

Keywords: Physical activity, time allocation, health, built environment

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"This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to either FaHCSIA or the Melbourne Institute."

1. Introduction

Poor diet and a lack of physical activity are major contributing factors to the worldwide obesity epidemic. Approximately 1.9 million deaths worldwide are attributable to physical inactivity (World Health Organisation – WHO, 2009). In Australia, where the data in this paper comes from, physical inactivity was the fourth leading cause of burden of disease in 2003, responsible for approximately 7% of the total burden of disease (Begg et. al. 2007). At least thirty minutes of moderate physical activity[1] five days a week reduces the risk of coronary heart disease, stroke, type II diabetes, and, specifically for women, the risk of colon and breast cancer (Center for Disease Control (CDC) 1996, WHO 2009). However, in Australia national surveys suggest that around 70% of adults are participating in less physical activity than this recommended amount, and that almost 50% of adults reported none or virtually no exercise in the past two weeks (Australian Bureau of Statistics, 2006).

A better understanding of the determinants of participation in physical activity can help policy makers to design better tools to increase participation and thus reduce the disease burden. There is an extensive public health literature examining physical activity participation of adults (for example Chau et al. 2008, Vaughn et al. 2008, and Welch et al. 2008); however this issue has not been extensively addressed from an economic perspective. The decision to participate in physical activity is an individual choice partially based on economic, social, and environmental factors. Therefore, core economic principles which have been designed and used for modelling responses to incentives as well as time trade-offs can be used to explain physical activity behaviour (Mavromaras, 2008).

A small number of papers have considered the economic determinants of physical activity participation. Farrell and Shields (2002) examine the influence of the family, income, and ethnicity on participation in sport using data from the Health Survey of England. Similarly, Eberth and Smith (2009) use the Scottish Health Survey to look at participation and time spent in activity. Humphreys and Ruseski (2007, 2009), use data from the US Behavioural Risk Factor Surveillance System to look at the decision to participate and the amount of time allocated to physical activity, and also the effects of state level spending on parks and recreation. Downward (2007) explores the economic choice to participate in sport using the UK General Household Survey. The general findings from these studies are that people with children, married people and females do less exercise, while those

[1] Moderate physical activity is defined as an activity that uses large muscle groups and is at least equivalent to brisk walking. Some examples are dancing, cycling, gardening, and swimming (CDC 1996).

with higher incomes do more.

One important shortcoming of these studies is that they are all based on simple cross-sections of data. Without repeated observations for individuals at different points in time they are unable to control for unobserved individual heterogeneity which will result in omitted variable bias and may produce misleading results. Our study makes a number of important contributions to the literature. Firstly we have a panel data set; the first six waves of the Household Income and Labour Dynamics of Australia (HILDA) survey. The panel enables us to estimate models with individual random effects, thus controlling for unobserved individual heterogeneity. Secondly, given that the variable we use to measure participation in physical activity is an ordinal one, we employ a random effects ordered probit framework. This also allows us to test the parallel regression assumption of the standard ordered probit model by estimating a random effects generalised ordered probit which allows the shift into different physical activity categories to vary by individual characteristics. Thirdly, unlike the existing studies, we have a physical activity question based upon weekly, rather than monthly, participation thus reducing recall bias. Finally, we explore differences in our findings by gender and by employment status.

To determine which factors influence physical activity participation a modified time allocation framework is applied, based upon the seminal work of Becker (1965) and the Cawley (2004) *'SLOTH'* framework[2]. Individuals have a finite amount of time to devote to market work, non-market work and leisure, which includes both sedentary activities and more active pursuits. There are time and cost inputs associated with these activities. The basic assumption is that as the opportunity cost of physical activity increases due to work or home commitments, individuals are less likely to exercise.

The structure of this paper is as follows. Section 2 describes the theoretical framework which forms the basis for the empirical analysis. Section 3 outlines econometric approach. The data and variables are defined and explained in Section 4. The results are presented in Section 5, and section 6 discusses these results and the implications of the analysis. Finally, Section 7 proposes areas for further research and concludes.

2. Theoretical Framework

[2] SLOTH stands for Sleep, Leisure, Occupation, Transportation and Home Based Activities (Cawley, 2004)

The theoretical framework is based on the model described in Humphreys and Ruseski (2009). The basic idea is that given time and budget constraints, individuals choose how to allocate their time between leisure (including physical activity), market work, and non-market work, in order to maximise a given utility function comprising consumption of commodities and leisure. In equilibrium the marginal value of household production, the marginal rate of substitution between consumption and leisure activities (including physical activity) and the market wage rate are equal. Due to data limitations regarding types of physical activity in the data source, it is assumed that the physical activity encapsulated in both non-market and market work is fixed. Thus, our focus is on how the amount of discretionary/leisure time available influences physical activity participation.

Physical activity participation requires inputs of both time and market goods. Assuming an individual chooses the amount of time they work, then the wage rate will determine how much time individuals devote to market work, non-market work, active leisure, and sedentary leisure in order to maximise their utility function. If individuals are not employed then they will choose to divide their time between only non-market work and leisure. This will influence the cost of participating in physical activity.

3. Econometric Framework

Let the physical activity participation of individual *i* in period *t* (P_{it}) be influenced by how individuals divide their time between market, non-market work, and leisure, represented by a vector of individual socio-economic characteristics (X_{it}) such as age, sex and income; geographical area variables (R_{it}) such as urban and rural identifiers; health (H_{it}), and individual preferences (J_{it}) such as sports club membership, such that:

$$P_{it} = \beta X_{it} + \psi R_{it} + \varphi J_{it} + \xi H_{it} + v_{it} \qquad (1)$$

$$v_{it} = \alpha_i + u_{it}$$

where $i=1,2,....n$ and $t=1,.....,T$

Let v_{it} be a normally distributed error term with mean *0* and variance σ_{it}^2 which is composed of unmeasured individual specific aspects of physical activity participation such as sporting prowess,

motivation, and other types of genetic endowment, which are time invariant (α_i) and a random component, u_{it}. P_{it} is an ordinal variable representing frequency of participation in physical activity in the past week. To estimate the probability of being in each of the response categories, it is assumed that:

$$P_{i,t} = k \text{ if } \mu_{k-1} < P_{i,t} \leq \mu_k \,,\; K = 0,...,K \qquad (2)$$

Where K is the number of response categories and μ are the threshold levels that are estimated. Equation (2) shows that if $P_{i,t}$ is between μ_{k-1} and μ_k, the response to the question on the weekly amount of physical activity participation is equal to k $(P_{i,t} = k)$[3]. This model is estimated as a random effects order probit (REOP) model via maximum likelihood using the *reoprob* command in STATA v10. The RE control for the impact of unobserved individual tastes and preferences for participation in physical activity, assuming these unobserved effects are time invariant.

The standard REOP assumes independence of the unobserved effects (α_i) and the explanatory variables contained in vectors X, R, H and J. If this assumption is violated the resulting coefficient estimates are inconsistent. To address this problem we use the Mundlak (1978) method. This involves using the individual specific means of the time varying explanatory variables to explicitly model the relationship between the explanatory variables X_i, R_i, J_i, and H_i and the individual effects:

$$\bar{X}_i = (1/T)\sum_{t=1}^{T} X_{it} \,,\; \bar{R}_i = (1/T)\sum_{t=1}^{T} R_{it} \,,\; \bar{J}_i = (1/T)\sum_{t=1}^{T} J_{i,t} \,, \text{and } \bar{H}_i = (1/T)\sum_{t=1}^{T} H_{it} \qquad (3)$$

The group means in (3) are included as additional explanatory variables in the REOP specification estimated from equation (1), and they act as a proxy for the time invariant individual effects, α_i. Modelling this dependence allows for unbiased estimation of β, ψ, φ and ξ regardless of whether or not X_i, R_i, J_i, and H_i are independent of α_i (Ebbes et al. 2004).

If the explanatory variables have different impacts on the likelihood of participating in each physical activity frequency category then the cut-point shift is not parallel. The random effects generalised ordered probit (REGOP) model allows for non-parallel shift points. The effects of the explanatory variables in (1) can now vary with the point at which the categories of the dependent

[3] See Greene (2002) for a more in-depth discussion of the ordered probit model.

variable are dichotomised. Following Boes and Winkelman (2006) the model can be shown by:

$$
\begin{aligned}
&P(P_{it}=0\mid\alpha_i)=F(-X_{it}B_o-R_{it}\psi_o-J_{i,t}\varphi_0-H_{it}\xi_0-\alpha_i)\\
&P(P_{it}=m\mid\alpha_i)=F(-X_{it}B_m-R_{i,t}\psi_m-J_{it}\varphi_m-H_{it}\xi_m-\alpha_i)\\
&-F(-X_{it}B_{m-1}-R_{it}\psi_{m-1}-J_{it}\varphi_{m-1}-H_{it}\xi_{m-1}-\alpha_i)\\
&\circ\\
&\circ\\
&\circ\\
&P(P_{it}=M\mid\alpha_i)=1-F(-X_{it}B_{M-1}-R_{it}\psi_{M-1}-J_{i,t}\varphi_{M-1}-H_{it}\xi_{M-1}-\alpha_i)
\end{aligned}
\qquad (4)
$$

Where $m=1,\ldots5$ and $M=6$ (the categories in the dependent variable, P_{it}).

The REGOP model estimates a set of coefficients for each of the $M-1$ points at which the dependent variable can be dichotomised; this includes the constant term. The standard normal distribution function that employs $F(.)$ as the cumulative distribution is used to estimate the model. It is assumed that the individual effects are normally distributed with a zero mean and variance σ^2. The Mundlak method is also used for the REGOP models to allow the correlation of X_i, R_i, J_i, and H_i with α_i. These models are estimated via maximum likelihood using the *regoprob* command in STATA v10.

A problem, common to longitudinal data sets like HILDA, is sample attrition. If individuals sharing similar characteristics such as poor health exit the survey this may bias the results. A Verbeek and Nijiman (1992) test is performed to test the impact of attrition on the estimation results. The null hypothesis of random non-response cannot be rejected in any case, thus we do not expect that attrition will bias our results.

It is possible that the factors which influence physical activity participation are different for non-workers and workers; and also different for men and women. All models are estimated separately by employment status and by gender to control for how the different opportunity cost of time for these groups may influence the likelihood of participating in the six physical activity categories. Chow tests are performed to determine whether the behaviour of men and women and workers are non-workers are significantly different. The results suggest that separate estimation by women/men

and workers/non-workers is warranted.

4. Data and Variables

The HILDA is a nationwide household panel survey with a focus on issues relating to families, income, employment, and well-being. It was designed to be consistent with the British Household Panel Survey (BHPS) and the German Socio-Economic Panel (GSOEP). Survey methodology and the motivation behind the creation of the HILDA are described in greater detail in Watson and Wooden (2006). The first wave was conducted between August and December 2001, the sample consisted of 19,914 respondents; the sample is extended each year to include any new household members. We use the first six waves of the survey (2001-2006); a sample a working age adults, with 23283 observations for men and 21318 observations for women.

4.1 Physical Activity

The physical activity measure is a categorical variable constructed from the question:

"In general how often do you participate in moderate or intense physical activity for at least 30 minutes? Moderate physical activity will cause a slight increase in breathing and heart rate such as brisk walking."

The response choices are: 1) *Not at all;* 2) *less than once a week*; 3) *1 to 2 times a week*; 4) *3 times a week*; 5) *more than three times a week but not everyday*; 6) *everyday*.

Figure 1 shows the distribution of physical activity participation by gender. Women are less likely to participate in frequent physical activity than men. In order to check the external validity of our outcome variable Table 1 compares mean physical activity levels for all six waves of the HILDA with four cross-sectional and longitudinal national and regional studies which ask respondents about the duration, intensity, type, and frequency of physical activity. The percentage of men and women who participate in at least the minimum recommended amount of physical activity is similar across these national and regional representative samples. Therefore we assume that the physical activity results from the HILDA are reasonably representative.

4.2 Covariates

The explanatory variables included in this analysis are used to explore how time allocation influences the likelihood of participating in physical activity. Individual characteristics such as age, age squared, education, income, marital status, and the presence of dependent children in various age groups are included. It is possible that the relationship between age and physical activity participation is concave. Caspersen et al. (2000) found that around retirement age (65 years old) there was an increase or stabilising effect on physical activity participation that was followed by a decline in later life. While our sample includes only working age people we still allow for a non-linear relationship between age and frequency of participation in physical activity. Higher levels of education may increase the potential wage rate if physical activity is a normal good, individuals with more education may substitute active leisure for paid work, *ceteris paribus.* However, individual preferences and knowledge about the health benefits of physical activity may suggest a positive association between physical activity participation and education. Married individuals may have more time commitments, such as family obligations, which increases the amount of time allocated to non-market work compared with single respondents. Farrell and Shields (2002) and Humphreys and Ruseski (2009) found a negative effect of being married on physical activity and sporting participation for both genders. The age of dependent children will influence how much leisure time is available which will effect physical activity participation. For example, Farrell and Shields (2002) find that having dependent infants reduces the likelihood of sporting participation for both men and women. Non-labour income is expected to increase participation in physical activity and this is supported findings from the previous literature.

Health will also influence how much time is dedicated to physical activity. Better health is likely to increase the likelihood of participating in physical activity (Farrell and Shields 2002 and Humphreys and Ruseski 2006). As physical activity is an input into the health production function, individuals may participate in physical activity to ensure future good health. The SF6D index, a preference based health measure derived from the SF-36 health survey (Brazier et al. 2002), is used to measure health. The SF6D is increasing in health with 1 representing full health and zero equivalent to death. There is likely to be an endogenous relationship between health and physical activity. Existing evidence suggests (CDC 1996; Milner 2007; WHO 2009) that individuals who participate in the medically recommended amount of physical activity have reduced risk of cardiovascular disease, type 2 diabetes, depression, anxiety, and stress. Also, individuals who are in better health may be more likely to participate in physical activity as an investment in future good health. This will lead to an upward bias on the health coefficients.

To capture how individual preferences influence participation in physical activity a time satisfaction

and sporting club membership variable are included in some model specifications. If individuals have a preference for spending their leisure participating in physical activity this will arguably be captured by the sports club membership variable. It is likely that unobserved preferences regarding how individuals want to use their leisure time will influence their likelihood of being a member of a sports organisation. For example, some individuals may prefer to use their leisure time to engage in sedentary activities decreasing their likelihood of belonging to a sports club organisation. The Mundlak approach, which allows the explanatory variables to be correlated with the unobserved effects, reduces the upward bias on the sports club coefficient caused by omitted variable bias.

Welch et al. (2008) found, amongst a sample of 1521 Australian women, that 73% reported time pressures as a barrier to physical activity participation. While actual total time available to an individual is fixed at 24 hours per day, perception of time available can vary, and perception of the amount of available leisure time may impact on physical activity participation. Heesch and Msse (2004) found among women aged 45-70, that a perceived lack of free time led to lower physical activity participation[4]. If individuals devote what they perceive as a large proportion of their total time to market and non-market work, resulting in dissatisfaction with the amount of leisure time available, they may be less likely to devote part of this leisure time to physical activity. Thus we expect a negative effect from the variable that identifies people who are dissatisfied with the amount of leisure time they have. The time satisfaction variable may be correlated with some of the other explanatory variables such as age of dependent children possibly affecting the interpretation of the regression results.

Some model specifications are estimated without the health, sports club, and time satisfaction variables to ascertain how inclusion of these variables affects the magnitude and significance of the other coefficients in the model. This is a robustness check for the effects of endogeneity bias and problems caused by multicollinearity.

The built environment may influence both the time and cost of participating in physical activity. There is some evidence that the built environment may act as a barrier to participating in physical activity if individuals do not have local access to parks, cycling and walking paths, and other sports facilities (Committee on Physical Activity, Health, Transportation and Land Use, 2005). The character of the neighbourhood may influence the likelihood of participating in outdoor physical activity. Saelens et al. (2003) found that neighbourhoods with high crime rates, boarded up shop

[4] One potential problem with the Heesch and Mse (2004) study is that they do not control for actual free time available.

fronts, and poorly maintained infrastructure discouraged walking and cycling. Two built environment variables are included in the analysis. The first variable controls for living in an urban environment and the other variable controls for the socio-economic disadvantage of the local area.

For the sub-sample of employed individuals, labour market variables such as number of hours worked, and the wage rate, will affect the position of the budget constraint. We assume that working full-time will reduce the amount of time available for participating in physical activity. For example, Nomaguchi and Bianchi (2004) find that full-time workers participate in less physical activity than their part-time counterparts. There is evidence that workers who are physically active have lower rates of absenteeism than those who are inactive (van den Heuvel et al. 2005 and van Amelsvoort et al. 2006). It has also been found that physical activity improves emotional well-being (WHO 2008). Therefore, participating in regular physical activity may have productivity effects which could lead to a higher wage rate, resulting in an upward bias on the coefficients on the wage variable. However, if physical activity is a normal good, then a higher wage rate will cause individuals to substitute physical activity for paid work. Also for employed people, the type of industry in which they are employed may influence their response to the physical activity survey question, as it does not explicitly distinguish between leisure and work based physical activity. Individuals employed in manual labour will participate in more work-related physical activity which may lead them to report that they are physically active, even though this activity is in work time rather than leisure time.

A full list of the explanatory variables used in this analysis is presented in Appendix A.

5. Results

Table 2 shows the descriptive statistics for the sample used for the empirical analysis. The statistics are divided by frequency of participation in physical activity, and shown separately for men and women. The raw statistics confirm many of our expectations about the factors that influence physical activity participation. For example, for both genders, a higher percentage of individuals who are currently not married or cohabiting participate in physical activity everyday. Individuals who live in a major city are less likely to exercise every day. The mean hourly wage is lower for individuals who exercise every day compared with the other physical activity categories. Parents with dependent children under the age of four tend to participate in lower weekly levels of physical activity.

Tables 3 and 4 present the estimated marginal effects from the REOP models for the sub-samples of employed and unemployed/inactive men and women respectively. These models are used to determine the impact of economic and demographic factors on the likelihood of participating in each category of physical activity. Due to the increasing nature of the ordered classes, the interpretation of the model parameters, β,ψ,φ and ξ are relatively straightforward. Positive signs indicate increased frequency of physical activity behaviour as the value of associated coefficient increases, and the converse is true for a negative sign.

For both genders more of the marginal effects are significant for the employed group. The opportunity cost of leisure time is higher for this group suggesting that economic and demographic factors play a more important role in influencing physical activity behaviour. ρ is significant in all models implying that time invariant individual effects should be controlled for. For both genders in all columns of Tables 3 and 4, living in an area of higher deprivation has a negative and significant impact on participating in more frequent physical activity. Better health has a positive and significant effect in most models. The significance and magnitude of some of the coefficients, such as education, change with the inclusion of health suggesting that health production and maintenance related to physical activity may be influenced by education. With the exception of women who are not employed (see column 6F), belonging to a sports club has a significant and positive effect on participating in more frequent physical activity. For employed men and women in all columns and non-employed women in columns 5F and 6F, having children between the ages of one and four has a negative and significant impact on more frequent physical activity participation. For employed individuals, working in a manual profession has a positive and significant impact on more frequent physical activity participation.

For non-employed men in column 4M, age and non-labour income have a negative effect on participating in more frequent physical activity. Higher levels of education increase the likelihood of participating in more frequent physical activity. Once the health variable is included in column 5M, the age and education and income coefficients are no longer significant. For employed men in columns 1M, 2M, and 3M, age and being married both have a significant and negative impact on participating in more frequent physical activity. In columns 2M and 3M higher levels of education have a significant and negative impact on more frequent physical activity participation. The cut-points which represent the different thresholds of physical activity participation are significant for all categories except the last one.

Next, focusing on women in Table 4, for employed women in column 1F and non-employed women in columns 4F, 5F, and 6F having a diploma or advanced diploma has a positive and significant effect on increased physical activity participation. In column 4F for non-employed women having a BA or higher compared to having no educational qualifications and being single compared to being divorced or separated has a positive and significant effect on the frequency of physical activity participation. For all women, having dependent children aged fifteen or older has a negative and significant effect on the frequency of physical activity participation. For employed women in columns 1F, 2F, and 3F having dependent children between the ages of five and fourteen and living in a major city have a significant and negative effects on the frequency of physical activity participation. The cut-points representing the thresholds of participating in physical activity three times a week or more than three times a week are not significant for both unemployed and employed women with the exception of exercising three times a week for employed women in column 1F.

Tables 5 and 6 show the marginal effects for the full model for the REGOP model using the Mundlak approach for men and women respectively. The results from a Wald (χ^2) test for parallel cut points between the physical activity categories rejects the null hypothesis of parallel shift for both genders. The significance and the magnitude of the marginal effects change by physical activity category implying that the variables influence each physical activity category differently. ρ is significant for all sub-groups. In both Tables 5 and 6, as was the case with the standard REOP, health and sports club membership have a positive and significant effect on participation in all the physical activity categories. Living in areas of higher deprivation has a negative and significant effect on participating in the lower categories of physical activity but this variable is not significant for any sub-group in the highest physical activity category (equation 5) for both men and women. Focusing on Table 5, having a BA or higher compared to no educational qualification is significant for employed men in all physical activity categories, however the sign of the marginal effects changes from positive to negative when moving to more frequent physical activity participation. Living in an inner regional area has a negative and significant effect on participating in the higher physical activity categories for men who are not employed. Next looking at Table 6, for employed women, having young children under the age of five has a significant and negative effect on participating in all levels of physical activity.

6. Discussion

The results from the models are generally consistent with the hypotheses established in the theoretical framework and findings from the descriptive statistics. We show that the higher opportunity cost of time resulting from being employed influences the amount of time spent participating in weekly physical activity. The hourly wage does not significantly impact on physical activity participation for either gender suggesting that there may not be a direct substitution of market work for active leisure. This higher opportunity cost of time may explain why employed married men are less likely to participate in more frequent physical activity and employed men and women with children are under the age of four are less like to exercise regularly. The magnitude of the marginal effects on preschool age children is larger for women than men. Physical activity transitions during parenthood may be moderated by gender with mothers' experiencing the largest decline, as women are traditionally the primary caregivers (Bellows-Rieken and Rhodes 2007). Specifically for women who are mothers, Verhoef and Love (1994) found that the amount of leisure time available to them was one of the most important predictors of physical activity participation. This may explain why the time satisfaction variable has a negative and significant impact on physical activity participation for women only.

The impact of education on physical activity differs by employment status, gender, and frequency of physical activity participation. The male employed results from the REGOP confirm that the opportunity cost of physical activity may affect participation in more frequent exercise as the sign of the marginal effects changes from positive to negative for having a BA or postgraduate qualifications when moving to higher physical activity categories. This finding is also consistent with Humphreys and Ruseski (2009) who suggested it is possible that those with more education may be employed in more sedentary occupations leaving them with less total time for physical activity participation. For non-employed women in the standard REOP model higher levels of education have a positive and significant impact on physical activity participation, which is consistent with the Australian literature (Armstrong et al. 2000 and Stratton et al. 2005). As the marginal effects are only significant for non-employed women this confirms the importance of the opportunity cost of time in influencing physical activity participation. For all sub-groups and both genders, belonging to a sport, community, or hobby organisation has a large and significant effect on physical activity participation. Farrell and Shields (2002) and Stratton et al. (2005) found that social contact was an important determinant of physical activity participation.

As would be expected, those in better health are more likely to participate in more frequent physical activity. These results are also consistent with the medical literature (for example CDC 1996, Hildebrandt et al. 2000, Milner 2007, and WHO 2009) which show a positive relationship between

health and regular physical activity.

Living in a major city has a significant and negative effect on employed women's physical activity participation in the standard REOP model. These results are consistent with Armstrong et al. (2000) and Stratton et al. (2005) who found that that the built environment has a significant impact on physical activity participation in an Australian population. For example, living in more remote areas may encourage people to use physical activity as means to facilitate social interactions with neighbours and friends as was found in Stratton et al. (2005). On the other hand, if the urban environment has a lack of parks, cycle paths, etc., this may act as a barrier for physical activity participation. Individuals would have to allocate time that could be used participating in physical activity to travelling to locations where they could engage in exercise reducing their overall physical activity participation.

Compared to those in areas of high deprivation those in areas of less deprivation are more likely to participate in more frequent physical activity. This variable may also be a proxy for wealth effects and socio-economic status effects not adequately measured by the income, education, and labour market variables included in the analysis. Interestingly, in the REGOP model this variable is no longer significant for the two highest categories of physical activity participation. Overall, the built environment variables suggest that easy access to sports facilitates, parks, etc. may play a role in determining how much time individuals allocate to physical activity.

7. Conclusion

Physical activity participation is important for promoting a healthy population. Understanding the economic and demographic factors which influence physical activity participation will help policy makers target at risk groups. The role of work on physical activity participation has not been investigated in the previous literature. This paper aimed to uncover the economic and demographic factors which influence the physical activity behaviour of working and non-working adults in Australia using a modified time allocation framework and a REOP model. The parallel shift between the different physical activity categories is tested by estimating a REGOP model.

Many of the predictions of the theoretical model are supported by the results. Rising opportunity cost of physical activity influences the participation decision. For employed individuals of both genders, physical activity appears to be a normal good, the more expensive it is to participate in physical activity the less likely are they to participation in more frequent exercise. Several of the

factors which affect the time allocated to physical activity participation are moderated by gender such as the presence of dependent children and perception of leisure time. Economic and demographic factors have less of a significant impact on the physical activity participation of non-workers. The parallel shift hypothesis is rejected suggesting that economic and demographic factors influence the five categories of physical activity participation differently.

In terms of policy, the results suggest that policy makers should focus on the promotion of family friendly exercise programs and facilities especially for working parents. Thus, couples especially those with young children will be able to combine child care and physical activity which should alleviate some of the time pressures associated with children that reduce physical activity participation. Encouraging family exercise will also help establish good habits for children which will hopefully stay with them to adulthood. Town planners and other interested stakeholders should ensure that the urban environment is conducive to physical activity participation. Governments should also stress the positive health benefits of physical activity in an attempt to increase participation.

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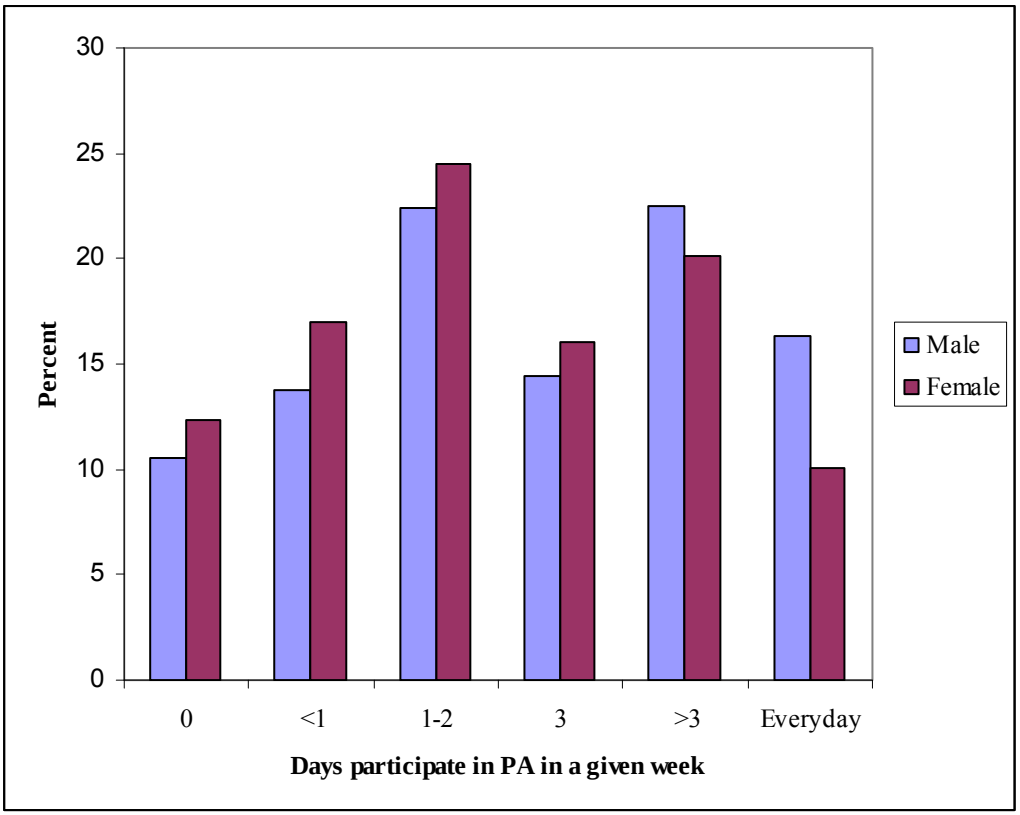
Figure 1: *Categorical Physical Activity (PA) Participation Variable*



For the x-axis the categories are: 1) Zero; 2) less than once a week; 3) 1 to 2 times a week; 4) 3 times a week; 5) more than three times a week but not everyday; 6) 7 day s a week.

Source: Waves 1 - 6 (2001-2006) of the HILDA.

Table 1:*Comparison of HILDA to other physical activity questionnaires*

% Participating in Medically Recommended Physical Activity (PA)*	MEN	WOMEN
HILDA 2001-2006	52.7	46.5
1999 National PA Survey	46.9	45.5
Western Australian Adults 2002	57.2	52.2
NSW Population Survey 1998, 2002-2005	52.6	43.8
Queensland Adults Omnibus 2001	49.1	41.1

* Based on the WHO (2009) definition for the minimum amount of activity required to maintain and promote health.

1) 1999 National PA Survey: participation in leisure time physical activity as well as frequency and intensity. See Armstrong et al. 2000 & www.aihw.gov.au/publications/index.cfm/title/5944.
2) Western Australian Adults 2002: duration, frequency, intensity, and type of activity. www.beactive.wa.gov.au/resources_factsheets_adult_2002.asp
3) NSW Population Survey: frequency and duration of moderate and vigorous intensity physical activity in past seven days. See Chau et al. 2008 and www.health.nsw.gov.au/public-health/survey/hsurvey.html)www.health.nsw.gov.au/public-health/survey/hsurvey.html.
4) Queensland Omnibus 2001: types of activity, such as walking, jogging, heavy gardening, but not frequency. See Health Information Centre, Queensland Health. See www.health.qld.gov.au/hic/default.asp.

Table 2:*Descriptive Statistics*

Men

Physical Activity	Never	<1	1-2 time	3 times	>3 times	Everyday	n
Employed	0.07	0.15	0.24	0.15	0.23	0.17	23283
Not in the Labour Force/Unemployed	0.19	0.12	0.19	0.13	0.22	0.16	9823
Manual Work	0.08	0.11	0.17	0.12	0.23	0.28	2179
Employed Full-Time	0.07	0.15	0.25	0.15	0.22	0.16	19265
Hourlywage	17.73	21.03	21.96	21.22	20.44	15.75	23252
Nonlabour income	2918.89	2699.35	2322.09	2445.50	2412.92	2637.78	33106
Age	45.10	41.02	39.94	39.74	41.11	40.06	26590
Year 12 or undefined certificate	0.08	0.13	0.24	0.24	0.16	0.23	4488
Certificate I, II, III, IV	0.12	0.15	0.22	0.14	0.22	0.17	9077
Diploma/Advanced Diploma	0.09	0.15	0.25	0.14	0.23	0.14	2821
BA or higher	0.06	0.15	0.27	0.18	0.24	0.10	6236
Children aged zero to four	0.09	0.18	0.27	0.14	0.18	0.14	3806
Children aged five to fifteen	0.09	0.18	0.25	0.15	0.21	0.14	6061
Children aged fifteen plus	0.13	0.16	0.23	0.14	0.21	0.14	4719
Legally Married/Cohabiting	0.11	0.15	0.23	0.14	0.22	0.15	21637
Single/Divorced/Widowed/Separated	0.10	0.11	0.20	0.15	0.24	0.20	11465
Outer Regional	0.11	0.13	0.21	0.12	0.23	0.20	4021
Inner Regional	0.11	0.13	0.20	0.14	0.23	0.19	8252
Major City	0.10	0.14	0.24	0.15	0.22	0.14	20149
Medium Deprivation	0.10	0.14	0.23	0.14	0.22	0.17	12484
High Deprivation	0.14	0.15	0.20	0.13	0.21	0.17	9965
SF6D	0.68	0.74	0.77	0.78	0.79	0.80	31319
Sports Club Member	0.06	0.09	0.24	0.17	0.26	0.18	13816
Dissatisfied with Free Time	0.10	0.17	0.23	0.23	0.14	0.19	6357

Women

Employed	0.08	0.19	0.26	0.17	0.21	0.10	21318
Not in the Labour Force/Unemployed	0.16	0.14	0.21	0.13	0.17	0.10	17841
Manual Work	0.11	0.16	0.20	0.14	0.22	0.16	1401
Employed Full-Time	0.08	0.19	0.25	0.16	0.21	0.09	10598
Hourlywage	18.02	18.84	18.78	18.76	19.33	17.34	21278
Nonlabour income	3068.78	2938.85	3135.82	2980.11	2994.14	3583.90	37297
Age	42.63	39.24	39.14	39.90	41.43	42.68	29941
Year 12 or undefined certificate	0.11	0.20	0.26	0.16	0.18	0.09	6054
Certificate I, II, III, IV	0.11	0.17	0.24	0.15	0.21	0.11	4820
Diploma/Advanced Diploma	0.07	0.16	0.25	0.20	0.22	0.10	3148
BA or higher	0.08	0.18	0.26	0.18	0.22	0.09	7568
Children aged zero to four	0.11	0.27	0.28	0.16	0.15	0.07	4880
Children aged five to fifteen	0.11	0.20	0.26	0.16	0.18	0.08	8613
Children aged fifteen plus	0.15	0.19	0.23	0.15	0.18	0.10	6938
Legally Married/Cohabiting	0.12	0.18	0.24	0.16	0.21	0.10	22951
Single/Divorced/Widowed/Separated	0.15	0.18	0.29	0.19	0.22	0.12	12609
Outer Regional	0.12	0.17	0.24	0.15	0.21	0.11	4290
Inner Regional	0.12	0.16	0.24	0.16	0.20	0.12	9293
Major City	0.13	0.17	0.25	0.16	0.20	0.09	23146
Medium Deprivation	0.12	0.17	0.24	0.16	0.20	0.10	14220
High Deprivation	0.16	0.18	0.23	0.14	0.18	0.10	11394
SF6D	0.68	0.73	0.76	0.77	0.78	0.79	35312
Sports Club Member	0.07	0.11	0.26	0.20	0.26	0.12	13825
Dissatisfied with Free Time	0.12	0.21	0.25	0.25	0.17	0.09	7833

All variables are given in percentages with the exception of age (years), SF6D (index 0 to 1) , hourly wage and household income (Australian dollars). n = number of observations (i*t)

Table 3: *Males Random Effects Ordered Probit Model (Marginal effects are shown)*

Dependent Variable	Employed						Not employed					
Physical Activity Participation	1M		2M		3M		4M		5M		6M	
Manual Work	0.22***	(0.04)	0.23***	(0.04)	0.22***	(0.04)						
Employed Full-Time	0.01	(0.03)	0.01	(0.03)	0.01	(0.03)						
Hourlywage	0.01	(0.0004)	-0.001	(0.0004)	-0.001	(0.004)						
Nonlabour income	-0.00001	(0.00004)	0.00004	(0.00004)	0.00005	(0.0004)	-0.0002***	(0.00006)	-0.03	(0.01)	0.0006	(0.0001)
Age	-0.05***	(0.01)	-0.04***	(0.01)	-0.04***	(0.01)	-0.06***	(0.02)	0.0003	(0.0001)	-0.02	(0.01)
Age Squared	0.001***	(0.0001)	0.0004	(0.00001)	0.004	(0.0001)	0.001***	(0.0001)	-0.06	(0.08)	0.0002	(0.0001)
Year 12 or undefined certificate	-0.06	(0.05)	-0.12*	(0.05)	-0.14**	(0.05)	-0.01	(0.08)	0.07	(0.07)	-0.08	(0.08)
Certificate I, II, III, IV	-0.01	(0.04)	-0.03	(0.04)	-0.04	(0.04)	0.10	(0.07)	0.16	(0.11)	0.04	(0.07)
Diploma/Advanced Diploma	-0.11	(0.06)	-0.16*	(0.06)	-0.17**	(0.06)	0.29*	(0.11)	0.07	(0.10)	0.13	(0.10)
BA or higher	-0.07	(0.05)	-0.16***	(0.04)	-0.19***	(0.05)	0.24*	(0.11)	-0.19	(0.10)	0.04	(0.10)
Children aged zero to four	-0.16***	(0.03)	-0.14***	(0.03)	-0.14***	(0.03)	-0.18	(0.11)	-0.05	(0.08)	-0.19	(0.10)
Children aged five to fifteen	-0.01	(0.03)	-0.01	(0.03)	0.02	(0.03)	-0.02	(0.09)	-0.05	(0.07)	-0.03	(0.08)
Children aged fifteen plus	-0.03	(0.03)	-0.02	(0.03)	-0.03	(0.03)	-0.12	(0.08)	-0.04	(0.08)	-0.03	(0.08)
Legally Married/Cohabiting	-0.12*	(0.04)	-0.12*	(0.05)	-0.12*	(0.04)	-0.03	(0.09)	-0.06	(0.11)	-0.02	(0.09)
Outer Regional	0.14	(0.10)	0.19	(0.10)	0.20	(0.10)	-0.23	(0.22)	-0.15	(0.22)	-0.20	(0.23)
Inner Regional	0.07	(0.09)	0.13	(0.09)	0.14	(0.10)	0.28	(0.22)	-0.21	(0.22)	-0.25	(0.22)
Major City	-0.15	(0.09)	-0.11	(0.09)	-0.07	(0.09)	-0.52*	(0.21)	-0.45	(0.22)	-0.48	(0.22)
Medium Deprivation	-0.11***	(0.03)	-0.08*	(0.03)	-0.07*	(0.03)	-0.23**	(0.07)	-0.16*	(0.07)	-0.16*	(0.07)
High Deprivation	-0.19***	(0.04)	-0.15***	(0.04)	-0.13***	(0.04)	-0.29	(0.07)	-0.18*	(0.08)	-0.17*	(0.07)
SF6D			0.97***	(0.04)	0.95***	(0.04)			0.71***	(0.08)	1.18***	(0.09)
Sports Club Member					0.21***	(0.02)					0.32***	(0.05)
Dissatisfied with Free Time					-0.01	(0.02)					-0.10	(0.06)
cut1	-3.51***	(0.22)	-3.62***	(0.21)	-3.68***	(0.21)	-3.51***	(0.38)	-3.29***	(0.38)	-3.34***	(0.39)
cut2	-2.52***	(0.21)	-2.62***	(0.21)	-2.67***	(0.21)	-2.84***	(0.39)	-2.61***	(0.38)	-2.65***	(0.38)
cut 3	-1.54***	(0.21)	-1.62***	(0.21)	-1.67***	(0.21)	-2.05***	(0.39)	-1.80***	(0.38)	-1.85***	(0.38)
cut 4	-0.97***	(0.21)	-1.06***	(0.21)	-1.11***	(0.21)	-1.56***	(0.39)	-1.30***	(0.38)	-1.34***	(0.38)
cut 5	0.05	(0.21)	-0.04	(0.21)	-0.08	(0.21)	-0.48	(0.39)	-0.23	(0.38)	-0.27	(0.38)
ρ	0.53***	(0.01)	0.51***	(0.001)	0.51***	(0.01)	0.52***	(0.02)	0.46***	(0.02)	0.46***	(0.02)
n	21793		21439		21326		4749		4662		4621	
log-likelihood	-34471.994		-33632.455		-33405.057		-7745.635		-7427.060		-7339.201	

*** Indicates significant at 1% level * *Indicates significance at 5% level. *Indicates significance at the 10% level. Standard Errors are in parenthesis. The Mundlak method is used in all equations to allow the explanatory variables to be correlated with the error term.

Table 4: *Females Random Effects Ordered Probit Model (Marginal effects are shown)*

Dependent Variable	Employed						Not employed					
Physical Activity Participation	1F		2F		3F		4F		5F		6F	
Manual Work	0.14**	(0.05)	0.15***	(0.04)	0.18***	(0.05)						
Employed Full-Time	0.01	(0.02)	0.001	(0.02)	0.02	(0.02)						
Hourlywage	0.0005	(0.001)	0.0001	(0.001)	0.00003	(0.00004)						
Nonlabour income	0.00008	(0.00004)	0.00004	(0.00004)	0.0004	(0.001)	-0.00001	(0.0004)	0.00001	(0.00004)	0.00006	(0.00004)
Age	-0.004	(0.01)	-0.01	(0.01)	-0.0002	(0.01)	-0.02	(0.01)	-0.003	(0.01)	-0.02	(0.01)
Age Squared	0.0001	(0.0001)	0.001	(0.001)	0.0001	(0.0001)	0.0003	(0.00001)	0.0001	(0.0001)	0.0001	(0.0001)
Year 12 or undefined certificate	-0.06 '	(0.04)	-0.08	(0.04)	-0.09	(0.04)	0.10	(0.06)	0.03	(0.05)	0.01	(0.06)
Certificate I, II, III, IV	0.05	(0.04)	0.06	(0.05)	0.07	(0.05)	0.12	(0.06)	0.09	(0.06)	0.08	(0.05)
Diploma/Advanced Diploma	0.13*	(0.06)	0.09	(0.05)	0.08	(0.06)	0.28***	(0.08)	0.23**	(0.08)	0.21**	(0.08)
BA or higher	0.11	(0.05)	0.05	(0.05)	0.03	(0.05)	0.21***	(0.07)	0.10*	(0.06)	0.08*	(0.06)
Children aged zero to four	-0.25***	(0.04)	-0.24***	(0.04)	-0.22***	(0.03)	-0.06	(0.04)	-0.13**	(0.04)	-0.13**	(0.04)
Children aged five to fifteen	-0.12***	(0.03)	-0.12***	(0.03)	-0.12***	(0.03)	0.04	(0.04)	-0.0001	(0.004)	-0.01	(0.04)
Children aged fifteen plus	-0.10***	(0.03)	-0.09**	(0.03)	-0.09**	(0.03)	-0.14**	(0.04)	-0.12*	(0.04)	-0.11*	(0.04)
Legally Married/Cohabiting	-0.03	(0.05)	-0.05	(0.05)	-0.05	(0.05)	0.02	(0.06)	-0.03	(0.06)	-0.03	(0.06)
Outer Regional	-0.08	(0.10)	-0.06	(0.10)	-0.06	(0.10)	0.19*	(0.08)	-0.02	(0.13)	0.001	(0.13)
Inner Regional	0.01	(0.10)	-0.0002	(0.10)	0.02	(0.10)	0.09	(0.10)	0.06	(0.13)	-0.03	(0.13)
Major City	-0.24*	(0.10)	-0.22*	(0.09)	-0.17*	(0.01)	0.01	(0.14)	-0.22	(0.13)	-0.18	(0.13)
Medium Deprivation	-0.11***	(0.03)	0.08*	(0.03)	-0.08*	(0.03)	-0.02	(0.13)	-0.13*	(0.05)	-0.11*	(0.05)
High Deprivation	-0.17***	(0.04)	0.14***	(0.04)	-0.13***	(0.04)	-0.21	(0.13)	-0.22***	(0.05)	-0.20***	(0.05)
SF6D			0.88***	(0.04)	0.85***	(0.04)	-0.16***	(0.05)	0.83***	(0.06)	0.78***	(0.06)
Sports Club Member					0.10***'	(0.04)	-0.28***	(0.05)			0.05	(0.04)
Dissatisfied with Free Time					-0.34***	(0.02)					-0.25***	(0.03)
cut1	-2.24***	(0.22)	-2.69***	(0.22)	-2.72***	(0.22)	-1.84***	(0.27)	-1.99***	(0.27)	-2.09***	(0.27)
cut2	-1.11***	(0.22)	-1.56***	(0.22)	-1.58***	(0.22)	-1.02***	(0.27)	-1.16***	(0.27)	-1.27***	(0.27)
cut 3	-0.10	(0.22)	-0.52	(0.22)	-0.54	(0.22)	-0.17	(0.27)	-0.31	(0.27)	-0.40	(0.26)
cut 4	0.57*	(0.22)	0.15	(0.22)	0.13	(0.22)	0.41	(0.27)	0.27	(0.27)	0.17	(0.26)
cut 5	1.79***	(0.22)	1.37***	(0.22)	1.36***	(0.22)	1.44***	(0.27)	1.30***	(0.27)	1.20***	(0.27)
ρ	0.55***	(0.01)	0.53***	(0.01)	0.52***	(0.01)	0.50***	(0.01)	0.45***	(0.01)	0.45***	'(0.01)
n	19997		19691		19586		9909				9661	
log-likelihood	-31108.637		-30383.967		-30086.351		-16192.169		-15737.139		-15582.296	

*** Indicates significant at 1% level * *Indicates significance at 5% level. *Indicates significance at the 10% level. Standard Errors are in parenthesis. The Mundlak method is used in all equations to allow the explanatory variables to be correlated with the error term.

Table 5: *Males Generalised Random Effects Ordered Probit (Marginal effects are shown)*

Dependent Variable	Employed					Not employed				
Physical Activity Participation	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Manual Work	-0.07	0.10	0.21***	0.28***	0.35***					
Employed Full-Time	-0.06	-0.08*	-0.07*	-0.04	0.14***					
Hourlywage	0.004	0.002	-0.001	-0.001*	-0.01***					
Nonlabour income	-0.0002	-0.00001*	0.00001	0.00004	0.0002***	0.00007	-0.0002	0.00006	0.00008	0.00001
Age	-0.02	-0.04***	-0.03***	-0.03**	-0.04**	-0.04	-0.05*	-0.03	-0.03	-0.01
Age Squared	0.0001	0.0004	0.004***	0.0004***	0.004***	0.0003	0.001	0.0004	0.0003	0.0001
Year 12 or undefined certificate	0.14*	0.03	-0.12	-0.23***	-0.34***	0.23	0.001	-0.17	-0.15	-0.15
Certificate I, II, III, IV	0.11	0.04	-0.04	-0.10	-0.16**	0.21	0.10	0.01	0.04	-0.03
Diploma/Advanced Diploma	0.31***	0.02	-0.22**	-0.29***	-0.44***	0.22	0.19	0.13	0.16	0.14
BA or higher	0.47***	0.14*	-0.16**	-0.41***	-0.71***	043**	0.29	0.07	-0.13	-0.23
Chilldren aged zero to four	-0.12	-0.13**	-0.19***	-0.18***	-0.07	-0.41**	-0.25	-0.19	-0.03	-0.10
Children aged five to fifteen	-0.003	0.01	-0.02	-0.01	-0.02	0.12	0.05	0.04	-0.14	-0.21
Children aged fifteen plus	-0.07	0.01	-0.04	-0.04	-0.001	-0.15	-0.13	-0.07	-0.10	0.10
Legally Married/Cohabiting	-0.05	-0.12*	-0.20***	-0.13*	-0.11*	0.05	0.003	-0.05	-0.11	-0.11
Outer Regional	0.25*	0.18	0.15	0.17	0.33**	0.44	0.31	-0.19	-0.63	-0.40
Inner Regional	0.19	0.14	0.17	0.12	0.25	0.24	0.17	-0.22	-0.63*	-0.33
Major City	0.06	-0.02	-0.07	-0.13	0.002	-0.005	-0.17	-0.54	-0.91***	-0.53*
Medium Deprivation	-0.13*	-0.15***	-0.09*	-0.03	0.04	-0.39***	-0.28**	-0.14	-0.12	-0.04
High Deprivation	-0.31***	-0.30***	-0.16***	-0.08*	0.07	-0.50***	-0.40***	-0.22*	-0.09	0.11
SF6D	0.79***	0.59***	0.72***	0.93***	0.77***	0.81***	0.67***	0.77***	0.89***	0.88***
Sports Club Member	0.48***	0.55***	0.23***	0.08**	0.04	0.43***	0.45***	0.36***	0.03	0.20**
Dissatisfied with Free Time	0.09**	0.10***	0.004	0.01	0.17***	0.14	0.12	0.12	0.28***	0.14
ρ	0.51***					0.48***				
χ^2	-32545.074	(0.000)				-7160.905	(0.000)			

*** Indicates significant at 1% level * *Indicates significance at 5% level. *Indicates significance at the 10% level. The p-value for the Wald χ^2 are shown in parenthesis next to the test.

Table 6: *Females Generalised Random Effects Ordered Probit (Marginal effects are shown)*

Dependent Variable	Employed					Not employed				
Physical Activity Participation	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Manual Work	-0.15*	0.04	0.30***	0.29***	0.40***					
Employed Full-Time	-0.01	-0.07*	-0.02	-0.09**	-0.14***					
Hourlywage	0.002*	-0.0003	-0.0002	0.001	-0.003					
Nonlabour income	0.00008	0.00006	-0.0007	0.00006	0.00006	0.00001	0.0004	0.00007	0.00003	0.0002*
Age	-0.04**	-0.02	0.01	0.01	0.01	-0.04*	-0.01	0.002	0.004	0.02
Age Squared	0.0005*	0.0002	0.00001	0.00001	-0.0001	0.0004*	0.0002	0.0002	0.0001	-0.001
Year 12 or undefined certificate	0.08	-0.05	-0.18***	-0.18***	-0.20**	0.05	-0.01	0.02	-0.06	0.01
Certificate I, II, III, IV	0.07	0.10	0.05	0.05	0.08	0.23**	0.17*	0.09	-0.001	-0.10
Diploma/Advanced Diploma	0.43***	0.26***	-0.13	-0.13	-0.23**	0.29*	0.21*	0.33***	0.14	0.04
BA or higher	0.39***	0.19***	-0.11	-0.11	-0.30***	0.26**	0.11	0.12	0.03	-0.16
Chilldren aged zero to four	-0.23***	-0.22***	-0.21***	-0.21***	-0.22**	-0.02	-0.17**	-0.17***	-0.20***	-0.12*
Children aged five to fifteen	0.03	-0.1	-0.18***	-0.19***	-0.15**	0.04	-0.01	0.0001	-0.06	-0.02
Children aged fifteen plus	-0.02	-0.08	-0.14***	-0.14***	-0.03	-0.10	-0.26***	-0.15*	-0.09	0.04
Legally Married/Cohabiting	-0.02	-0.13*	-0.01	-0.01	-0.02	0.03	-0.04	-0.04	-0.07	-0.16*
Outer Regional	-0.05	-0.003	-0.09	-0.11	-0.04	-0.08	-0.07	-0.07	0.19	-0.08
Inner Regional	0.03	0.09	-0.01	-0.05	0.04	-0.12	-0.11	-0.11	0.16	-0.07
Major City	-0.17	-0.06	-0.16	-0.24	-0.19	-0.23	-0.20	-0.20	-0.02	-0.30
Medium Deprivation	-0.17***	-0.13***	-0.06	-0.02	0.02	-0.19*	-0.19***	-0.19	-0.10	-0.06
High Deprivation	-0.32***	-0.23***	-0.10*	-0.04	0.02	-0.41***	-0.33***	-0.32***	-0.10	-0.001
SF6D	0.76***	0.98***	0.81***	0.81***	0.58***	0.43***	0.84***	0.84***	0.89***	0.78***
Sports Club Member	0.49***	0.61***	0.08**	0.26***	0.01	0.45***	0.49***	0.49***	0.15***	0.06
Dissatisfied with Free Time	0.11*	0.15***	0.26***	0.08**	0.02	0.15**	0.13**	0.13**	0.03	-0.12*
ρ	0.53***					0.46***				
χ^2	-15742.252	(0.000)				-15284.159	(0.000)			

*** Indicates significant at 1% level * *Indicates significance at 5% level. *Indicates significance at the 10% level. The p-value for the Wald χ^2 are shown in parenthesis next to the test.

Appendix A: *Variable Labels and Definitions*

Variable Name	Description
Dependent Variable	
Physical Activity	0=None, 1=Less than Once a Week, 2=1 to 2 times a week 3= 3 times a week, 4=more than three times a week but not everyday 5=everyday
Explanatory Variables	
Sports Club Member	0=Not member of sporting/hobby/community based org 1= Member of sporting/hobby/community based org
Dissatisfied with Free Time	0=Satisfied/Neutral with the amount of free time 1=Dissatisfied with amount of free time
Marital Status	0=Separated/Divorced ,Widowed, Never Married 1=Legally Married/Cohabiting
Age	Age in years
Agesqrd	Age squared
Children aged zero to four	0=No children aged 0-4, 1=Children aged 0-4
Children aged five to fifteen	0=No children aged 5-15, 1=Children aged 5-15
Children aged fifteen plus	0=No dependents at home age 15+, 1= dependents at home age 15+
	Region Variables
Remoteness	0=Remote /Very remote 1=Outer regional 2=Inner Regional 3=Major City
Social Deprivation	0=Low Disadvantage (lowest three deciles of social deprivation) 1=Medium Disadvantage (4 middle deciles of social deprivation) 2=High Disadvantage (highest 3 deciles of social deprivation)
	Labour Variables
Unemployed/Not in Labour Force	0=Employed 1=Unemployed/Not in the Labour Force
Employed Full-Time	0=Part time 1=Full time
Hourlywage	Weekly gross wage divided by hours worked per week
Non-labour income	Household financial year gross income-Household financial year market income/Number of people in the household
Manual Work	0=Managerial/Profession/Associate Professional/Tradework, Advanced Services/Intermediate Services, Intermediate Production/Elementary Work 1=-Manual Work
Education	0-No qualifications 1-Year 12 or undefined certificate (less than secondary schooling in the UK or a high school diploma in the US) 2-Certificate I, II, III, IV (equivalent to secondary schooling in the UK or a high school diploma in the US). 3-Diploma/Advanced Diploma (equivalent to Further Education the UK or an associate degree in the US)) 4-degree or higher
	Health
SF6D	Preference based health index, 1 = full health, 0 = equivalent to death.

See http://www.melbourneinstitute.com/hilda/onlinedd/Default.aspx for more information about the HILDA variables.