LONGITUDINAL RELATIONSHIP BETWEEN PARTICIPATION IN PHYSICAL ACTIVITY AND HEALTH

Logan McLeod, Jane E. Ruseski

Working Paper No: 150002

January 27, 2015

Longitudinal Relationship between Participation in Physical Activity and Health

Logan McLeod[a] and Jane E. Ruseski[b,*]

[a] *Wilfrid Laurier University, School of Business & Economics, Department of Economics*
[b] *West Virginia University, Department of Economics*

Abstract

Health production models include participation in physical activity as an input. We investigate the longitudinal relationship between participation in physical activity and health outcomes using a random effects probit model and a dynamic unobserved effect probit model. Estimates based on data from 8 cycles of the Canadian National Population Health Survey (NPHS) indicate lagged participation in physical activity has a modest negative effect on the incidence of high blood pressure, ulcers, arthritis, and heart disease. Lagged participation in physical activity has a relatively large negative effect on the probability of being in fair or poor health self-reported health.

JEL Classification: I12; I18

Keywords: health production; physical activity; lifestyle choices; random effects probit; dynamic unobserved effects probit

Preliminary Draft.
Please do not quote or cite without the authors' consent.

*Corresponding Author: Jane E. Ruseski. Email: *jeruseski@mail.wvu.edu*

1 Introduction

Habitual physical activity is widely accepted as an effective way to mitigate the risks of chronic diseases, obesity, and premature death. In their systematic review, Warburton et al. (2010) conclude the current literature clearly supports dose-response relationship between physical activity, all-cause mortality, and the seven chronic diseases (cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, type 2 diabetes, and osteoporosis) most often associated with physical inactivity. The Canadian Society for Exercise Physiology (CSEP) and the Public Health Agency of Canada (PHAC) have worked together for nearly 20 years on the development of the Canadian Physical Activity (CPA) Guidelines to promote healthy active living among Canadians (Tremblay et al., 2011). The latest CPA guidelines, released in 2011, contain recommendations for physical activity for children, youth, adults, and older adults. For adults (aged 18-64), the guidelines are to accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more, to achieve health benefits (Tremblay et al., 2011). Based on self-reported data from the Canadian Community Health Surveys (CCHS), 54% of Canadians were considered moderately active or active in 2011, an increase from 52% in 2005 (Statistics Canada, 2012). Despite this self-reported improvement in participation rates, only 15% of adult Canadians (over age 20) met the new physical activity guidelines based on objective accelerometer data (Colley et al., 2011). Simultaneously, the prevalence of obesity has risen over the past 25 years (Shields et al., 2010). It is these types of statistics that makes the dissemination and promotion of the physical activity guidelines a policy priority.

Although regular physical activity is commonly included in epidemiological studies as a health practice associated with good health, the relationship between physical activity and health outcomes has not been as extensively studied in the health economics literature. Three recent exceptions using Canadian data are Humphreys et al. (2014) who use one cycle of the CCHS Public Use Microdata File (PUMF); Sarma et al. (2014) who use three cycles of CCHS Confidential Master File; and Sarma et al. (2014) who use eight cycles of the National Population Health Survey (NPHS). The objective of this paper is to examine the impact of physical activity on health outcomes using longitudinal data from the Canadian National Population Health Survey (NPHS). We estimate random effects probit and dynamic random effects probit models for 6 chronic health conditions (diabetes, high blood pressure, heart disease, arthritis, asthma and ulcers) and fair/poor self-reported health status, and 3 measures of physical activity (active, moderate and daily). We find physical activity has an important and lasting effect on health status. Results from the dynamic random effects probit models indicate people who engage in physical activity at any level are less likely to have fair / poor self-reported health.

2 Health Production

2.1 Health Production Framework

Our conceptualization of the relationship between participation in physical activity and health is based on Grossman's health production model (Grossman (1972)). The Grossman model builds on the concept of household production introduced by Becker (1965) to develop a model of the demand for health. The model links household production and investment in human capital theories to describe the demand for health as having a consumption motive (people receive utility from being healthy), an investment motive (by investing in better health, people can increase the amount of healthy time available to earn income), or both. We use Grossman's health production model to motivate the econometric analysis of the relationship between non-medical inputs (such as physical activity) and health outcomes.

In the basic health production model, individuals are assumed to have preferences over their health (H_t) and the consumption of other commodities (C_t), which are produced by combining purchased market goods and time. Extension of the basic health production model have included factors other than age to affect the stock of health (e.g., Cawley (2004), and Humphreys and Ruseski (2011)). For example, the expanded health production model assumes the stock of health is affected by healthy behaviours, such as participation in physical activity (PA_t). Given this, an individual's preferences can be described by a utility function: $U(C, H, PA)$.

The stock of health depreciates over time. Individuals can invest in their stock of health by producing health through the combination of medical inputs (M_t), non-medical inputs (such as physical activity), and time. Individuals make choices about how to allocate their time and resources to health investments and other activities subject to monetary budget and time constraints. The health production function can be written as

$$H_t = h(H_{t-1}, X_{t-1}, M_{t-1}, PA_{t-1}), \tag{1}$$

where H_t is the stock of health in period t; $h(\cdot)$ is the health production function; X_{t-1} represents non-medical inputs to health in period $t-1$; M_{t-1} is purchased medical inputs; and PA_{t-1} is participation in physical activity. It is generally assumed all inputs have an positive, and diminishing, marginal product.

Equation (1) also highlights the temporal relationship between health and inputs to health production by recognizing the influence of healthy behaviours on health may not be contemporaneous. Some activities, like smoking, may provide utility today but are expected to decrease the stock of

health in the future. Conversely, other activities - like healthy eating habits and regular exercise - may increase or decrease utility today but are expected to increase the health stock (net of normal depreciation) in the future.[1] Given this, participation in physical activity can also be viewed as having a consumption motive (utility is provided directly by participating), an investment motive (participating in physical activity is an input into health production, which is an investment in health), or both.

One implication of equation (1), and the assumption of positive, and diminishing, marginal product of physical activity, is it tells us (all else equal) the health stock in period t will be greater with positive participation in physical activity relative to no participation:

$$E[H_t|PA_{t-1} > 0] > E[H_t|PA_{t-1} = 0] \tag{2}$$

The health production framework recognizes individuals are heterogeneous in terms of health production. Investment in health realized by any individual depend on their initial endowment of health, their health production efficiency, and their decisions about engaging in healthy behaviours. The optimality conditions arising from this type of model describe the tradeoffs individuals face between choices that provide direct satisfaction and choices that provide indirect satisfaction through the production of health. The optimality conditions provide the basis for constructing and estimating empirical models of health outcomes.

2.2 Empirical Health Production Studies

There is a large and diverse empirical literature examining the demand for health within a Grossman health production framework. Of most relevance for our paper are studies exploring the relationship between health behaviours, rather than medical inputs, and health. The main empirical challenge in these studies is accounting for unobservable individual heterogeneity and endogeneity of health inputs. For example, the decision to be physically active is likely correlated with unobservable factors like time preferences and enjoyment or lack of enjoyment of exercise. Several approaches can be used to address this endogeneity including instrumental variables and recursive bi- or multivariate probit models.

Examples of studies using instrumental variables methods are Rosenzweig and Schultz (1983) and Mullahy and Portney (1990). Rosenzweig and Schultz (1983) estimated a health production function in which birth weight is the health outcome of interest. The inputs affecting birth weight are prenatal medical care, characteristics of the mother (e.g., employment status while pregnant),

---

[1] We acknowledge participation in physical activity may decrease health for some individuals, either through injury or given the initially low stock of health an individual may have when they initially decide to participate.

smoking while pregnant, age and number of births, prices, and income. Mullahy and Portney (1990) examined the effect of cigarette smoking, air pollution, climatological conditions and other risk factors on the production of respiratory health. Treating smoking as an endogenous variable, they found that increased smoking results in more days of respiratory illness.

More recent empirical studies model the production of health as recursive structures with reduced form equations for healthy behaviours and a structural equation for the health production function (e.g., Contoyannis and Jones (2004), Balia and Jones (2008), Schneider and Schneider (2009), Humphreys et al. (2014), Sarma et al. (2014), and Sarma et al. (2014)). Contoyannis and Jones (2004) evaluated the effects of socioeconomic status and healthy behaviours on health. Using data from the 1984 and 1991 British Health and Lifestyle Survey (HALS), they estimated the structural parameters of a health production function together with the reduced form parameters for healthy behaviour equations. Health was measured by a binary indicator of self-assessed health status. The endogenous healthy behaviour variables were based on the "Alameda Seven":eating breakfast; maintaining proper weight; not snacking between meals; never smoking cigarettes; regular physical activity; moderate or no use of alcohol; and getting 7-8 hours of sleep regularly (Belloc and Breslow, 1972). They found that sleeping well, exercising, and not smoking had positive effects on the probability of having excellent or good self-reported health. However, eating breakfast and moderate alcohol consumption were not indicators of health status.

Balia and Jones (2008) also used the British HALS (1984 and 2003) to estimate the effects of healthy behaviours on mortality. They were particularly interested in evaluating the contribution of healthy behaviours to the observed socioeconomic gradient of mortality. Like Contoyannis and Jones (2004), health was measured by a binary indicator of self-assessed health status and the healthy behaviour variables are based on the Alameda Seven. Mortality was measured as a binary variable taking on the value of 1 if the respondent had died before the May 2003 survey and zero otherwise. Balia and Jones (2008) found that all of the healthy behaviour indicators had a negative sign but only non-smoking, eating breakfast, and obesity were statistically significant. Regular exercise was not found to be an important determinant of health. They also found that healthy behaviours do indeed contribute in an important way to the socioeconomic gradient of mortality.

Schneider and Schneider (2009) examined the impact of smoking, alcohol consumption, and obesity on self-assessed health status using data from the 2006 German Socio-economic Panel (SOEP). Like Contoyannis and Jones (2004) and Balia and Jones (2008), they estimated the structural parameters of a health production function and reduced form parameters of the three healthy behaviour equations as a recursive system. They found differential effects of smoking, alcohol consumption and obesity on health status by gender. Drinking and obesity had a negative impact

on male health but no significant effect of smoking was found. For females, drinking positively influenced health status but smoking and obesity were not significant.

Humphreys et al. (2014) examined the impact of participation in physical activity on six health outcome measures using data from the 2005/06 Canadian Community Health Survey (i.e., CCHS cycle 3.1) PUMF. They estimated bivariate probit models with a structural equation for health and reduced form equation for participation in physical activity. They found contemporaneous participation in physical activity reduces the incidence of diabetes, high blood pressure, heart disease, asthma, and arthritis as well as being in fair or poor self-reported health. There appears to be a diminishing marginal impact on adverse health outcomes from an increase in the intensity of physical activity above the moderate level. However, Humphreys et al. (2014) used cross-sectional data and thus was not able to comment on the dynamic relationship between physical activity and health.

Sarma et al. (2014) extended Humphreys et al. (2014) by evaluating the effect of both leisure time (LTPA) and work related physical activity (WRPA) on obesity, diabetes, high blood pressure, and heart disease using data from three cycles of the CCHS Confidential Master Files (Cycles 1.1 (2000/01), 2.1 (2003/04), and 3.1 (2005/06)). They estimated instrumental variables and bivariate probit models using monthly average temperatures as an instrument for the endogenous physical activity variable. In contrast to Humphreys et al. (2014), they did not find an effect of LTPA on the probability of having diabetes, high blood pressure, or heart disease. On the other hand, they found that WRPA had a negative effect on obesity and having diabetes, high blood pressure, and heart disease.

In a separate paper, Sarma et al. (2014) ask a similar question to Sarma et al. (2014) but focus on an individuals' body mass index (BMI) as the health outcome measure. They use longitudinal data from eight cycles of the NPHS (1994/1995 to 2008/2009) and estimate: (i) static fixed-effects model; (ii) static random-effects model; (iii) a difference GMM procedure, and (iv) dynamic fixed-effects instrumental variables model using lags of LTPA and WRPA as the excluded instruments. Overall, LTPA is found to reduce BMI with a larger effect for females. WRPA is found to have a modest effect (less than half a BMI point) on reducing BMI, again with a modestly larger effect for females.

3 Data

3.1 Canadian National Population Health Survey

This paper adds to the empirical literature on health production by evaluating the dynamic relationship between physical activity and health. We use data from eight cycles (1994/1995 - 2008/2009) of the Canadian National Population Health Survey (NPHS). The NPHS is a longitudinal survey that collects health and socio-demographic information every two years from the same sample of household residents, age 12 and older, in all ten provinces. The NPHS excludes populations living in the three Territories, residents of health care institutions, those living on Indian Reserves, Canadian Forces Bases and in some remote areas in Quebec and Ontario. The longitudinal sample contains 17,276 persons, is representative at the provincial level, and is not renewed over time (Statistics Canada (2010)).

The NPHS is a complex survey based on a two-stage, stratified, cluster design. To account for the NPHS's complex survey design, Statistics Canada provides sample weights. The sample weights are computed using an initial weight representing the inverse probability of selection into the survey. The initial weight is then adjusted for survey specific factors (such as non-response). Adjustments are also made for the longitudinal sample due to attrition. The last adjustment consists of post-stratification within each province to ensure consistency with population estimates based on the 1996 Canadian Census (Statistics Canada (2010)).

3.2 Variables

The primary variables of interest are measures of participation in leisure time physical activity and measures of health outcomes.

Our measures of participation in leisure time physical activity (PA_{it}) are based on the detailed questions regarding a respondent's frequency and intensity of physical activity. We define four binary variables capturing different frequency and intensity of participation: (i) *active participation*, (ii) a *moderately active participation*, (iii) a *inactive participation*, and (iv) *daily participation*. The four measures of participation in leisure time physical activity capture frequency and intensity of participation and can be interpreted as the second stage choice of a respondent, conditional on the first stage (i.e. deciding whether to participate in physically activity at all).

The three binary variables *active participation*, *moderately active participation*, and *inactive participation* are derived from the physical activity index (PAI). The PAI is based on the average daily energy expended (kcal/kg/day) on leisure time physical activity in the past three months. Energy expenditure is based on the frequency and duration of reported sessions of physical activity

and the metabolic equivalent task (MET) value of the specific activity.[2] The MET is a value of metabolic energy cost expressed as a multiple of the resting metabolic rate. For example, an activity of 4 METS requires four times the amount of energy as compared to when the body is at rest. *Active participation* is defined as having an average daily energy expenditure greater than or equal to 3. *Moderately active participation* is defined as having an average daily energy expenditure greater than or equal to 1.5 and less than 3. *Inactive participation* is defined as having an average daily energy expenditure less than 1.5.

The fourth binary variable (*daily participation* in physical activity) is based on responses about leisure time physical activity over the previous three months. These three binary variables identify individuals who engage in physical activity frequently and intensely. The first three measures of participation in physical activity (*active participation*, *moderately active participation*, and *inactive participation*) reflect frequency and intensity of physical activity. The fourth measure of participation in physical activity (*daily participation*) reflects high frequency of participation but not intensity. This delineation in the physical activity variables should allow us to evaluate the extent to which frequency and intensity of participation in physical activity are needed for health benefits. Membership to the first three measures of participation in physical activity is mutually exclusive since they all measure frequency and intensity of participation. However, there is likely overlap between membership in the first three measures of participation in physical activity and *daily participation*in physical activity, because daily participation does not reflect intensity of participation.

Our measures of a respondent's health outcomes (H_{it}) are based on the detailed questions regarding a respondent's physical health and the presence of chronic conditions. Specifically, we define seven binary variables, which take a value of 1 if the individual reports having the condition and zero otherwise, corresponding to seven different health outcomes: (i) self-reported fair or poor health; (ii) diabetes; (iii) high blood pressure; (iv) heart disease; (v) arthritis; (vi) asthma; and (vii) ulcers. These seven health outcomes are among the most frequently reported negative health outcomes in the NPHS. Most of these health outcomes (but specifically high blood pressure, diabetes, and heart disease) have been linked to healthy behaviours and can be influenced by physical activity.

The analysis also controls for demographic and socioeconomic variables contribute to participation in physician activity and health outcomes. The demographic variables included in the model, but not discussed in detail here, include: age, sex, marital status, a binary variable equal to one if there are kids (under the age of 12) present in the household, Canadian born, province of resi-

---

[2]The MET value is equal to the energy cost of an activity: (kcal/kg per hour)/365. This converts yearly data into daily data.

dence. Finally we also include height (in meters) as a continuous exogenous variable as it is a good predictor of mortality and morbidity risks and captures heterogeneity in initial health endowments (Balia and Jones (2008)).[3]

The main socioeconomic variables of interest are household income and level of education. Household income is measured using a binary variable to indicate the income decile in each cycle. Household income is not adjusted for household size and composition. Rather, household size and composition variables are included as independent variables in the regression analysis. The binary variable for household income decile accounts for differences in the relative income position of households in the analysis and for a nonlinear relationship between household income, physical activity and health. The level of education is a derived variable indicating the highest level of education attained by the individual: less than high school, high school graduate, some post secondary, and post secondary graduate. We also control for employment status, whether the household's primary source of income is welfare, and whether the house is owned by a household member.

The initial sample size of the NPHS longitudinal sample is 17,276 individuals. The analysis sample is restricted to respondents who are: (i) 18 years of age or older in 1994, (ii) with complete response pattern across all 8 cycles, and (iii) not missing information on any of the dependent or independent variables. The restrictions result in an analysis sample size of 5,332 individuals over 8 years giving us 42,656 "person-year" observations.[4]

3.3 Descriptive Statistics

Table 1 present the mean participation rates for the physical activity variables and health outcome variables for each cycle and pooled across all cycles. Section 1 of Table 1 shows a slight majority of respondents are physically inactive in the pooled sample (52.1%). Of respondents who are physically active, 32.9% participate daily, 21.4% are active participants, and 26.5% are moderately active participants.

Mean participation rates by cycle in Table 1 are also presented graphically in Figure 1. Interestingly, we observe roughly a 13 percentage point increase in *daily* participation in physical activity (from a low of 26.9% in 1994 to 39.8% in 2008) and a 12.5 percentage point decrease in respondents who are physically *inactive* over time (from a high of 59.2% in 1994 to 46.7% in 2008). During

---

[3]The NPHS reports height as a categorical variable with 75 different categories. Each category corresponds to 1-inch height increments (or approximately 2.5cm). The categorical height variable is converted to 'height in meters' by taking the mid-point of each height category, and dividing by 100.

[4]There were 3,159 individuals under 18 years of age, 7,962 individuals with incomplete response patterns across all 8 cycles, 915 observations dropped due to missing information on any of the dependent variables, and 124 observations dropped due to missing information for height, employment status, Canadian born, and home ownership. One concern that may arise from the sample restrictions is how a systematic risk of selection into the sample may affect the results.

the same period, there was a five percentage point increase in *moderately active* participation in physical activity (from 23.2% in 1994 to 28.2% in 2008) and an 7.5 percentage point increase in *active* participation in physical activity (from 17.6% in 1994 to 25.1% in 2008).

Section 2 of Table 1 shows some variation in the prevalence of health outcomes in the pooled sample. The most prevalent health outcomes are arthritis (18.5%), high blood pressure (14.2%), fair/poor self-reported health (8.1%), and asthma (7.9%). The least prevalent health outcomes are ulcers (2.9%), heart disease (3.8%), and diabetes (4.4%). Mean prevalence rates of health outcomes by cycle reported in Table 1 are also presented graphically in Figure 1 which illustrates the increase between 1994 to 2008. The largest increases occurred in diabetes (almost a 400% increase from 1.6% in 1994 to 8.1% in 2008), heart disease (a 280% increase from 1.6% in 1994 to 6.1% in 2008), high blood pressure (a 259% increase from 6.5% in 1994 to 23.3% in 2008), and arthritis (a 173% increase from 9.8% in 1994 to 26.9% in 2008). By comparison, there was only a modest increase in the prevalence rates of asthma (a 52% increase from 5.7% in 1994 to 8.7% in 2008), fair or poor self-reported health (a 42% increase from 6.7% in 1994 to 9.5% in 2008), and ulcers (an 8% increase from 2.8% in 1994 to 3.1% in 2008).

Table 2 presents the mean of the demographic and socioeconomic variables by cycle. The mean age in the pooled sample is 46.7 years old. Just over half the sample is female (53.0%). The majority are employed (71.4%), married (70.3%), report having kids under the age of 12 in the household (46.1%), are Canadian born (82.1%), and own their home (77.1%). A minority reports welfare as the main source of household income (2.4%), have completed post-secondary education (43.9%) - with and 14.2% having less than a high school education.

4   Empirical Methods

The main question to answer is how is an individual's health (H_i) is affected by their participation in physical activity (PA_i). Fundamentally, we are trying to estimate how participation in physical activity, and other exogenous factors (X_i), affects expected health outcomes: $E[H_i|PA_i, X_i]$.

The ideal experiment would be to randomize individuals with respect to PA_i, then $E[H_i|PA_i, X_i]$ would give the true effect of PA_i on H_i. However, we can not run the ideal experiment and must instead draw inference from observational data about $E[H_i|PA_i, X_i]$. The challenge using observational data is individuals are not randomized into PA_i. In fact, participation in physical activity is likely correlated with an individual-specific effect (c_i), that may also be correlated with H_i.[5]

A number of potential econometric techniques could be used to model the conditional mean

---

[5]We use the same notation (c_i) as Chamberlain (1982), Wooldridge (2002), and Cameron and Trivedi (2005) to emphasize the c_i is a random variable and not a parameter of the model.

function. The three panel data approaches most relevant to this analysis are: (i) a random effects probit; and (ii) a dynamic unobserved effects probit.

4.1 Random Effects (RE) Probit

The random effects (RE) probit models the presence of a health condition in period t (H_{it}) as a function of participation in physical activity at time t (PA_{it}), a vector of observable individual characteristics at time t, (X_{it}), and an unobserved individual effect (α_i):

$$E[H_i|PA_i, X_i, c_i] = P[H_{it} = 1|PA_{it}, \mathbf{X_{it}}, c_i] = \Phi(c_i + \mathbf{X_{it}}\beta_i^{RE} + \delta^{RE}PA_{it}) \tag{3}$$

where $\Phi(\cdot)$ is a standard normal conditional density function. The parameter of interest in equation (3) is δ_i^{RE} which can be interpreted as the effect of choosing to participate in physical activity in period t on the probability of having a given health outcome.

The RE probit assumes the unobserved individual effects (c_i) are normal distributed with $c_i \sim N[0, \sigma_c^2]$. A main assumptions of the RE probit is that $\mathbf{X}_{it}$ and PA_{it} are strictly exogenous. One implication is $\mathbf{X}_{it}$ can not include a lagged health outcome variable ($H_{i,t-j}$, where $j = 1, 2, \ldots, T$). The strict exogeneity assumption prevents the RE probit from estimating the dynamic relationship between participation in physical activity and health outcomes. The RE probit is estimated using maximum likelihood by choosing the parameters ($\beta^{RE}, \delta^{RE}, \sigma_c^2$) that maximizes the log-likelihood function.

4.2 Dynamic Unobserved Effects (DUE) Probit

A natural extension of the RE probit model is the inclusion of lag values of health and physical activity (Wooldridge, 2002). The model will take the same general form as Equation (3), but with the additional dynamic terms:

$$\begin{aligned} E[H_{it}|\mathbf{X_{it}}, PA_{i,t-1}, H_{i,t-1}, c_i] &= P[H_{it} = 1|\mathbf{X_{it}}, PA_{i,t-1}, H_{i,t-1}, c_i] \\ &= \Phi(c_i + \mathbf{X_{it}}\beta_i^{DUE} + \delta^{DUE}PA_{i,t-1} + \gamma^{DUE}H_{it-1}). \end{aligned} \tag{4}$$

Again, the parameter of interest is δ^{DUE}, which is interpreted as the effect of choosing to participate in physical activity last period on the probability of having a given health condition this period. The second parameter of interest is γ^{DUE}, which is interpreted as a measure of state dependence of a health outcome (i.e. the effect of having a health condition last period on the probability of having the same health condition this period). The RE probit is estimated using

maximum likelihood by choosing the parameters $(\beta^{DUE}, \delta^{DUE}, \gamma^{DUE}, \sigma_c^2)$ that maximizes the log-likelihood function.

5 Regression Results

The relationship between the level of participation in physical activity and health outcomes is the primary focus of this investigation.

To summarize and interpret the estimates relating to our primary focus from the 63 models, Table 3 only reports the coefficient and standard error estimates for the different measures of participation in physical activity (*active*, *moderate*, and *daily*), both contemporaneous and lagged, as well as for the lagged health outcome.[6],[7]

5.1 Effect of Physical Activity on Fair/Poor Self-Reported Health

Overall, there is a negative and statistically significant (at the 1% level) effect of participation in physical activity (contemporaneous or lagged) on the probability of fair/poor self-reported health status. The coefficient estimates are larger (in magnitude) in random effects probit model (using contemporaneous participation in physical activity) than in the dynamic unobserved effects probit (using lagged participation in physical activity).

The magnitude of the effect is also larger for more frequent and intense participation in physical activity. Moving from being *inactive* to being *active* ($\delta^{RE} = -0.521$, $\delta^{DUE} = -0.283$) reduces the probability of reporting fair/poor self-reported health by more than changing from being *inactive* to being *moderately active* ($\delta^{RE} = -0.318$, $\delta^{DUE} = -0.216$).

If we focus on the effect of *daily* participation (which, recall, only measures frequency and not intensity of participation in physical activity) we still see a negative and statistically significant effect of participation in physical activity on the probability of fair/poor self-reported health status ($\delta^{RE} = -0.240$, $\delta^{DUE} = -0.177$).

5.2 Effect of Physical Activity on Other Health Outcomes

Interestingly, there does not appear to be a consistent negative (or statistically significant) effect of participation in physical activity (contemporaneous or lagged) on the probability of other health

---

[6]We report contemporaneous participation in physical activity for each of our three different measures (*active*, *moderate*, and *daily*) for each of the seven health outcomes using a random effect probit estimator, plus lagged participation and lagged health outcomes for each of our three different measures of participation in physical activity for each of the seven health outcomes using a random effect probit estimator ($(3 \times 7) + (2 \times 3 \times 7) = 63$) for a total of 63 models.

[7]A full set of coefficient estimates from all models is reported in Tables A.1 to A.7 in the the Appendix.

outcomes. The random effects probit model suggest virtually no relationship between contemporaneous participation in physical activity (using any measure) and chronic health conditions. The only statistically significant relationship in the random effects probit models is for *daily* participation and arthritis, which is positive ($\delta^{RE} = 0.086$) and statistically significant (at the 5% level). This is a somewhat interesting finding as it suggests in some cases, frequent physical activity may have a negative effect on health.

The lack of a relationship between contemporaneous physical activity and chronic conditions is not completely surprising since it likely takes some time before regular participation in physical activity generates significant and sustainable health benefits. Estimates from the dynamic unobserved effects probit generally support this hypothesis for some chronic health outcomes. People who reported being *active* or physically active *daily* were less likely to report having high blood pressure ($\delta^{DUE}_{active} = -0.144$, $\delta^{DUE}_{daily} = -0.105$). People who were *active* or *moderate*ly active were less likely to report having heart disease ($\delta^{DUE}_{active} = -0.183$, $\delta^{DUE}_{moderate} = -0.125$). People who are *active* were less likely to report having arthritis ($\delta^{DUE}_{active} = -0.054$). Finally, moderately active participants were less likely to report having ulcers suggesting that physical activity could be acting as a stress reducer.

6 Discussion

Using a Grossman health production framework, we look at the influence of participation in physical activity on health. We focus on participation in physical activity because sedentary lifestyles have been recognized as a modifiable risk factor for chronic diseases like diabetes, heart disease, stroke, and arthritis. However, questions remain regarding the frequency and intensity of physical activity needed to reduce the incidence of disease.

Using using data from 8 cycles of the NPHS, we look at how participation in physical activity affects health contemporaneously (using a random effects probit model) and over time (using a dynamic unobserved effects probit model). We use three measures of participation in physical activity (active participation, moderately active participation, and daily participation). The first two measures are based on energy expended on leisure time physical activity, and capture both the intensity and frequency of activity. The third measure simply captures frequency of participation.

We find evidence suggesting lagged participation in physical activity has a relatively large negative effect on the probability of being in fair or poor health self-reported health. If self-reported health is interpreted as a multidimensional measure of health, then this result suggests participation in physical activity may have positive effects on health beyond what is captured by the presence of a

single health condition. This may be partially explained by the results showing lagged participation in physical activity has a more modest negative effect on the incidence of high blood pressure, ulcers, arthritis, and heart disease. Conversely, it may simply be that unobserved individual heterogeneity has stronger links between self-reported health and participation in physical activity (e.g., people who choose to participate in physical activity may simply perceive themselves to be healthier).

The magnitude of the effects are larger contemporaneously, but are generally statistically insignificant. Conversely, there are more statistically significant effects of participation in physical activity on health in the dynamic model. A strength of the dynamic unobserved effects probit is the control for lagged health status. The results suggest strong state dependence (both in terms of magnitude and statistical significance) in health outcomes. Once controlling for this, we still find modest to strong effects of participation in physical activity on health. However, one limitation of the dynamic unobserved effects probit is the limited control for unobserved individual heterogeneity affecting both investment decisions in health and participation in physical activity. The dynamic unobserved effects probit does account for unobserved individual heterogeneity affecting health, and state dependence in health. State dependence may control for unobserved individual heterogeneity to some extent, but future work should attempt to model unobserved individual heterogeneity more explicitly.

Figure 1: Mean, participation in physical activity, by cycle
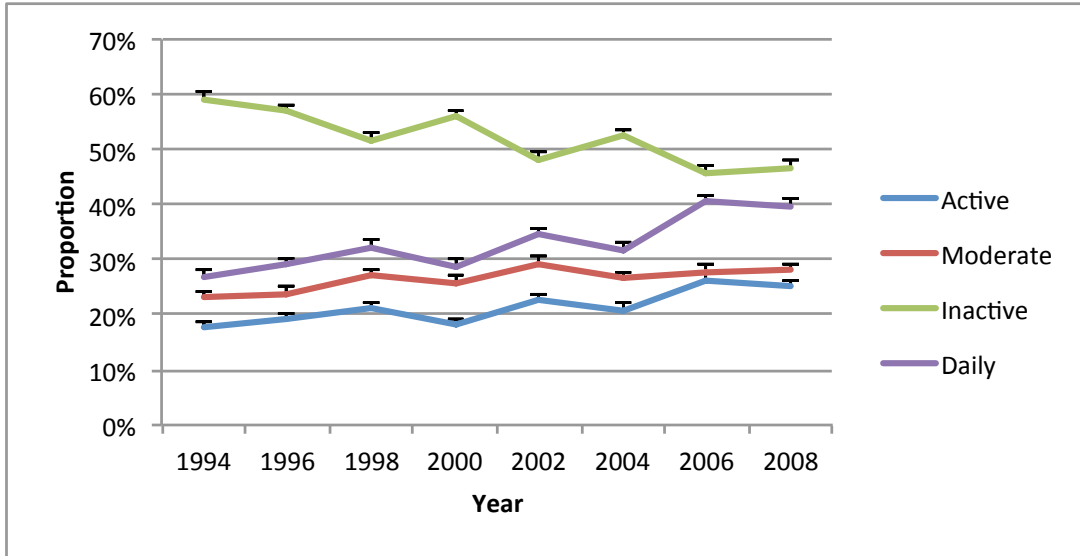
Figure 2: Prevalence of health outcomes, by cycle
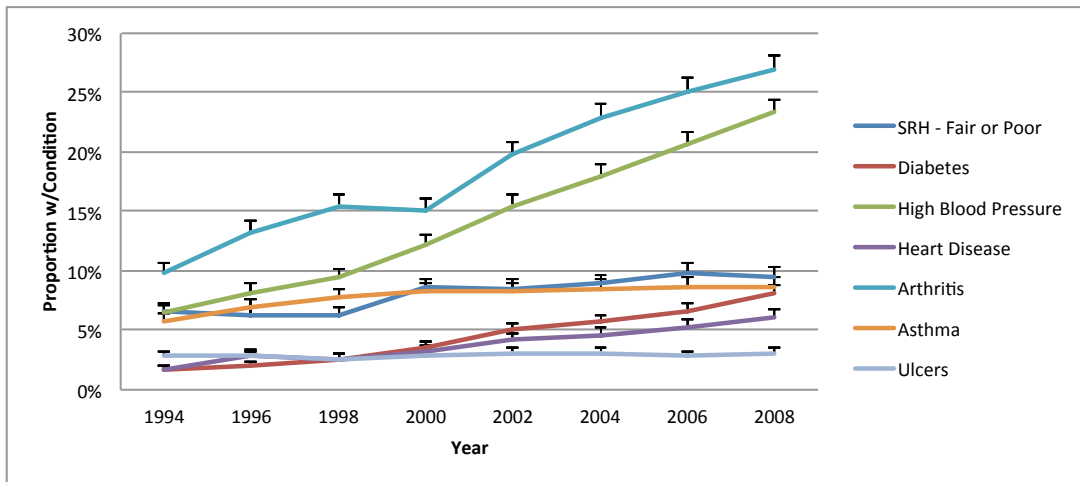
Table 1: Means, Participation in Physical Activity and Health Outcomes, by cycle

Variable	1994	1996	1998	2000	2002	2004	2006	2008	Pooled 1994-2008
1. Participation in Physical Activity									
Active	0.176	0.192	0.210	0.183	0.225	0.210	0.264	0.251	0.214
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Moderately Active	0.232	0.239	0.272	0.259	0.293	0.267	0.279	0.282	0.265
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Inactive	0.592	0.569	0.518	0.558	0.482	0.524	0.457	0.467	0.521
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Daily	0.269	0.292	0.322	0.287	0.344	0.317	0.404	0.398	0.329
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.002)
2. Health Outcomes									
SRH - Fair or Poor	0.067	0.062	0.063	0.086	0.085	0.090	0.098	0.095	0.081
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
Diabetes	0.016	0.020	0.026	0.035	0.050	0.057	0.066	0.081	0.044
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.001)
High Blood Pressure	0.065	0.082	0.094	0.122	0.154	0.180	0.206	0.233	0.142
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)
Heart Disease	0.016	0.028	0.026	0.032	0.042	0.046	0.053	0.061	0.038
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
Arthritis	0.098	0.133	0.154	0.151	0.198	0.230	0.251	0.269	0.186
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.002)
Asthma	0.057	0.069	0.078	0.083	0.082	0.085	0.087	0.087	0.079
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
Ulcers	0.028	0.029	0.026	0.029	0.031	0.030	0.028	0.031	0.029
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)

Table 2: Means, Demographic and Socioeconomic Status Variables, by cycle

	Cycle								Pooled
Variable	1994	1996	1998	2000	2002	2004	2006	2008	1994-2008
Demographic									
Age	39.7	41.7	43.7	45.8	47.7	49.7	51.7	53.7	46.7
	(0.186)	(0.185)	(0.185)	(0.185)	(0.185)	(0.185)	(0.185)	(0.185)	(0.069)
Female	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Height	1.691	1.692	1.691	1.690	1.690	1.690	1.688	1.688	1.690
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Married	0.687	0.690	0.695	0.701	0.702	0.710	0.720	0.720	0.703
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Single	0.211	0.196	0.174	0.157	0.140	0.125	0.115	0.104	0.153
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)
Widow/Separated	0.102	0.113	0.132	0.143	0.158	0.163	0.165	0.176	0.144
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Marital Status Not Stated	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Kids	0.584	0.554	0.531	0.501	0.442	0.400	0.363	0.315	0.461
	(0.013)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.010)	(0.010)	(0.004)
Immigrant	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179	0.179
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Canadian Born	0.821	0.821	0.821	0.821	0.821	0.821	0.821	0.821	0.821
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Newfoundland	0.020	0.019	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Prince Edward Island	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Nova Scotia	0.035	0.035	0.034	0.036	0.037	0.036	0.036	0.035	0.036
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
New Brunswick	0.027	0.027	0.027	0.027	0.028	0.028	0.027	0.027	0.027
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Quebec	0.257	0.258	0.259	0.259	0.257	0.257	0.258	0.257	0.258
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Ontario	0.395	0.390	0.392	0.390	0.390	0.391	0.388	0.389	0.391
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Manitoba	0.034	0.033	0.032	0.033	0.033	0.033	0.032	0.032	0.033
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Saskatchewan	0.029	0.029	0.029	0.028	0.028	0.027	0.027	0.027	0.028
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Alberta	0.088	0.090	0.091	0.093	0.093	0.093	0.093	0.093	0.092
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)

Table 2, continued

	Cycle								Pooled
	1994	1996	1998	2000	2002	2004	2006	2008	1994-2008
British Columbia	0.110	0.114	0.112	0.110	0.108	0.108	0.110	0.111	0.111
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Socioeconomic Status									
Employed	0.716	0.732	0.733	0.739	0.724	0.713	0.693	0.663	0.714
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Not Employed	0.081	0.067	0.058	0.044	0.044	0.041	0.047	0.046	0.053
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
Retired	0.193	0.192	0.193	0.185	0.192	0.190	0.191	0.194	0.191
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Work Status Not Stated	0.010	0.009	0.016	0.032	0.040	0.055	0.068	0.096	0.041
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.001)
Welfare Primary Source	0.043	0.034	0.032	0.024	0.020	0.013	0.013	0.015	0.024
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Owns Home	0.732	0.742	0.750	0.762	0.775	0.790	0.806	0.814	0.771
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.002)
Household Income Decile									
Lowest	0.065	0.066	0.069	0.063	0.067	0.064	0.067	0.073	0.067
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.001)
2nd	0.075	0.080	0.066	0.075	0.069	0.075	0.082	0.085	0.076
	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.001)
3rd	0.072	0.076	0.087	0.071	0.084	0.084	0.086	0.083	0.080
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
4th	0.082	0.084	0.091	0.088	0.084	0.096	0.090	0.090	0.088
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
Middle	0.088	0.090	0.093	0.093	0.114	0.089	0.098	0.095	0.095
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
6th	0.100	0.099	0.103	0.104	0.089	0.100	0.091	0.093	0.097
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
7th	0.108	0.104	0.103	0.105	0.107	0.102	0.094	0.088	0.101
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
8th	0.103	0.110	0.112	0.112	0.098	0.100	0.097	0.095	0.103
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
9th	0.118	0.112	0.111	0.111	0.110	0.104	0.101	0.089	0.107
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)
Highest	0.133	0.132	0.129	0.122	0.116	0.110	0.104	0.096	0.118
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Not Stated	0.057	0.047	0.037	0.056	0.062	0.076	0.090	0.114	0.067
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.001)

Table 2, continued

	Cycle								Pooled
	1994	1996	1998	2000	2002	2004	2006	2008	1994-2008
Highest Level of Education									
Less than High School	0.165	0.151	0.145	0.141	0.137	0.135	0.134	0.131	0.142
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
High School	0.171	0.161	0.157	0.151	0.149	0.145	0.142	0.142	0.152
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Some Post-Secondary	0.270	0.284	0.269	0.255	0.256	0.255	0.255	0.248	0.261
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Post-Secondary	0.394	0.404	0.428	0.445	0.453	0.460	0.462	0.462	0.439
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Not Stated	0.001	0.000	0.000	0.007	0.004	0.005	0.007	0.018	0.005
	(0.000)	0.000	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)

Table 3: Coefficient Estimates (PA_{it}, $PA_{i,t-1}$, and $H_{i,t-1}$), Random Effects and Dynamic Unobserved Effects Probit

		Random Effect Probit			Dynamic Unobserved Effects Probit					
Model:		Physical Activity (δ^{RE})			Lagged Physical Activity (δ^{DUE})			Lagged Health Outcome (γ^{DUE})		
Health Outcome (H_{it})	Ind. Var:	Active	Moderate	Daily	Active	Moderate	Daily	Active	Moderate	Daily
(Dep. Variable)	PA									
SRH - Fair or Poor		-0.521 ***	-0.318 ***	-0.240 ***	-0.283 ***	-0.216 ***	-0.177 ***	1.007 ***	0.891 ***	0.729 ***
		(0.044)	(0.034)	(0.031)	(0.038)	(0.032)	(0.031)	(0.046)	(0.045)	(0.042)
Diabetes		0.007	-0.128	0.084	-0.020	-0.025	0.008	3.860 ***	3.847 ***	3.831 ***
		(0.108)	(0.085)	(0.076)	(0.049)	(0.044)	(0.039)	(0.069)	(0.066)	(0.059)
High Blood Pressure		-0.059	-0.040	0.005	-0.144 ***	-0.036	-0.105 ***	2.801 ***	2.776 ***	2.775 ***
		(0.053)	(0.040)	(0.037)	(0.030)	(0.027)	(0.025)	(0.031)	(0.034)	(0.038)
Heart Disease		-0.045	0.055	0.053	-0.183 **	-0.125 **	-0.043	1.565 ***	1.261 ***	1.044 ***
		(0.070)	(0.053)	(0.048)	(0.058)	(0.050)	(0.048)	(0.084)	(0.084)	(0.073)
Asthma		-0.012	.	0.039	-0.031	-0.043	-0.013	3.233 ***	3.270 ***	3.262 ***
		(0.062)	.	(0.047)	(0.041)	(0.037)	(0.033)	(0.084)	(0.040)	(0.035)
Arthritis		0.061	-0.010	0.086 **	-0.054 *	-0.022	-0.039	2.284 ***	2.188 ***	1.931 ***
		(0.042)	(0.032)	(0.029)	(0.029)	(0.026)	(0.026)	(0.032)	(0.038)	(0.044)
Ulcers		-0.107	-0.027	-0.021	-0.043	-0.131 **	-0.026	2.321 ***	2.231 ***	2.035 ***
		(0.067)	(0.054)	(0.049)	(0.050)	(0.047)	(0.043)	(0.064)	(0.068)	(0.076)

$* \ p < 0.10$, $** \ p < 0.05$, $*** \ p < 0.01$

note: random effects probit for asthma & moderately active did not converge.

20

References

Balia, S. and A. Jones (2008). Mortality, lifestyle and socio-economic status. *Journal of Health Economics 27*, 1–26.

Becker, G. (1965). A Theory of the Allocation of Time. *The Economic Journal 75*(299), 493–517.

Belloc, N. and L. Breslow (1972). The relationship of physical health status and health practices. *Preventive Medicine 1*, 409–421.

Cameron, A. C. and P. Trivedi (2005). *Microeconometrics*. Cambridge University Press.

Cawley, J. (2004). An economic framework for understanding physical activity and eating behaviors. *American Journal of Preventive Medicine 27*(3), 117–125.

Chamberlain, G. (1982). Multivariate regression models for panel data. *Journal of Econometrics 18*(1), 5–46.

Colley, R. C., D. Garriguet, I. Janssen, C. L. Craig, J. Clarke, and M. S. Tremblay (2011). Physical activity of Canadian adults: accelerometer results from the 2007 to 2009 Canadian health measures survey. *Health Rep 22*(1), 7–14.

Contoyannis, P. and A. Jones (2004). Socio-economic status, health and lifestyle. *Journal of Health Economics 23*, 965–995.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy 80*(2), 223–255.

Humphreys, B. and J. Ruseski (2011). The economics of participation and time spent in physical activity. *B.E. Journal of Economic Analysis & Policy 11*(1), 1–38.

Humphreys, B. R., L. McLeod, and J. E. Ruseski (2014). Physical activity and health outcomes: Evidence from Canada. *Health Economics 23*(1), 33–54.

Mullahy, J. and P. Portney (1990). Air pollution, cigarette smoking and the production of respiratory health. *Journal of Health Economics 9*, 193–205.

Rosenzweig, M. and T. Schultz (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.

Sarma, S., R. A. Devlin, J. Gilliland, M. K. Campbell, and G. S. Zaric (2014). The effect of leisure-time physical activity on obesity, diabetes, high bp and heart disease among Canadians: Evidence from 2000/01 to 2005/06. *Health Economics* (DOI: 10.1002/hec.3106), 1–17.

Sarma, S., G. S. Zaric, M. K. Campbell, and J. Gilliland (2014). The effect of physical activity on adult obesity: Evidence from the Canadian NPHS panel. *Economics and Human Biology 14*, 1–21.

Schneider, B. and U. Schneider (2009). Determinants and consequences of health behavior: new evidence from German micro data. SOEP Working Paper 253, DIW Berlin, The German Socio-Economic Panel (SOEP).

Shields, M., M. S. Tremblay, M. Laviolette, C. L. Craig, I. Janssen, and S. C. Gorber (2010). Fitness of Canadian adults: results from the 2007-2009 Canadian Health Measures Survey. *Health Reports-Statistics Canada 21*(1).

Statistics Canada (2010). *National Population Health Survey - Household Component - Cycles 1 to 8 (1994/1995 to 2008/2009) Longitudinal Documentation.* Statistics Canada.

Statistics Canada (2012). CANSIM Table 105-0501, Health indicator profile. Technical report.

Tremblay, M. S., D. E. Warburton, I. Janssen, D. H. Paterson, A. E. Latimer, R. E. Rhodes, M. E. Kho, A. Hicks, A. G. LeBlanc, L. Zehr, et al. (2011). New Canadian physical activity guidelines. *Applied Physiology, Nutrition, and Metabolism 36*(1), 36–46.

Warburton, D., S. Charlesworth, A. Ivey, L. Nettlefold, and S. Bredin (2010). A systematic review of the evidence for Canada's physical activity guidelines for adults. *Int J Behav Nutr Phys Act 7*(1), 39.

Wooldridge, J. (2002). *Econometric analysis of cross section and panel data.* The MIT press.

A   Appendix

Table A.1: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Fair/Poor Self-Reported Health Status by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	-0.521 ***	-0.318 ***	-0.24 ***	.	.	.
	(0.044)	(0.034)	(0.031)	.	.	.
Lagged Physical Activity	.	.	.	-0.283 ***	-0.216 ***	-0.177 ***
	.	.	.	(0.038)	(0.032)	(0.031)
Lagged SRH	.	.	.	1.007 ***	0.891 ***	0.729 ***
	.	.	.	(0.046)	(0.045)	(0.042)
Age	0.014 ***	0.015 ***	0.016 ***	0.006 ***	0.007 ***	0.009 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Male	0.112	0.133 *	0.123 *	0.087 *	0.103 *	0.116 **
	(0.071)	(0.069)	(0.067)	(0.052)	(0.054)	(0.055)
Single	-0.061	-0.022	-0.014	-0.07	-0.047	-0.03
	(0.070)	(0.068)	(0.064)	(0.058)	(0.059)	(0.059)
Widow/Separated	0.191 ***	0.155 ***	0.165 ***	0.087 **	0.106 **	0.109 **
	(0.052)	(0.050)	(0.047)	(0.044)	(0.044)	(0.044)
Marital Status Not Stated	-5.111	-5.12	-6.207	-5.829	-5.742	-5.692
	(756.099)	(709.491)	(11943.515)	(649.047)	(670.359)	(725.973)
Employed	-0.426 ***	-0.446 ***	-0.375 ***	-0.348 ***	-0.381 ***	-0.35 ***
	(0.043)	(0.041)	(0.038)	(0.040)	(0.040)	(0.038)
Lowest Income Decile	0.76 ***	0.694 ***	0.696 ***	0.656 ***	0.681 ***	0.728 ***
	(0.089)	(0.086)	(0.078)	(0.082)	(0.083)	(0.078)
2nd Income Decile	0.549 ***	0.563 ***	0.556 ***	0.494 ***	0.523 ***	0.54 ***
	(0.085)	(0.081)	(0.074)	(0.078)	(0.078)	(0.074)
3rd Income Decile	0.508 ***	0.47 ***	0.462 ***	0.392 ***	0.461 ***	0.454 ***
	(0.084)	(0.081)	(0.074)	(0.078)	(0.078)	(0.074)
4th Income Decile	0.368 ***	0.367 ***	0.343 ***	0.313 ***	0.382 ***	0.378 ***
	(0.085)	(0.081)	(0.074)	(0.078)	(0.078)	(0.073)
Middle Income Decile	0.293 ***	0.377 ***	0.345 ***	0.306 ***	0.327 ***	0.324 ***
	(0.085)	(0.080)	(0.073)	(0.077)	(0.078)	(0.073)
6th Income Decile	0.25 ***	0.284 ***	0.267 ***	0.232 ***	0.275 ***	0.274 ***
	(0.085)	(0.081)	(0.074)	(0.079)	(0.079)	(0.074)
7th Income Decile	0.156 *	0.155 *	0.15 **	0.111	0.191 **	0.146 *
	(0.086)	(0.082)	(0.074)	(0.081)	(0.080)	(0.075)
8th Income Decile	0.268 ***	0.272 ***	0.233 ***	0.176 **	0.267 ***	0.226 ***
	(0.083)	(0.079)	(0.072)	(0.078)	(0.078)	(0.072)
9th Income Decile	0.002	-0.007	0.014	-0.033	-0.002	0.016
	(0.086)	(0.082)	(0.073)	(0.082)	(0.082)	(0.075)
Income Decile Not Stated	0.433 ***	0.432 ***	0.409 ***	0.388 ***	0.454 ***	0.442 ***
	(0.088)	(0.085)	(0.077)	(0.081)	(0.082)	(0.077)
Welfare Primary Source	0.394 ***	0.453 ***	0.415 ***	0.463 ***	0.429 ***	0.429 ***
	(0.083)	(0.080)	(0.074)	(0.082)	(0.082)	(0.078)
Owns Home	-0.012	-0.023	-0.031	-0.003	-0.053	-0.064
	(0.049)	(0.047)	(0.044)	(0.042)	(0.042)	(0.042)
Less than High School	0.229 ***	0.245 ***	0.246 ***	0.139 **	0.166 ***	0.18 ***
	(0.082)	(0.081)	(0.078)	(0.061)	(0.063)	(0.065)
Some Post-Secondary	-0.001	-0.002	-0.011	-0.006	0.011	-0.018
	(0.076)	(0.074)	(0.071)	(0.058)	(0.060)	(0.061)
Post-Secondary	-0.133 *	-0.096	-0.147 **	-0.081	-0.065	-0.121 **
	(0.074)	(0.072)	(0.069)	(0.056)	(0.058)	(0.059)
Not Stated	0.188	0.198	0.183	0.068	0.17	0.179
	(0.187)	(0.179)	(0.167)	(0.171)	(0.170)	(0.158)
Height	-0.918 ***	-0.87 ***	-0.972 ***	-0.443 *	-0.471 *	-0.654 **
	(0.330)	(0.323)	(0.309)	(0.253)	(0.259)	(0.264)

23

Table A.1, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Kids	-0.134 ***	-0.112 ***	-0.097 ***	-0.127 ***	-0.116 ***	-0.109 ***
	(0.029)	(0.027)	(0.025)	(0.026)	(0.026)	(0.025)
Canadian Born	-0.088	-0.102	-0.089	-0.033	-0.074	-0.065
	(0.080)	(0.078)	(0.076)	(0.057)	(0.059)	(0.061)
Newfoundland	-0.22 *	-0.254 **	-0.194 *	-0.212 **	-0.16 *	-0.162 *
	(0.113)	(0.110)	(0.107)	(0.083)	(0.084)	(0.088)
Prince Edward Island	-0.248 **	-0.278 **	-0.222 **	-0.217 **	-0.222 **	-0.234 **
	(0.120)	(0.116)	(0.112)	(0.086)	(0.089)	(0.093)
Nova Scotia	0.234 **	0.216 **	0.263 ***	0.097	0.132 *	0.142 *
	(0.100)	(0.097)	(0.094)	(0.073)	(0.076)	(0.078)
New Brunswick	0.149	0.067	0.129	0.001	0.113	0.087
	(0.102)	(0.100)	(0.097)	(0.076)	(0.076)	(0.080)
Quebec	-0.246 ***	-0.288 ***	-0.248 ***	-0.242 ***	-0.215 ***	-0.242 ***
	(0.080)	(0.078)	(0.075)	(0.058)	(0.060)	(0.062)
Manitoba	-0.028	-0.128	-0.013	-0.087	-0.014	-0.035
	(0.111)	(0.111)	(0.105)	(0.081)	(0.083)	(0.086)
Saskatchewan	-0.035	-0.025	0.018	-0.07	0.034	0
	(0.110)	(0.106)	(0.103)	(0.081)	(0.082)	(0.085)
Alberta	0.039	0.014	0.049	-0.064	0.035	0.008
	(0.093)	(0.090)	(0.086)	(0.069)	(0.070)	(0.072)
British Columbia	0.131	0.12	0.099	0.049	0.106	0.078
	(0.094)	(0.092)	(0.088)	(0.069)	(0.071)	(0.072)
Constant	-1.167 **	-1.261 **	-1.316 **	-1.336 ***	-1.398 ***	-1.317 ***
	(0.568)	(0.555)	(0.530)	(0.440)	(0.448)	(0.456)
$\ln \sigma_c^2$	0.379 ***	0.362 ***	0.406 ***	-0.729 ***	-0.574 ***	-0.259 ***
	(0.056)	(0.054)	(0.051)	(0.105)	(0.096)	(0.079)
σ_c	1.208	1.199	1.225	0.694	0.751	0.878
	(0.034)	(0.033)	(0.031)	(0.036)	(0.036)	(0.035)
ρ	0.594	0.590	0.600	0.325	0.360	0.436
	(0.014)	(0.013)	(0.012)	(0.023)	(0.022)	(0.019)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-7,350.08	-7,979.35	-9,264.82	-6,416.35	-6,915.54	-8,136.48

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$

Table A.2: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Diabetes by Physical Activity Measure

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	0.007	-0.128	0.084	.	.	.
	(0.108)	(0.085)	(0.076)	.	.	.
Lagged Physical Activity	.	.	.	-0.02	-0.025	0.008
	.	.	.	(0.049)	(0.044)	(0.039)
Lagged Diabetes	.	.	.	3.86 ***	3.847 ***	3.831 ***
	.	.	.	(0.069)	(0.066)	(0.059)
Age	0.239 ***	0.242 ***	0.246 ***	0.013 ***	0.013 ***	0.013 ***
	(0.007)	(0.006)	(0.006)	(0.002)	(0.002)	(0.002)
Male	0.856 ***	1.024 ***	0.79 ***	0.206 ***	0.123 **	0.136 **
	(0.268)	(0.271)	(0.252)	(0.063)	(0.061)	(0.054)
Single	0.459	0.358	0.472 *	0.058	-0.006	0.029
	(0.301)	(0.289)	(0.262)	(0.071)	(0.071)	(0.062)
Widow/Separated	-0.242	-0.192	-0.234	-0.054	-0.021	-0.038
	(0.169)	(0.173)	(0.153)	(0.057)	(0.055)	(0.049)
Marital Status Not Stated	-7.29	-4.531	-5.661	-5.217	-4.896	-4.725
	(58545.7)	(5257.0)	(193000.0)	(127000.0)	(40804.2)	(23791.9)
Employed	0.036	-0.245 *	-0.174	-0.023	-0.031	-0.035
	(0.134)	(0.128)	(0.112)	(0.057)	(0.055)	(0.049)
Lowest Income Decile	0.564 **	0.381	0.264	0.159	0.346 ***	0.299 ***
	(0.254)	(0.245)	(0.215)	(0.112)	(0.111)	(0.098)
2nd Income Decile	0.526 **	0.208	0.168	0.071	0.091	0.106
	(0.238)	(0.233)	(0.204)	(0.105)	(0.108)	(0.094)
3rd Income Decile	0.757 ***	0.503 **	0.418 **	0.213 **	0.321 ***	0.29 ***
	(0.234)	(0.227)	(0.200)	(0.100)	(0.101)	(0.088)
4th Income Decile	0.496 **	0.375 *	0.249	0.046	0.261 **	0.181 **
	(0.232)	(0.225)	(0.198)	(0.105)	(0.102)	(0.090)
Middle Income Decile	0.718 ***	0.55 **	0.444 **	0.1	0.265 ***	0.204 **
	(0.232)	(0.222)	(0.195)	(0.101)	(0.100)	(0.089)
6th Income Decile	0.488 **	0.206	0.176	0.129	0.188 *	0.19 **
	(0.229)	(0.221)	(0.193)	(0.102)	(0.104)	(0.090)
7th Income Decile	0.235	-0.104	-0.092	-0.134	0.062	0.032
	(0.240)	(0.225)	(0.199)	(0.113)	(0.108)	(0.094)
8th Income Decile	0.264	0.12	0.099	-0.003	0.155	0.123
	(0.222)	(0.214)	(0.186)	(0.103)	(0.102)	(0.089)
9th Income Decile	0.206	0.038	0.012	0.101	0.067	0.097
	(0.215)	(0.201)	(0.177)	(0.099)	(0.106)	(0.090)
Income Decile Not Stated	0.554 **	0.333	0.269	0.174 *	0.275 ***	0.233 **
	(0.236)	(0.238)	(0.206)	(0.104)	(0.106)	(0.093)
Welfare Primary Source	-0.708 **	-0.277	-0.427	0.1	-0.029	0.004
	(0.332)	(0.294)	(0.282)	(0.140)	(0.146)	(0.129)
Owns Home	0.146	0.094	0.085	0.048	0.041	0.038
	(0.156)	(0.149)	(0.135)	(0.056)	(0.054)	(0.049)
Less than High School	-0.16	-0.369	-0.426	-0.071	-0.061	-0.062
	(0.305)	(0.315)	(0.289)	(0.072)	(0.068)	(0.062)
Some Post-Secondary	-0.623 **	-0.467	-0.647 **	0.035	-0.031	0.006
	(0.298)	(0.301)	(0.274)	(0.067)	(0.066)	(0.058)
Post-Secondary	-0.449	-0.362	-0.643 **	-0.112 *	-0.067	-0.08
	(0.290)	(0.295)	(0.269)	(0.066)	(0.063)	(0.057)
Not Stated	-0.664	-1.259 ***	-0.755 *	-0.363	-0.031	-0.078
	(0.446)	(0.467)	(0.406)	(0.316)	(0.256)	(0.242)
Height	-0.606	-2.033 *	-1.02	-0.73 **	-0.02	-0.255
	(1.049)	(1.040)	(0.971)	(0.305)	(0.295)	(0.263)
Kids	-0.23 **	-0.295 **	-0.241 **	-0.143 ***	-0.169 ***	-0.129 ***
	(0.117)	(0.118)	(0.103)	(0.046)	(0.045)	(0.038)

Table A.2, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	0.375	0.242	0.197	0.098	-0.033	0.001
	(0.327)	(0.344)	(0.315)	(0.069)	(0.063)	(0.057)
Newfoundland	-0.061	0.049	0.159	-0.199 **	-0.156 *	-0.101
	(0.466)	(0.400)	(0.387)	(0.099)	(0.093)	(0.083)
Prince Edward Island	-0.412	-0.483	-0.469	-0.228 **	-0.106	-0.082
	(0.490)	(0.512)	(0.469)	(0.105)	(0.095)	(0.085)
Nova Scotia	0.794 **	0.784 **	0.727 **	0.002	0.038	0.025
	(0.356)	(0.366)	(0.344)	(0.081)	(0.079)	(0.072)
New Brunswick	-0.157	-0.143	-0.151	-0.08	-0.102	-0.042
	(0.401)	(0.393)	(0.379)	(0.086)	(0.088)	(0.076)
Quebec	0.42	0.384	0.414	-0.156 **	-0.104	-0.09
	(0.313)	(0.308)	(0.295)	(0.066)	(0.063)	(0.057)
Manitoba	0.081	-0.049	-0.072	-0.228 **	-0.214 **	-0.167 *
	(0.451)	(0.454)	(0.436)	(0.102)	(0.099)	(0.086)
Saskatchewan	-0.93 **	-1.351 ***	-0.964 **	-0.161	-0.24 **	-0.169 *
	(0.452)	(0.475)	(0.427)	(0.098)	(0.101)	(0.088)
Alberta	-0.507	-0.614 *	-0.384	-0.162 *	-0.136 *	-0.137 *
	(0.365)	(0.364)	(0.334)	(0.085)	(0.082)	(0.073)
British Columbia	-0.626 *	-0.865 **	-0.661 *	-0.168 **	-0.093	-0.127 *
	(0.367)	(0.381)	(0.353)	(0.084)	(0.081)	(0.071)
Constant	-24.096 ***	-21.802 ***	-23.503 ***	-1.779 ***	-2.936 ***	-2.603 ***
	(1.883)	(1.852)	(1.720)	(0.537)	(0.522)	(0.466)
$\ln \sigma_c^2$	3.882 ***	3.97 ***	3.958 ***	-14.085	-11.341	-10.779
	(0.045)	(0.042)	(0.041)	(14.980)	(11.218)	(9.625)
σ_c	6.964	7.278	7.237	0.001	0.003	0.005
	(0.156)	(0.151)	(0.149)	(0.007)	(0.019)	(0.022)
ρ	0.980	0.981	0.981	0.000	0.000	0.000
	(0.001)		(0.001)	(0.000)	(0.000)	(0.000)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-2,735.20	-2,777.98	-3,220.61	-1847.332	-1,989.38	-2,494.13

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$

Table A.3: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, High Blood Pressure by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	-0.059	-0.04	0.005	.	.	.
	(0.053)	(0.040)	(0.037)	.	.	.
Lagged Physical Activity	.	.	.	-0.144 ***	-0.036	-0.105 ***
	.	.	.	(0.030)	(0.027)	(0.025)
Lagged High Blood Pressure	.	.	.	2.801 ***	2.776 ***	2.775 ***
	.	.	.	(0.031)	(0.034)	(0.038)
Age	0.154 ***	0.158 ***	0.159 ***	0.019 ***	0.021 ***	0.021 ***
	(0.004)	(0.004)	(0.004)	(0.001)	(0.002)	(0.002)
Male	0.096	0.216 *	0.186	0.011	0.041	0.034
	(0.126)	(0.129)	(0.120)	(0.038)	(0.038)	(0.034)
Single	0.1	0.203	0.188 *	-0.012	-0.018	-0.02
	(0.128)	(0.124)	(0.111)	(0.045)	(0.045)	(0.040)
Widow/Separated	-0.159 **	-0.164 **	-0.132 *	-0.065 *	-0.046	-0.053 *
	(0.078)	(0.076)	(0.068)	(0.035)	(0.035)	(0.031)
Marital Status Not Stated	-0.101	-0.699	-0.678	0.009	-0.69	-0.684
	(1.5)	(1.2)	(1.2)	(2.1)	(1.2)	(1.2)
Employed	-0.118 **	-0.163 ***	-0.155 ***	-0.025	-0.018	-0.026
	(0.059)	(0.057)	(0.051)	(0.035)	(0.034)	(0.030)
Lowest Income Decile	0.391 ***	0.415 ***	0.351 ***	0.008	0.06	0.086
	(0.115)	(0.113)	(0.099)	(0.070)	(0.068)	(0.061)
2nd Income Decile	0.412 ***	0.409 ***	0.395 ***	0.109 *	0.069	0.126 **
	(0.105)	(0.102)	(0.090)	(0.062)	(0.061)	(0.055)
3rd Income Decile	0.369 ***	0.283 ***	0.314 ***	0.084	0.077	0.115 **
	(0.103)	(0.100)	(0.088)	(0.062)	(0.060)	(0.054)
4th Income Decile	0.386 ***	0.279 ***	0.282 ***	0.046	0.106 *	0.118 **
	(0.101)	(0.098)	(0.086)	(0.062)	(0.059)	(0.054)
Middle Income Decile	0.331 ***	0.274 ***	0.253 ***	0.077	0.117 **	0.139 ***
	(0.098)	(0.096)	(0.083)	(0.060)	(0.058)	(0.052)
6th Income Decile	0.204 **	0.231 **	0.209 **	0.072	0.063	0.118 **
	(0.097)	(0.094)	(0.082)	(0.061)	(0.059)	(0.053)
7th Income Decile	0.273 ***	0.207 **	0.229 ***	-0.001	0.018	0.051
	(0.098)	(0.093)	(0.082)	(0.062)	(0.059)	(0.053)
8th Income Decile	0.101	0.025	0.078	0.046	0.058	0.09 *
	(0.094)	(0.091)	(0.078)	(0.059)	(0.057)	(0.051)
9th Income Decile	0.07	0.048	0.06	0.033	0.027	0.056
	(0.090)	(0.086)	(0.074)	(0.059)	(0.058)	(0.051)
Income Decile Not Stated	0.159	0.093	0.1	-0.09	-0.005	-0.004
	(0.105)	(0.103)	(0.090)	(0.067)	(0.065)	(0.058)
Welfare Primary Source	0.024	-0.03	0.008	0.241 ***	0.27 ***	0.224 ***
	(0.130)	(0.132)	(0.118)	(0.085)	(0.083)	(0.077)
Owns Home	-0.131 *	-0.037	-0.066	-0.034	0.003	-0.007
	(0.074)	(0.072)	(0.066)	(0.035)	(0.034)	(0.031)
Less than High School	-0.108	0.007	0	0.042	0.061	0.047
	(0.161)	(0.164)	(0.155)	(0.045)	(0.044)	(0.040)
Some Post-Secondary	0.149	0.439 ***	0.301 **	0.011	0.041	0.037
	(0.141)	(0.144)	(0.133)	(0.043)	(0.042)	(0.038)
Post-Secondary	-0.034	0.153	0.04	-0.013	0.015	-0.004
	(0.137)	(0.141)	(0.130)	(0.041)	(0.040)	(0.036)
Not Stated	-0.285	-0.234	-0.182	0.106	0.036	0.012
	(0.257)	(0.264)	(0.239)	(0.180)	(0.179)	(0.166)
Height	-0.054	-0.625	-0.234	-0.345 *	-0.312 *	-0.306 *
	(0.522)	(0.540)	(0.482)	(0.188)	(0.186)	(0.167)
Kids	-0.038	-0.091 **	-0.032	-0.121 ***	-0.12 ***	-0.112 ***
	(0.045)	(0.045)	(0.039)	(0.024)	(0.023)	(0.021)

Table A.3, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	0.367 **	0.344 **	0.403 ***	0.069 *	0.028	0.029
	(0.158)	(0.163)	(0.154)	(0.042)	(0.041)	(0.037)
Newfoundland	0.199	0.16	0.183	0.042	0.05	0.034
	(0.195)	(0.193)	(0.183)	(0.057)	(0.055)	(0.051)
Prince Edward Island	-0.14	-0.127	-0.169	-0.029	-0.028	-0.032
	(0.216)	(0.219)	(0.204)	(0.059)	(0.058)	(0.052)
Nova Scotia	0.56 ***	0.537 ***	0.488 ***	0.031	0.075	0.063
	(0.196)	(0.193)	(0.182)	(0.055)	(0.053)	(0.048)
New Brunswick	0.142	0.076	0.092	-0.027	-0.052	-0.035
	(0.189)	(0.190)	(0.179)	(0.055)	(0.054)	(0.049)
Quebec	-0.173	-0.232	-0.228	-0.074 *	-0.088 **	-0.095 ***
	(0.148)	(0.148)	(0.139)	(0.041)	(0.040)	(0.036)
Manitoba	-0.294	-0.268	-0.378 *	-0.052	-0.092	-0.066
	(0.210)	(0.215)	(0.197)	(0.059)	(0.058)	(0.052)
Saskatchewan	0.088	0.083	0.118	-0.062	-0.024	-0.028
	(0.210)	(0.215)	(0.198)	(0.059)	(0.057)	(0.052)
Alberta	-0.179	-0.262	-0.197	-0.113 **	-0.124 **	-0.114 **
	(0.170)	(0.170)	(0.155)	(0.052)	(0.051)	(0.045)
British Columbia	-0.121	-0.306 *	-0.203	-0.053	-0.076	-0.089 **
	(0.169)	(0.177)	(0.157)	(0.051)	(0.052)	(0.045)
Constant	-11.44 ***	-10.937 ***	-11.709 ***	-1.992 ***	-2.196 ***	-2.205 ***
	(0.918)	(0.939)	(0.844)	(0.331)	(0.329)	(0.300)
$\ln \sigma_c^2$	2.249 ***	2.301 ***	2.333 ***	-14.851	-3.767 ***	-3.876 ***
	(0.045)	(0.045)	(0.041)	(72.862)	(1.148)	(1.447)
σ_c	3.079	3.160	3.210	0.001	0.152	0.144
	(0.070)	(0.071)	(0.065)	(0.022)	(0.087)	(0.104)
ρ	0.905	0.909	0.912	0.000	0.023	0.020
	(0.004)	(0.004)	(0.003)	(0.000)	(0.025)	(0.029)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-7,444.04	-7,807.37	-9,301.66	-5474.6781	-6,092.16	-7438.0253

$* \ p < 0.10, ** \ p < 0.05, *** \ p < 0.01$

28

Table A.4: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Heart Disease by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	-0.045	0.055	0.053	.	.	.
	(0.070)	(0.053)	(0.048)	.	.	.
Lagged Physical Activity	.	.	.	-0.183 ***	-0.125 **	-0.043
	.	.	.	(0.058)	(0.050)	(0.048)
Lagged High Blood Pressure	.	.	.	1.565 ***	1.261 ***	1.044 ***
	.	.	.	(0.084)	(0.084)	(0.073)
Age	0.074 ***	0.07 ***	0.073 ***	0.034 ***	0.041 ***	0.048 ***
	(0.006)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
Male	0.777 ***	0.666 ***	0.692 ***	0.394 ***	0.456 ***	0.508 ***
	(0.145)	(0.134)	(0.130)	(0.087)	(0.097)	(0.103)
Single	-0.366 **	-0.209	-0.255 *	-0.215 **	-0.202 *	-0.261 **
	(0.163)	(0.149)	(0.144)	(0.105)	(0.116)	(0.122)
Widow/Separated	-0.166 *	-0.182 **	-0.177 **	-0.118 *	-0.169 **	-0.139 *
	(0.096)	(0.091)	(0.085)	(0.071)	(0.076)	(0.077)
Marital Status Not Stated	-7.714	-7.814	-6.565	-8.901	-7.422	-7.709
	(31781.0)	(50795.7)	(1611.9)	(70339.7)	(1861.6)	(4015.5)
Employed	-0.279 ***	-0.274 ***	-0.233 ***	-0.252 ***	-0.265 ***	-0.25 ***
	(0.080)	(0.074)	(0.068)	(0.066)	(0.068)	(0.067)
Lowest Income Decile	0.17	0.337 **	0.274 **	0.224 *	0.181	0.192
	(0.153)	(0.143)	(0.130)	(0.125)	(0.127)	(0.124)
2nd Income Decile	0.152	0.205	0.168	0.161	0.073	0.125
	(0.140)	(0.133)	(0.121)	(0.115)	(0.118)	(0.115)
3rd Income Decile	0.174	0.222 *	0.19	0.205 *	0.157	0.174
	(0.138)	(0.130)	(0.118)	(0.113)	(0.115)	(0.113)
4th Income Decile	-0.04	0.029	-0.034	-0.059	-0.084	-0.097
	(0.140)	(0.133)	(0.119)	(0.118)	(0.119)	(0.115)
Middle Income Decile	0.036	0.045	0.025	0.043	-0.051	-0.033
	(0.138)	(0.131)	(0.117)	(0.114)	(0.117)	(0.114)
6th Income Decile	-0.029	0.053	0.022	0.027	-0.113	-0.055
	(0.137)	(0.128)	(0.116)	(0.115)	(0.118)	(0.113)
7th Income Decile	0.019	0.044	0.043	0.063	-0.006	0.023
	(0.136)	(0.128)	(0.114)	(0.115)	(0.116)	(0.111)
8th Income Decile	-0.342 **	-0.226 *	-0.265 **	-0.242 **	-0.291 **	-0.258 **
	(0.138)	(0.131)	(0.115)	(0.119)	(0.122)	(0.113)
9th Income Decile	-0.095	-0.14	-0.145	-0.117	-0.148	-0.171
	(0.131)	(0.125)	(0.110)	(0.115)	(0.115)	(0.108)
Income Decile Not Stated	-0.043	0.019	-0.006	0.047	-0.05	-0.017
	(0.143)	(0.137)	(0.123)	(0.119)	(0.123)	(0.118)
Welfare Primary Source	0.214	0.155	0.189	0.089	0.193	0.169
	(0.173)	(0.169)	(0.151)	(0.153)	(0.158)	(0.154)
Owns Home	-0.31 ***	-0.259 ***	-0.261 ***	-0.165 **	-0.198 ***	-0.211 ***
	(0.092)	(0.085)	(0.081)	(0.068)	(0.073)	(0.075)
Less than High School	0.126	0.129	0.127	-0.004	0.049	0.081
	(0.167)	(0.157)	(0.152)	(0.099)	(0.111)	(0.121)
Some Post-Secondary	0.183	0.233	0.162	0.056	0.112	0.093
	(0.160)	(0.150)	(0.145)	(0.096)	(0.107)	(0.116)
Post-Secondary	0.029	0.081	0.032	0.011	0	0.012
	(0.157)	(0.148)	(0.142)	(0.092)	(0.104)	(0.112)
Not Stated	-0.289	-0.041	-0.132	-0.145	-0.213	-0.219
	(0.349)	(0.329)	(0.304)	(0.286)	(0.307)	(0.294)
Height	-0.871	-0.587	-0.604	-0.185	-0.383	-0.376
	(0.632)	(0.594)	(0.561)	(0.406)	(0.448)	(0.471)
Kids	-0.163 **	-0.124 *	-0.139 **	-0.083 *	-0.117 **	-0.1 *
	(0.068)	(0.064)	(0.058)	(0.050)	(0.054)	(0.053)

Table A.4, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	0.875 ***	0.763 ***	0.829 ***	0.455 ***	0.496 ***	0.581 ***
	(0.187)	(0.170)	(0.168)	(0.106)	(0.118)	(0.129)
Newfoundland	-0.184	-0.253	-0.299	-0.233 *	-0.203	-0.229
	(0.218)	(0.206)	(0.204)	(0.131)	(0.143)	(0.159)
Prince Edward Island	-0.345	-0.387 *	-0.373	-0.244 *	-0.324 **	-0.282 *
	(0.247)	(0.230)	(0.227)	(0.138)	(0.158)	(0.170)
Nova Scotia	0.055	0.057	0.081	-0.054	-0.007	0.008
	(0.202)	(0.186)	(0.183)	(0.118)	(0.131)	(0.143)
New Brunswick	-0.22	-0.188	-0.216	-0.196	-0.228 *	-0.222
	(0.207)	(0.188)	(0.187)	(0.123)	(0.137)	(0.150)
Quebec	-0.205	-0.23	-0.225	-0.193 **	-0.181 *	-0.198 *
	(0.155)	(0.145)	(0.141)	(0.090)	(0.100)	(0.110)
Manitoba	-0.511 **	-0.502 **	-0.54 **	-0.271 **	-0.377 **	-0.372 **
	(0.242)	(0.228)	(0.218)	(0.137)	(0.159)	(0.168)
Saskatchewan	-0.348	-0.433 **	-0.381 *	-0.26 *	-0.339 **	-0.342 **
	(0.222)	(0.212)	(0.203)	(0.133)	(0.152)	(0.163)
Alberta	-0.395 **	-0.436 **	-0.412 **	-0.354 ***	-0.255 *	-0.297 **
	(0.198)	(0.184)	(0.179)	(0.121)	(0.131)	(0.140)
British Columbia	-0.318	-0.102	-0.194	-0.185	-0.117	-0.186
	(0.200)	(0.180)	(0.175)	(0.115)	(0.128)	(0.137)
Constant	-7.01 ***	-7.121 ***	-7.417 ***	-4.29 ***	-4.535 ***	-5.373 ***
	(1.148)	(1.065)	(1.016)	(0.738)	(0.805)	(0.855)
$\ln \sigma_c^2$	1.444 ***	1.333 ***	1.411 ***	-0.045	0.299 **	0.667 ***
	(0.110)	(0.082)	(0.083)	(0.156)	(0.143)	(0.124)
σ_c	2.058	1.948	2.025	0.978	1.161	1.396
	(0.113)	(0.080)	(0.084)	(0.076)	(0.083)	(0.086)
ρ	0.809	0.791	0.804	0.489	0.574	0.661
	(0.017)	(0.014)	(0.013)	(0.039)	(0.035)	(0.028)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-3,469.87	-3,689.71	-4,396.79	-3,121.34	-3,347.05	-3,963.89

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$

Table A.5: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Arthritis by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	0.061	-0.01	0.086 ***	.	.	.
	(0.042)	(0.032)	(0.029)	.	.	.
Lagged Physical Activity	.	.	.	-0.054 *	-0.022	-0.039
	.	.	.	(0.029)	(0.026)	(0.026)
Lagged Arthritis				2.284 ***	2.188 ***	1.931 ***
				(0.032)	(0.038)	(0.044)
Age	0.091 ***	0.093 ***	0.095 ***	0.019 ***	0.022 ***	0.03 ***
	(0.003)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)
Male	-0.605 ***	-0.594 ***	-0.611 ***	-0.194 ***	-0.245 ***	-0.274 ***
	(0.096)	(0.097)	(0.091)	(0.039)	(0.041)	(0.046)
Single	-0.196 **	-0.185 **	-0.131	-0.17 ***	-0.216 ***	-0.204 ***
	(0.092)	(0.092)	(0.082)	(0.046)	(0.048)	(0.052)
Widow/Separated	-0.057	-0.093	-0.036	-0.059 *	-0.1 ***	-0.069 *
	(0.060)	(0.058)	(0.053)	(0.035)	(0.035)	(0.038)
Marital Status Not Stated	-6.544	-9.781	-7.294	-4.928	-4.782	-5.452
	(4496.1)	(1.33×10^8)	(78294.2)	(1220.5)	(509.1)	(1903.7)
Employed	-0.12 ***	-0.122 ***	-0.105 ***	-0.072 **	-0.112 ***	-0.096 ***
	(0.046)	(0.044)	(0.039)	(0.033)	(0.033)	(0.034)
Lowest Income Decile	0.342 ***	0.334 ***	0.367 ***	0.174 ***	0.233 ***	0.279 ***
	(0.090)	(0.088)	(0.078)	(0.066)	(0.066)	(0.066)
2nd Income Decile	0.26 ***	0.244 ***	0.296 ***	0.104 *	0.162 ***	0.199 ***
	(0.083)	(0.081)	(0.071)	(0.059)	(0.060)	(0.060)
3rd Income Decile	0.192 **	0.246 ***	0.252 ***	0.124 **	0.142 **	0.168 ***
	(0.081)	(0.079)	(0.070)	(0.059)	(0.059)	(0.059)
4th Income Decile	0.167 **	0.188 **	0.206 ***	0.002	0.111 *	0.104 *
	(0.080)	(0.077)	(0.068)	(0.059)	(0.058)	(0.058)
Middle Income Decile	0.124	0.169 **	0.177 ***	0.045	0.085	0.094
	(0.078)	(0.076)	(0.066)	(0.057)	(0.057)	(0.057)
6th Income Decile	-0.043	0.078	0.09	0.028	0.043	0.051
	(0.078)	(0.075)	(0.066)	(0.058)	(0.058)	(0.057)
7th Income Decile	0.064	0.16 **	0.162 **	0.081	0.119 **	0.119 **
	(0.076)	(0.074)	(0.064)	(0.057)	(0.057)	(0.056)
8th Income Decile	0.017	0.066	0.103 *	-0.016	0	0.016
	(0.074)	(0.072)	(0.063)	(0.056)	(0.057)	(0.055)
9th Income Decile	-0.067	-0.017	0.022	-0.083	0.022	-0.004
	(0.072)	(0.070)	(0.060)	(0.057)	(0.056)	(0.054)
Income Decile Not Stated	0.147 *	0.178 **	0.214 ***	0.013	0.037	0.072
	(0.083)	(0.080)	(0.071)	(0.062)	(0.063)	(0.062)
Welfare Primary Source	0.22 **	0.282 ***	0.169 *	0.305 ***	0.3 ***	0.267 ***
	(0.103)	(0.099)	(0.089)	(0.080)	(0.080)	(0.081)
Owns Home	-0.129 **	-0.174 ***	-0.106 **	-0.016	-0.058 *	-0.046
	(0.057)	(0.056)	(0.050)	(0.034)	(0.034)	(0.038)
Less than High School	0.116	0.095	0.076	0.01	0.02	0.019
	(0.114)	(0.114)	(0.108)	(0.046)	(0.047)	(0.055)
Some Post-Secondary	0.089	0.091	0.075	0.017	0.021	0.015
	(0.101)	(0.100)	(0.093)	(0.043)	(0.044)	(0.050)
Post-Secondary	0.028	0.066	0.032	-0.035	-0.059	-0.057
	(0.098)	(0.098)	(0.091)	(0.041)	(0.042)	(0.048)
Not Stated	0.071	0.01	0.028	-0.29 *	-0.195	-0.208
	(0.207)	(0.204)	(0.185)	(0.175)	(0.175)	(0.167)
Height	-0.365	-0.655	-0.385	0.045	0.223	0.033
	(0.416)	(0.422)	(0.384)	(0.189)	(0.194)	(0.220)
Kids	-0.12 ***	-0.166 ***	-0.132 ***	-0.123 ***	-0.12 ***	-0.125 ***
	(0.032)	(0.031)	(0.027)	(0.022)	(0.021)	(0.022)

Table A.5, continued

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	0.344 ***	0.348 ***	0.362 ***	0.07 *	0.052	0.096 *
	(0.115)	(0.117)	(0.113)	(0.042)	(0.044)	(0.050)
Newfoundland	-0.108	-0.177	-0.157	-0.001	-0.039	-0.03
	(0.151)	(0.150)	(0.146)	(0.057)	(0.059)	(0.069)
Prince Edward Island	-0.572 ***	-0.507 ***	-0.521 ***	-0.157 ***	-0.161 ***	-0.202 ***
	(0.162)	(0.161)	(0.153)	(0.061)	(0.062)	(0.073)
Nova Scotia	0.286 **	0.312 **	0.282 **	-0.002	0.022	0.046
	(0.141)	(0.138)	(0.133)	(0.055)	(0.056)	(0.065)
New Brunswick	-0.023	0.036	-0.035	-0.062	-0.019	-0.049
	(0.143)	(0.142)	(0.137)	(0.055)	(0.056)	(0.066)
Quebec	-0.811 ***	-0.828 ***	-0.819 ***	-0.299 ***	-0.254 ***	-0.365 ***
	(0.112)	(0.111)	(0.106)	(0.043)	(0.044)	(0.052)
Manitoba	0.029	0.072	0.046	0.003	0.06	0.046
	(0.147)	(0.152)	(0.140)	(0.057)	(0.059)	(0.068)
Saskatchewan	-0.044	-0.032	-0.031	-0.094	-0.015	-0.072
	(0.145)	(0.148)	(0.138)	(0.059)	(0.059)	(0.069)
Alberta	0.028	0.052	0.052	-0.025	0.037	0.03
	(0.119)	(0.120)	(0.112)	(0.049)	(0.050)	(0.057)
British Columbia	-0.365 ***	-0.322 **	-0.369 ***	-0.165 ***	-0.113 **	-0.177 ***
	(0.127)	(0.129)	(0.119)	(0.052)	(0.054)	(0.061)
Constant	-5.786 ***	-5.442 ***	-6.154 ***	-2.363 ***	-2.754 ***	-2.932 ***
	(0.719)	(0.724)	(0.662)	(0.335)	(0.343)	(0.387)
$\ln \sigma_c^2$	1.501 ***	1.521 ***	1.561 ***	-2.126 ***	-1.717 ***	-0.677 ***
	(0.045)	(0.044)	(0.040)	(0.244)	(0.208)	(0.121)
σ_c	2.118	2.140	2.182	0.345	0.424	0.713
	(0.047)	(0.047)	(0.043)	(0.042)	(0.044)	(0.043)
ρ	0.818	0.821	0.826	0.107	0.152	0.337
	(0.007)	(0.006)	(0.006)	(0.023)	(0.027)	(0.027)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-9,472.79	-9,979.71	-12,111.53	-7,253.51	-7,920.53	-9,789.24

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$

Table A.6: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Asthma by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	-0.012	·	0.039	·	·	·
	(0.062)		(0.047)	·	·	·
Lagged Physical Activity	·	·	·	-0.031	-0.043	-0.013
	·		·	(0.041)	(0.037)	(0.033)
Lagged Asthma	·	·	·	3.233 ***	3.27 ***	3.262 ***
	·		·	(0.041)	(0.040)	(0.035)
Age	0.014 ***	·	0.018 ***	-0.005 ***	-0.005 ***	-0.004 ***
	(0.003)		(0.003)	(0.002)	(0.002)	(0.001)
Male	-0.42 ***	·	-0.413 ***	-0.091 *	-0.094 *	-0.091 **
	(0.121)		(0.112)	(0.053)	(0.052)	(0.046)
Single	-0.007	·	0.086	0.014	-0.023	-0.021
	(0.102)		(0.091)	(0.057)	(0.057)	(0.050)
Widow/Separated	0.074	·	0.06	0.046	0.054	0.033
	(0.088)		(0.079)	(0.050)	(0.049)	(0.044)
Marital Status Not Stated	-5.591	·	-8.525	-4.98	-4.997	-4.987
	(11325.4)		($4.28\text{x}10^8$)	($1.26\text{x}10^5$)	($1.11\text{x}10^5$)	($8.79\text{x}10^4$)
Employed	0.142 **	·	0.168 ***	0.007	-0.014	0.004
	(0.069)		(0.060)	(0.047)	(0.046)	(0.041)
Lowest Income Decile	0.379 ***	·	0.409 ***	0.164 *	0.139	0.172 **
	(0.137)		(0.121)	(0.094)	(0.090)	(0.081)
2nd Income Decile	0.279 **	·	0.286 **	0.081	0.021	0.059
	(0.129)		(0.113)	(0.087)	(0.083)	(0.075)
3rd Income Decile	0.087	·	0.163	0.004	-0.05	0.01
	(0.130)		(0.113)	(0.089)	(0.085)	(0.076)
4th Income Decile	0.182	·	0.173	0.015	-0.027	-0.005
	(0.125)		(0.109)	(0.087)	(0.082)	(0.074)
Middle Income Decile	0.129	·	0.122	0.059	-0.058	0.02
	(0.122)		(0.107)	(0.083)	(0.081)	(0.072)
6th Income Decile	0.185	·	0.083	0.003	-0.036	0.007
	(0.119)		(0.105)	(0.085)	(0.081)	(0.072)
7th Income Decile	0.096	·	0.107	0.065	0.055	0.063
	(0.119)		(0.102)	(0.083)	(0.078)	(0.070)
8th Income Decile	0.163	·	0.163	0.102	0.016	0.083
	(0.116)		(0.100)	(0.081)	(0.078)	(0.069)
9th Income Decile	0.011	·	0.011	0.026	-0.059	-0.001
	(0.116)		(0.099)	(0.083)	(0.080)	(0.070)
Income Decile Not Stated	0.146	·	0.199 *	0.226 **	0.032	0.145 *
	(0.135)		(0.118)	(0.089)	(0.090)	(0.079)
Welfare Primary Source	0.191	·	0.17	0.218 **	0.101	0.173 *
	(0.147)		(0.129)	(0.102)	(0.105)	(0.093)
Owns Home	-0.241 ***	·	-0.209 ***	-0.081 *	-0.085 **	-0.092 **
	(0.073)		(0.065)	(0.044)	(0.043)	(0.039)
Less than High School	0.052	·	0.153	0.104	0.101	0.105 *
	(0.151)		(0.139)	(0.067)	(0.064)	(0.058)
Some Post-Secondary	0.396 ***	·	0.432 ***	0.134 **	0.087	0.107 **
	(0.132)		(0.121)	(0.061)	(0.058)	(0.053)
Post-Secondary	0.391 ***	·	0.457 ***	0.086	0.05	0.071
	(0.130)		(0.119)	(0.059)	(0.056)	(0.051)
Not Stated	1.374 ***	·	1.164 ***	0.478 **	0.647 ***	0.506 ***
	(0.305)		(0.270)	(0.205)	(0.196)	(0.182)
Height	0.065	·	-0.088	-0.332	-0.392	-0.351
	(0.552)		(0.507)	(0.261)	(0.254)	(0.227)
Kids	-0.041	·	-0.028	0.018	0.02	0.019
	(0.039)		(0.034)	(0.025)	(0.024)	(0.022)

Table A.6, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	0.517 ***	·	0.534 ***	0.102 *	0.114 *	0.116 **
	(0.158)		(0.144)	(0.062)	(0.061)	(0.055)
Newfoundland	-0.708 ***	·	-0.632 ***	-0.208 **	-0.295 ***	-0.241 ***
	(0.240)		(0.204)	(0.088)	(0.091)	(0.080)
Prince Edward Island	-0.413 **	·	-0.433 **	-0.248 ***	-0.136 *	-0.188 **
	(0.208)		(0.192)	(0.090)	(0.083)	(0.077)
Nova Scotia	0.198	·	0.053	0.032	0.053	0.041
	(0.165)		(0.157)	(0.071)	(0.070)	(0.063)
New Brunswick	-0.159	·	-0.15	-0.119	-0.083	-0.069
	(0.181)		(0.169)	(0.078)	(0.077)	(0.068)
Quebec	0.033	·	0.051	-0.093 *	0.007	-0.029
	(0.126)		(0.118)	(0.054)	(0.052)	(0.047)
Manitoba	-0.059	·	-0.133	-0.111	-0.094	-0.066
	(0.187)		(0.179)	(0.081)	(0.082)	(0.071)
Saskatchewan	-0.133	·	-0.193	-0.104	0.044	0.018
	(0.179)		(0.170)	(0.080)	(0.074)	(0.067)
Alberta	0.112	·	0.1	-0.05	0.044	0.013
	(0.148)		(0.137)	(0.066)	(0.064)	(0.057)
British Columbia	-0.153	·	-0.219	-0.118 *	-0.015	-0.081
	(0.161)		(0.149)	(0.071)	(0.070)	(0.061)
Constant	-5.987 ***	·	-6.45 ***	-1.461 ***	-1.321 ***	-1.499 ***
	(0.956)		(0.875)	(0.457)	(0.445)	(0.399)
$\ln \sigma_c^2$	2.231 ***	·	2.417 ***	-12.593	-12.461	-13.852
	(0.037)		(0.035)	(8.919)	(8.253)	(16.020)
σ_c	3.052	·	3.348	0.002	0.002	0.001
	(0.057)		(0.059)	(0.008)	(0.008)	(0.008)
ρ	0.903	·	0.918	0.000	0.000	0.000
	(0.003)		(0.003)	(0.000)	(0.000)	(0.000)
nT	31,242	·	42,656	27,401	29,838	37,324
T	8	·	8	7	7	7
Log likelihood	-4,074.59	·	-4,980.43	-2,781.61	-2,947.68	-3,678.45

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$

Note: Random effects probit for moderate physical activity did not converge.

Table A.7: Coefficient Estimates - Random Effects and Dynamic Unobserved Effects Probit, Ulcers by Physical Activity Measure

	Random Effect Probit			Dynamic Unobserved Effects Probit		
PA:	Active	Moderate	Daily	Active	Moderate	Daily
Physical Activity	-0.107	-0.027	-0.021	.	.	.
	(0.067)	(0.054)	(0.049)	.	.	.
Lagged Physical Activity	.	.	.	-0.043	-0.131 ***	-0.026
	.	.	.	(0.050)	(0.047)	(0.043)
Lagged Arthritis				2.321 ***	2.231 ***	2.035 ***
				(0.064)	(0.068)	(0.076)
Age	-0.002	-0.003	-0.003	-0.002	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Male	0.078	0.02	0.046	0.025	0.068	0.045
	(0.117)	(0.116)	(0.105)	(0.065)	(0.067)	(0.066)
Single	-0.305 ***	-0.363 ***	-0.272 ***	-0.125 *	-0.162 **	-0.131 *
	(0.116)	(0.119)	(0.102)	(0.075)	(0.078)	(0.075)
Widow/Separated	0.02	0.028	0.023	-0.037	-0.029	0.007
	(0.087)	(0.085)	(0.076)	(0.059)	(0.060)	(0.058)
Marital Status Not Stated	-4.572	1.238	1.142	-3.74	1.551 **	1.304 *
	(1843.4)	(1.1)	(1.1)	(1649.6)	(0.7)	(0.7)
Employed	-0.12 *	-0.175 **	-0.122 **	-0.042	-0.116 **	-0.085
	(0.071)	(0.069)	(0.062)	(0.056)	(0.056)	(0.054)
Lowest Income Decile	0.324 **	0.33 **	0.252 **	0.284 **	0.191 *	0.224 **
	(0.142)	(0.140)	(0.122)	(0.111)	(0.112)	(0.105)
2nd Income Decile	0.303 **	0.366 ***	0.285 **	0.241 **	0.173 *	0.245 **
	(0.133)	(0.131)	(0.114)	(0.104)	(0.103)	(0.097)
3rd Income Decile	0.367 ***	0.336 ***	0.305 ***	0.267 ***	0.252 **	0.26 ***
	(0.131)	(0.128)	(0.111)	(0.101)	(0.099)	(0.095)
4th Income Decile	0.152	0.148	0.067	0.105	-0.017	0.038
	(0.133)	(0.131)	(0.114)	(0.106)	(0.106)	(0.099)
Middle Income Decile	0.018	0.113	0.014	0.025	0.027	0.013
	(0.133)	(0.128)	(0.113)	(0.105)	(0.102)	(0.098)
6th Income Decile	0.238 *	0.231 *	0.191 *	0.099	0.088	0.08
	(0.128)	(0.127)	(0.109)	(0.105)	(0.102)	(0.097)
7th Income Decile	0.134	0.28 **	0.146	0.061	0.01	0.018
	(0.130)	(0.125)	(0.109)	(0.105)	(0.104)	(0.098)
8th Income Decile	0.119	0.13	0.045	0.064	0.025	0.026
	(0.125)	(0.124)	(0.107)	(0.103)	(0.102)	(0.096)
9th Income Decile	0.071	0.006	-0.007	-0.024	-0.125	-0.079
	(0.127)	(0.125)	(0.107)	(0.107)	(0.107)	(0.098)
Income Decile Not Stated	0.028	0.027	0.006	-0.017	-0.091	-0.041
	(0.144)	(0.143)	(0.124)	(0.117)	(0.117)	(0.109)
Welfare Primary Source	0.291 **	0.193	0.234 *	0.249 **	0.181	0.289 ***
	(0.135)	(0.135)	(0.121)	(0.111)	(0.119)	(0.109)
Owns Home	-0.005	-0.085	-0.006	-0.051	-0.046	-0.027
	(0.080)	(0.077)	(0.070)	(0.055)	(0.055)	(0.055)
Less than High School	0.421 ***	0.407 ***	0.379 ***	0.169 **	0.163 **	0.2 ***
	(0.137)	(0.135)	(0.124)	(0.075)	(0.077)	(0.077)
Some Post-Secondary	0.082	0.13	0.079	-0.004	-0.007	0.002
	(0.128)	(0.126)	(0.114)	(0.074)	(0.074)	(0.074)
Post-Secondary	-0.061	0.037	-0.023	-0.033	-0.058	-0.059
	(0.124)	(0.123)	(0.110)	(0.070)	(0.072)	(0.071)
Not Stated	0.32	0.514 *	0.382	0.203	0.294	0.205
	(0.316)	(0.289)	(0.271)	(0.279)	(0.270)	(0.260)
Height	-0.889 *	-0.594	-0.835 *	-0.552 *	-0.704 **	-0.654 **
	(0.540)	(0.534)	(0.485)	(0.318)	(0.325)	(0.321)
Kids	-0.126 ***	-0.12 ***	-0.114 ***	-0.113 ***	-0.122 ***	-0.117 ***
	(0.046)	(0.043)	(0.039)	(0.036)	(0.036)	(0.035)

Table A.7, continued

PA:	Random Effect Probit			Dynamic Unobserved Effects Probit		
	Active	Moderate	Daily	Active	Moderate	Daily
Canadian Born	-0.208	-0.167	-0.167	-0.084	-0.065	-0.115
	(0.131)	(0.130)	(0.120)	(0.068)	(0.071)	(0.070)
Newfoundland	-0.2	-0.032	-0.049	-0.085	-0.111	-0.098
	(0.184)	(0.170)	(0.159)	(0.098)	(0.098)	(0.100)
Prince Edward Island	0.002	0.082	0.055	-0.074	-0.035	-0.032
	(0.183)	(0.175)	(0.163)	(0.100)	(0.099)	(0.101)
Nova Scotia	0.227	0.255	0.248 *	0.039	-0.053	0.004
	(0.161)	(0.157)	(0.145)	(0.088)	(0.093)	(0.092)
New Brunswick	0.027	0.037	0.009	-0.084	-0.087	-0.045
	(0.173)	(0.168)	(0.157)	(0.094)	(0.095)	(0.095)
Quebec	-0.218 *	-0.237 *	-0.188	-0.104	-0.144 **	-0.119 *
	(0.131)	(0.131)	(0.119)	(0.069)	(0.071)	(0.071)
Manitoba	-0.139	0.064	-0.022	-0.053	-0.074	-0.046
	(0.188)	(0.177)	(0.165)	(0.098)	(0.101)	(0.100)
Saskatchewan	-0.033	0.025	-0.003	-0.093	-0.07	-0.021
	(0.178)	(0.177)	(0.161)	(0.101)	(0.102)	(0.099)
Alberta	-0.225	-0.242	-0.193	-0.166 *	-0.079	-0.108
	(0.162)	(0.161)	(0.143)	(0.090)	(0.088)	(0.087)
British Columbia	-0.228	-0.102	-0.154	-0.115	-0.085	-0.153 *
	(0.166)	(0.161)	(0.146)	(0.090)	(0.092)	(0.092)
Constant	-1.888 **	-2.413 ***	-2.023 **	-1.261 **	-0.891	-1.174 **
	(0.926)	(0.917)	(0.833)	(0.553)	(0.564)	(0.556)
$\ln \sigma_c^2$	0.999 ***	1.017 ***	1.006 ***	-1.795 ***	-1.52 ***	-1.018 ***
	(0.062)	(0.058)	(0.051)	(0.283)	(0.244)	(0.195)
σ_c	1.648	1.663	1.654	0.407	0.468	0.601
	(0.051)	(0.048)	(0.042)	(0.058)	(0.057)	(0.058)
ρ	0.731	0.734	0.732	0.142	0.180	0.265
	(0.012)	(0.011)	(0.010)	(0.035)	(0.036)	(0.038)
nT	31,242	33,891	42,656	27,401	29,838	37,324
T	8	8	8	7	7	7
Log likelihood	-3,086.80	-3,284.53	-3,911.27	-2,345.86	-2,462.20	-3,015.87

$* \ p < 0.10, \ ** \ p < 0.05, \ *** \ p < 0.01$