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The Economic Choice of Participation and Time Spent in Physical Activity and Sport in Canada

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Abstract

The health benefits of participation in physical activity are well documented, yet the prevalence of meeting physical activity guidelines remains low.We examine the determinants of participation in physical activity in Canada by estimating double hurdle models of participation and time spent using data from the 2001 Canadian Community Health Survey (CHHS). We find higher income is associated with a higher probability of participating and less time spent in widely practiced sports like running and swimming, but the size of the income effect is relatively small. The hourly wage is generally positive and significant in both the participation and time spent equations suggesting a dominating income effect. Distinguishing between the extensive and intensive margins of the participation decision is important for untangling the effects of income, age, gender and family structure on these choices.

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1 Introduction

The health benefits of participation in sport are well documented, yet the prevalence of meeting physical activity guidelines is improving in Canada but still remains low. (Gilmour 2007) Even if the rate of participation in sport demonstrates an upward trend, questions about frequency and intensity needed to provide health benefits remain. Two-thirds of adult Canadians (over age 20) do not meet the guidelines for sufficient physical activity as defined in Canada's Physical Activity Guide (Public Health Agency of Canada, 2006). A goal of the Canadian Sport Policy is to enhance Canadian's participation in sport and physical activity at all levels by 2012. The observed decline in Canadians' participation in sport between 1992 and 1998 motivates this goal.

In this paper, we estimate a model of the decision to participate in leisure time sports activities (hereafter, simply sports) that is rooted in economic theory. The theoretical model motivating the econometric analysis is based on Becker's (1965) well-known theory of household production. The model recognizes that decisions about sport participation are made on two margins: the extensive margin of participation (Should I participate in sport?); and the intensive margin of frequency and duration (How much time should I spend participating in sport?). This distinction has implications for the way observed correlates of practicing sport (for example, income and education) affect the participation and duration decisions.

We estimate our empirical model using data from the 2001 Canadian Community Health Survey. The data reflect the fact that many Canadians choose not to participate in sport or be physically active. Our econometric approach is to account for the large number of zeros observed in the measures of physical activity by estimating a hurdle model of participation and time spent practicing sport. Our control variables include several of the factors repeatedly documented as associated with sport participation in the sports economics and sports management literature and with physical activity in the numerous behavioral studies of physical activity, like age, income, education, gender and marital status.

We focus our analysis on seven sports and physical activities: walking, swimming, exercising at home, cycling and running, golfing and weight lifting. We find that individuals with higher income are more likely to participate in these activities but, conditional on participating, spend less time. This finding is important even though numerous studies have found a positive correlation between income and physical activity because it suggests that the income effect works differently on the extensive and intensive margins. Our model also shows that a change in the opportunity cost of time has both an income and substitution effect on the participation and duration decisions. These effects work in opposite directions and are empirically testable. Our findings generally suggest that the income effect dominates the substitution effect. These results can help inform the design of policy interventions aimed at increasing participation in physical activity. Finding a positive income effect on the extensive margin suggests that consumers will respond to economic incentives to initiate sports programs.

2 Background and Related Literature

Participation in sport declined significantly in Canada between 1992 and 1998. According to information contained in Statistics Canada's General Social Survey (GSS), the percentage of Canadians aged 15 years and older who reported participating in sport dropped from 45% in 1992 to 34% in 1998. The drop in participation was widespread, cutting across all age groups, provinces, education levels, income brackets and gender (Ogrodnik, 1999). This decline in participation in sport does not mean Canadians are physically inactive, as rates of participation in other types of physical activity like walking have increased. A comparison of reported physical activity from the 1996/1997 National Population and Health Survey (NPHS) to reported physical activity in the 2005 Canadian Community Health Survey (CCHS) indicates the proportion of Canadians aged 12 or older who reported at least moderately active leisure time activities rose from 43% to 52%. Still, even though physical activity appears to be on the rise, almost half of all of Canadians were inactive during their leisure time (Gilmour, 2007).

Physical inactivity is considered a major public health issue, because it is a modifiable risk factor for a number of health problems including cardiovascular disease, osteoporosis, obesity, high blood pressure, and depression (Warburtton et al., 2006). The economic burden of physical inactivity can be substantial and was estimated at $5.3 billion, 2.6% of total health care costs in Canada, in 2001 (Katzmarzyk and Janssen 2004). Sari (2008) estimates that moderately active individuals, compared with active individuals use between 2.4% to 9.6% more healthcare services. A goal of Canadian sport policy is that by 2012 a significantly higher proportion of Canadians from all segments of society should be involved in quality sports activities at all levels and in all forms of participation (The Canadian Sport Policy, 2002, p.16). A critical component to achieving this goal is an understanding of the differential causal effects of economic, social, and ecological factors on individuals' decisions to participate in sport. There is evidence that physical activity behaviors in general, including sport participation are affected by policies and physical environments (Humpel et al. 2002).

The public health priority of promoting regular physical activity and the complexity of physical activity behavior have motivated hundreds of studies on the topic. The majority of the studies employ health behavior and behavioral medicine approaches to examine the correlates of physical activity. This literature has been extensively reviewed. (See Sallis and Owen (1999), Sallis et al (2000), Sherwood and Jeffery (2000), and Sallis et al (2008).) Bauman et al (2002) assess the status of the behavioral research on physical activity. They argue that in order for research on physical activity to progress, studies of the mechanisms underlying physical activity are needed. A table in a recent review, adapted from Sallis and Owens (1999), summarizes the results of about 300 studies of the correlates of physical activity in the clinical and public health literature (Bauman et al, 2002 p. 11). This table shows that studies consistently find a statistical association between physical activity and many demographic, socioeconomic, psychological, physical environment, and biological factors. For example, Bauman et al (2002) note that gender (male), education and income are positively associated with physical activity in many studies while a negative association between age and physical activity is repeatedly documented. The consistent demonstration of associations between many factors and physical activity suggests that the causal relationships are quite complex, yet understanding the causal mechanisms underlying physical activity behavior is an important component of developing individual and public health recommendations and designing effective policy interventions.

Economics offers an alternative but complementary approach to examining physical activity behavior. Physical activity, like many other health behaviors is episodic. Some people exercise, while others do not. Some people begin to exercise regularly but then stop and then begin again. Central to understanding why some people engage in regular, vigorous physical activity while others do not or why people start and stop exercising regularly is the question of how people allocate their time. Why do people spend their leisure time engaged in physical activity when they could spend it engaged in sedentary activities? Time constraints are the most frequently reported barriers to exercise by both sedentary and active individuals (Dishman et al, 1985;King et al, 1990). Economics is useful for exploring this question because it provides a framework for studying how people allocate their time to competing activities and what factors affect these decisions.

The number of studies examining participation in physical activity (including sport) from an economics perspective is emerging in the health and sports economics literature. The existing literature is motivated from a variety of economic perspectives and several studies use data from large-scale, nationally representative surveys. Studies using US data include Eisenberg and Okeke (2009); Humphreys and Ruseski (2007); Cawley, Meyerhoefer and Newhouse (2007, 2005); and Kaestner and Xu (2007). Eisenberg and Okeke (2009) link the BRFSS data from 1993-2000 with weather data from the National Climatic Data Center to examine how physical activity across socioeconomic groups responds to changes in weather. They find that within cold temperature ranges, a decrease in temperature causes a decrease in physical activity and this effect is generally larger for lower education and income groups. Humphreys and Ruseski (2007) analyze participation across broad groups of physical activity using data from the 1998 and 2000 BRFSS augmented with state-level data on government spending on parks and recreation. They find considerable variation in participation and time spent in physical activity across groups of activities. Changes in government spending on parks and recreations increases participation in some activities but reduces it in others. Cawley et al (2007, 2005) examine the effect of physical education and state policies on physical activity using data from the Youth Risk Behavior Surveillance System (YRBSS) merged with data on state minimum physical education requirements. They find that certain state regulations are effective in raising the number of minutes students spend in physical activity but have no impact on youth body mass index or the probability of being overweight. Kaestner and Xu (2006) examine the association between girls' participation in high school sports, as a result of Title IX legislation, on the physical activity, body mass and body composition of adolescent women using the first two waves of the National Health and Nutritional Examination Surveys (NHANES I and II). They find that an increase in girls' participation in high school sports is associated with with an increase in physical activity and an improvement in weight and body mass.

The existing economic literature contains a number of studies using nationally representative survey data from the UK. These studies include Farrell and Shields (2002); Downward (2004, 2007) and Downward and Riordan (2007) and focus on examining the demand for sports participation. Farrell and Shields investigate the economic and demographic factors that influence participation in 10 sports using data drawn from the 1997 Health Survey of England. Downward (2004) uses data from the 1996 General Household Survey to explore the factors associated with participation in 12 sporting activities. This research is extended in Downward (2007) and Downward and Riordan (2007) using data from the 2002 General Household Survey. Downward (2007) estimates a reduced form of sport participation that includes variables used in earlier empirical work. Consistent with the public health literature, these studies all find that participation in sport is affected by family commitments, ethnicity, age, household income and education. Downward and Riordan (2007) explore the role of social interactions in affecting the demand for sport participation and find that social and personal capital are important factors in determining sports participation.

A few studies use large-scale, nationally representative survey data from Germany and Canada. Breuer and Wicker (2009, 2008) use data from the German Socio-Economic Panel (GSOEP) to explore the economic and demographic factors influencing sport participation. When examining participation in sport over the lifespan, Breur and Wicker (2008) find that the consistently documented finding in cross-sectional studies that physical activity declines with age is not supported in longitudinal studies. Sari (2008) examines the the impact of the lack of physical activity on healthcare utilization using data from the Canadian Community Health Survey (CCHS). His results suggest that physical inactivity increases hospital stays and the use of physician and nurses services. Lechner (2009) also uses the GSOEP data to analyze the long-run effects of sport participation on labor market outcomes and health and life satisfaction measures. He finds that participation in sport on at least a monthly basis has positive effects on wages, earnings, health status and general life satisfaction.

A useful starting point for thinking about how individuals make decisions about sport participation is the "income-leisure trade off" model of labor supply in which participation in physical activity is a time allocation decision. However, as discussed by Gratton and Taylor (2000), modeling an individual's decision to be physically active is complex because physical activity can be viewed as a non-durable consumption good, a durable consumption good, and an investment good. In light of this, Becker's (1965) household production and Grossman's (1972) health production models offer more useful starting points for modeling individuals' decisions about physical activity. Few studies present formal theoretical models of participation in physical activity. The theoretical foundation for the econometric analysis in this paper is an economic model of participation and time spent in physical activity (Humphreys and Ruseski, 2009). The model of participation in sport is an extension of the SLOTH framework of time allocation (Cawley, 2004) that is based on Becker's (1965) model of labor and leisure choice. We estimate the model using data from the 2001 nationally representative CCHS.

3 Theoretical Framework

The theoretical model motivating our econometric analysis is an economic model of participation and time spent in sport.[1] The model of sport participation is an extension of the SLOTH framework of time allocation. (Cawley, 2004) The framework is based on Becker's (1965) model of labor and leisure choice. The SLOTH framework assumes that individuals choose how to allocate their time to maximize their utility subject to budget, time and biological constraints where SLOTH is an acronym for the activities to which individuals allocate their time. Specifically, S represents time spent sleeping; L represents time spent at leisure, O represents time spent at paid work; T represents time spent in transportation to work; and H represents time spent in home production, or unpaid work. Participation in leisure-time sports is captured in L, as is time spent in sedentary leisure activities such as watching television or playing computer games.[2] We extend the SLOTH

[1]See Humphreys and Ruseski, 2009 for the formal presentation and analysis of the model.

[2]In a recent paper, Aguiar and Hurst (2007) documented trends in the allocation of time in the United States over the last forty years. They find that time allocated to leisure activities increased significantly over this time period.

framework by combining the key temporal elements of the framework with a recreation demand model (McConnell, 1992) to analyze decisions about participation and time spent in sport. The key behavioral decisions in the model are the separate but related decisions to participate in physical activity (the extensive margin) and how long to participate per episode of sport activity (the intensive margin).

Individuals maximize utility by allocating time to participation in sport and all other activities (such as sleeping, sedentary leisure, working for pay and working at home) and purchasing a bundle of goods and services subject to time and budget constraints. The utility function is $U(a, t, z)$ where a represents the individual's decision to participate in sport; t is the amount of time spent per episode of sport activity; and z represents the individual's decision to engage in the other activities. The budget constraint is $Y = F_a + c_a at + c_z z$ where Y is money income; F_a is the fixed cost of engaging in physical activity; c_a is the variable cost associated with engaging in sports; and c_z is the cost all other goods and services. The budget constraint includes both fixed and variable costs associated with participating in sports. The fixed costs are one-time costs incurred to participate in sports but do not depend on how many times the individuals participates. An example of a fixed cost is the monthly membership dues at a health club. An individual pays this flat, fixed amount regardless of how many times he uses the gym during the month. Variable costs are costs that depend on the amount of time or the number of times the individual engages in physical activity. Examples of variable costs are equipment maintenance costs, coaches' fees and personal trainer fees.

The time constraint is $T^* = at + \theta z$ where T^* is the time available for consumption activities such as sports and θ is time spent consuming z. Assume that T^*, t and θ are measured in the same units such as hours. Let T be the total time available for work and all other activities. Hence, $T^* = T - h$ where h is time spent working. If individuals can choose the amount of hours they work, then h is endogenous and wage earnings w can be expressed in terms of total time available and time spent not working: $wh = w(T - at - \theta z)$ This equation captures the notion that any time spent in sports activity and other activities is time not available for work and reduces earnings. Thus, the wage is the opportunity cost of engaging in activities other than work. The full budget (or income) constraint includes the opportunity cost of time $y_0 + wT = F_a + p_a at + p_z z$ where y_0 is exogenous income; wT is potential income if individuals spend all of their time working; $p_a = c_a + w$ is the full cost of participating in sports activities; and $p_z = c_z + \theta w$ is the full cost of participating in other activities. The characterization of the solution to the consumer's utility maximization problem gives rise to empirically testable implications about the effect of economic

In addition, the adjustment process of reallocating time to leisure differed for men and women.

factors on decisions about participation in sport. The testable implications are discussed in the next section.

3.1 Testable Implications

Consumers choose a, t and z to maximize utility subject to the full budget constraint. The lagrangian for this problem is

$$V = U(a,t,z) - \lambda(F_a + p_a \cdot a \cdot t + p_z z - y) \tag{1}$$

where $y = y_0 + wT$. The empirically testable implications emanate from a analyzing the effects of changes in income and the opportunity cost of time (measured by wages) on the decisions to participate in sport (the extensive margin) and the amount of time spent participating in sport (the intensive margin). We treat the decision to participate in sport as a continuous count variable rather than a dichotomous variable restricted to take on the values of zero or one. This approach is consistent with the time dimension of the participation in physical activity and sport data used in our empirical analysis, the month prior to the survey. Each episode of sport activity requires a separate participation decision, so the participation decision is made repeatedly over time. As a result, observed episodes of sport activity are not limited to zero or one over the relevant time period. Consider first the effect of a change in income on the participation and time spent decisions.

Testable Implication 1: The effect of a change in income on participation is positive if marginal utility from participating in sport does not affect the marginal utility from other activities. Formally, we have: $\partial a/\partial y > 0$ if $U_{za} = 0$.

This follows from the comparative static expression for $\partial a/\partial y$:

$$\frac{\partial a}{\partial y} = \frac{|J_a|}{|J_p|} = \frac{U_{za}p_z - p_a t U_{zz}}{p_z(-U_{aa}p_z + U_{az}p_a t) - p_a t(-U_{za}p_z + U_{zz}p_a t)} \tag{2}$$

Convexity requires $|J_p| => 0$, so the denominator of equation (2) is positive and the sign depends on the sign of the numerator. $U_{zz} < 0$ by assumption, so the sign of the numerator depends on U_{za}. This cross partial describes the relationship between the marginal utility from participating in physical activity and the marginal utility from other activities like meals or watching television. If $U_{za} = 0$, then $\frac{\partial a}{\partial y} > 0$. Intuitively, it seems reasonable to assume that the marginal satisfaction associated with participating in sports is independent of the marginal satisfaction of other non-active leisure activities.

Testable Implication 2: The effect of a change in income on the optimal amount of time spent participating in sport is positive if the marginal utility of time spent participating in sport does not affect the marginal utility from other activities. Formally, we have: $\partial t/\partial y > 0$ if $U_{zt} = 0$

This follows from the comparative static expression for $\partial t/\partial y$:

$$\frac{\partial t}{\partial y} = \frac{|J_t|}{|J_d|} = \frac{U_{zt}p_z - p_a a U_{zz}}{p_z(-U_{tt}p_z + U_{tz}p_a a) - p_a a(-U_{zt}p_z + U_{zz}p_a a)} \tag{3}$$

Convexity requires $|J_d| > 0$, so the denominator of equation (3) is positive and the sign depends on the sign of the numerator. $U_{zz} < 0$ by assumption, so the sign of the numerator depends U_{zt}. If $U_{zt} = 0$, then $\frac{\partial t}{\partial y} > 0$.

The opportunity cost of time affects the decision to participate in physical activity and the amount of time devoted to physical activity. Recall, $p_a = c_a + w$ and $p_z = c_z + \theta w$. The opportunity cost of time is the wage rate w. Expanding the lagrangian to explicitly show the full cost of time spent in physical activity and all other activities yields

$$V = U(a, t, z) - \lambda(F_a + (c_a + w) \cdot a \cdot t + (c_z + \theta w)z - y). \tag{4}$$

The individual's choices are the same in this expanded model; namely, to choose a, t and z to maximize utility.

We examine the effect of a change in the opportunity cost of time, (dw), on the participation decision, a and the amount of time spent in physical activity, t. The comparative static expressions are:

$$\frac{\partial a}{\partial w} = \frac{(ta + \theta z)[U_{za}(-c_z - \theta w) - U_{zz}(-c_a t - wt)] - (-c_z - \theta w)[\lambda t(-c_z - \theta w) - \lambda\theta(-c_a t - wt)]}{-t(c_a + w)[U_{za}(-c_z - \theta w) - U_{zz}(-c_a t - wt)] - (-c_z - \theta w)[U_{aa}(-c_z - \theta w) - U_{az}(-c_a t - wt)]} \tag{5}$$

and

$$\frac{\partial t}{\partial w} = \frac{(ta + \theta z)[U_{zt}(-c_z - \theta w) - U_{zz}(-c_a a - wa)] - (-c_z - \theta w)[\lambda a(-c_z - \theta w) - \lambda\theta(-c_a a - wa)]}{-a(c_a + w)[U_{zt}(-c_z - \theta w) - U_{zz}(-c_a a - wa)] - (-c_z - \theta w)[U_{tt}(-c_z - \theta w) - U_{tz}(-c_a a - wa)]} \tag{6}$$

.

The first terms of Equation 5 and Equation 6 resemble the income effect of a change in the price of a market good. In the standard consumer theory model, an increase in the price of a good effectively decreases the consumer's real income, and the income effect is greater as the importance of the good in the consumer's budget increases. The income effect of a change in the opportunity cost of time has the opposite effect on the consumer's real income than the income effect of a change in the price of some market good. This occurs because an increase in the opportunity cost of time effectively means a higher wage and an increase in real income. If sport participation is a normal good, then we would expect the income effect of an increase in the opportunity cost of time to be positive. The income effect is weighted by the amount of time available for all activities other than work. Thus, the total amount of time spent in all non-work activities, rather than only the time in sport participation, determines the effect of a change in the opportunity cost of time on participation. This occurs because the opportunity cost of time is the same for sports activities and all other activities and individuals are constrained by the total amount of time available.

The second term is the substitution effect of a change in the opportunity cost of time. The substitution effect is negative which means that the likelihood of participating in sport decreases as the opportunity cost of time increases. The signs of both comparative static expressions, $\partial a/\partial w$ and $\partial t/\partial w$ depend on the signs of the income and substitution effects. We cannot sign the entire expressions because the substitution and income effect move in opposite directions. This discussion generates our third testable implication.

Testable Implication 3: The effect of a change in the opportunity cost of time on both participation and time spent in sport is positive if the income effect dominates the substitution effect or negative if the substitution effect dominates the income effect. Formally, we have: $\partial w/\partial a > 0$ and $\partial w/\partial t > 0$ if the income effect of the change in the opportunity cost of time dominates the substitution effect. Similarly $\partial w/\partial a < 0$ and $\partial w/\partial t < 0$ if the substitution effect of the change in the opportunity cost of time dominates the income effect.

In summary, the model motivating our empirical analysis describes consumer's decisions about participating in sport on the extensive and intensive margins and time spent all other activities. The advantage of constructing our model with reference to Becker's household production model is that it characterizes sport participation as a multi-dimensional good that is produced with both time- and goods-intensive commodities. Decisions about sport participation are affected by changes in the relative price of time and market goods. Our analysis of the effect of changes in income and the opportunity cost of time on participation and time spent in sports activities generated three testable implications. We now turn to empirically analyzing the effect of economic factors and individual characteristics on decisions about participating and time spent in sports and physical activities.

4 Econometric Analysis of Participation and Time Spent in Sports and Physical Activities

4.1 Data Description

We empirically examine the testable implications from our consumer choice model using the CCHS Cycle 1.1. The survey is a cross-sectional survey that includes population level information on health status, health care utilization and health determinants. Until recently, the CCHS operated on a two-year cycle. The CCHS Cycle 1.1 was conducted between September 2000 and November 2001 and included persons aged 12 or older. Seasonal effects were eliminated by randomly dividing the sample to ensure that each month of the year was properly represented for each region of the country. (Statistics Canada 2002). The survey includes data on leisure time physical activity (primarily sports activities), work-related physical activity, smoking and drinking habits, eating habits, chronic conditions, general health status and health care utilization. The survey also includes data on demographic factors like age, gender, marital status, ethnicity and household composition, and on economic factors like income and labor market participation. This makes the CCHS data an ideal setting for analyzing the effect of economic factors and individual characteristics of participation in sports.

130,880 persons were included in the CCHS Cycle 1.1 survey. The questions about participation in different physical activities specify leisure time. The basic physical activity question in the CCHS survey is:

> *Have you done any of the following in the past three months? - Walking for exercise, gardening, swimming, bicycling, popular or social dance, home exercises, ice hockey, ice skating, inline skating, jogging or running, golfing, exercise class or aerobics, downhill skiing, bowling, baseball or softball, tennis, weight training, fishing, volleyball, basketball, other or no activity.*

Respondents could indicate up to three "other" leisure-time physical activities. We initially define participation in sports activities using this survey question. The CCHS asks further questions about the number of times individuals participated in the various physical activities and how much time (in minutes) they spent per episode. The question asking about frequency of participation is:

> *In the past three months, how many time did you activity -e.g. walk for exercise?*

The question about duration elicit an approximation of about how much time individuals' spent on each episode of reported physical activity. The possible response categories are: 1 = 1 to 15 minutes; 2 = 16 to 30 minutes; 3 = 31 to 60 minutes; 4 = more than one hour. These data provide enough detail to construct an estimate of the total time spent participating in sports activities in the past three months. We constructed a measure of minutes spent per episode by setting each categorical response to the mid-point of the range as follows:

$$time_{spent} = \begin{cases} 7 & \text{if response} = 1 \\ 22 & \text{if response} = 2 \\ 45 & \text{if response} = 3 \\ 75 & \text{if response} = 4 \end{cases}$$

.

Table 1 contains summary statistics on frequency, participation rates, number of participation episodes and minutes spent per episode for the sample of adults used in our econometric analysis.

Table 1: Distribution of Physical Activities

Activity	Frequency	Participation Rate	Times Participated	Minutes Spent per Episode
Walking	62082	62.51%	46.08	37.57
Gardening	42165	42.45%	24.51	53.09
Home Exercise	21718	21.87%	39.78	25.88
Cycling	16211	16.32%	20.11	43.86
Swimming	16112	16.22%	14.03	45.63
Dancing	14105	14.20%	6.93	64.93
Golf	10558	10.63%	10.69	73.76
Fishing	9324	9.39%	7.65	72.59
Weight Lifting	8923	8.98%	30.20	41.41
Running	7748	7.80%	23.58	33.03
Other 1	7652	7.70%	19.33	62.72
Other 2	7138	7.18%	20.22	63.80
Bowling	6711	6.75%	6.06	70.51
Aerobics	5902	5.94%	23.20	50.03
Softball	3854	3.88%	10.03	69.17
Skating	3729	3.75%	6.52	55.30
Inline Skating	3307	3.33%	10.61	49.52
Hockey	2947	2.97%	13.24	67.38
Skiing	2572	2.59%	6.14	72.83
Volleyball	2469	2.49%	7.45	63.78
Basketball	2438	2.45%	10.16	53.25
Tennis	2180	2.19%	9.47	62.37
Other 3	1274	1.28%	19.32	62.62
# of Observations	99,322			

Walking is by far the most frequent activity with 62.51% of the sample reporting walking for exercise at least once in the past three months. Participating in more than one of these physical activities is relatively common in the CCHS. Table 2 shows the number of activities that respondents reported participating in during the past three months. Approximately 63% of the sample reported participating in multiple activities. Participating in more than 4 activities is relatively uncommon.

4.2 Description of Sample and Variables

Since we are interested in examining the economic factors and individual characteristics that affect the decisions about participation and time spent in sports activities, we use a subsample of the CCHS Cycle 1.1 in our empirical analysis. First, Table 1 shows considerable heterogeneity in the

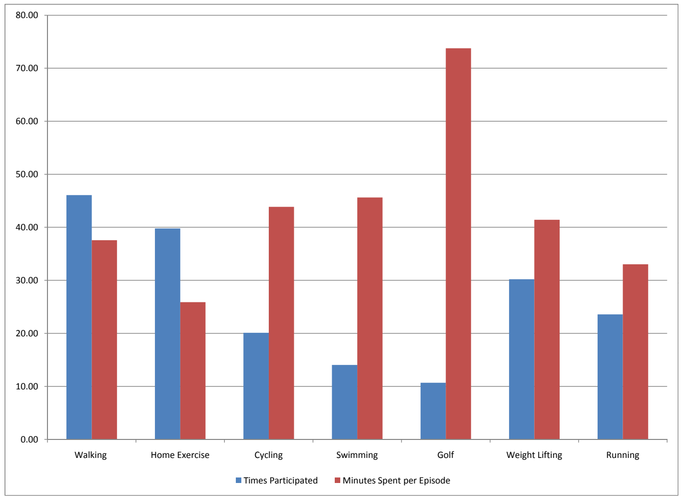
Table 2: Distribution of Number of Activities

Number of Activities	Frequency	Percent
0	17,770	17.89
1	19,206	19.34
2	18,801	18.93
3	14,618	14.72
4	9,961	10.03
5	6,647	6.51
6	4,252	4.28
7	2,878	2.90
8	1,916	1.93
9	1,287	1.30
10	827	0.83
11	584	0.59
12	288	0.29
13	204	0.21
14	120	0.12
15	71	0.07
16	34	0.03
17	23	0.02
18	11	0.01
19	4	0.00
# of Observations	99,322	

types of physical activities individuals participated in, participation rates, number of episodes and time spent per episode. An empirical analysis using aggregated data for all possible activities will mask potentially important variation in the effect of economic factors and individual characteristics on decisions about participation and time spent in sports activities. It may well be the case the effect of income on the decision to run is different than its effect on the decision to ski since running entails few monetary costs while skiing is relatively expensive. Rather than make ad hoc decisions about how to group activities, we focus our empirical analysis on adult participation in seven of the most common activities that are clearly sports or physical activities: walking, swimming, cycling, running, home exercise, golf and weight lifting.

Figure 1 shows the frequency of participation and average amount of time spent in the CCHS these seven activities. The seven activities displayed in Figure 1 differ in important ways that might affect participation and time spent. About one third of the sample reported participating in at least one of these seven activities at least one time in the past three months. The number of times that each participant reported taking part in these activities exhibits quite a bit of variation. Home exercise incorporates a wide variety of exercise activities that can be done in the home,

Figure 1: Participation and Time Spent for 7 Frequent Activities



like running on a treadmill or doing yoga. Walkers and home exercisers participated the most frequently, and swimmers and golfers the least frequently. On the other hand, walkers and home exercisers spend less time per episode of activity than swimmers and golfers. These differences in frequency of participation and time spent likely reflect differences in the total cost of participation in each activity. Home exercise does not require leaving the house, and can be done in any weather. For most individuals, swimming and golfing require travel to a pool or golf course and paying a fee to participate thereby raising the total cost of participation. Golfing is also time intensive as it takes several hours to play 18 holes. Cycling, weight lifting and running frequency falls in between these two extremes. Cycling and running require going outside and also require some equipment.

Figures 2 and 3 illustrate the frequency of participation distribution for the activities in this sample. For purposes of constructing these figures, walking, home exercise and weight lifting are grouped together as physical activities and running, cycling, swimming and golfing are grouped together as sports activities. Note that the distribution of frequency of participation reported in the sample shows considerable skew for the four sports activities. Most of participants report participating only a few times in the previous three months, but a small number of participants report very frequent participation. Taking swimming as an example, Figure 3 shows that 60% of the swimmers in the sample reported swimming ten or fewer times in the past three months. A small number of swimmers report participating 60 to 90 times over the past three months, which corresponds to daily, or nearly daily participation. It is also possible that the frequency distributions of participation reflect some respondent recall bias since three months is a fairly long time period over which to remember how many times they participated in any one activity.

Figure 2: Frequency Distribution for Walking, Home Exercise and Weight Lifting

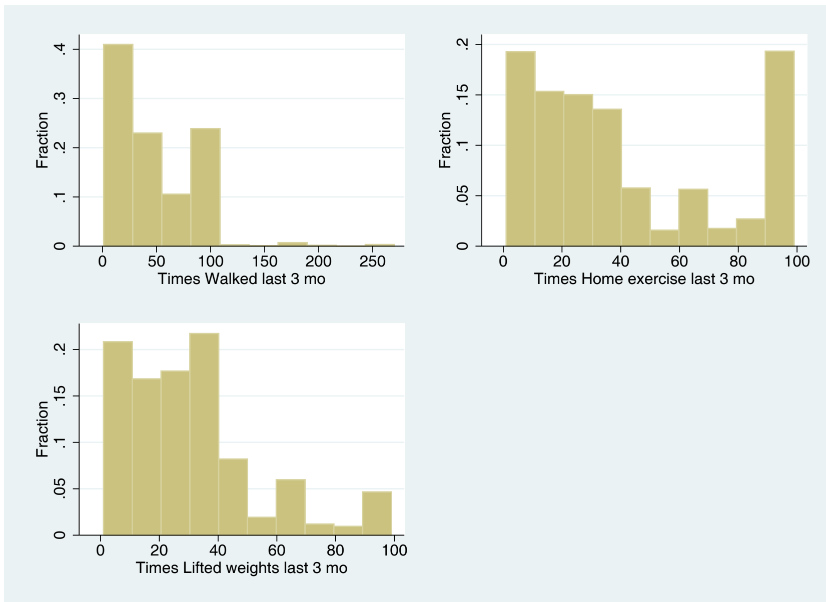
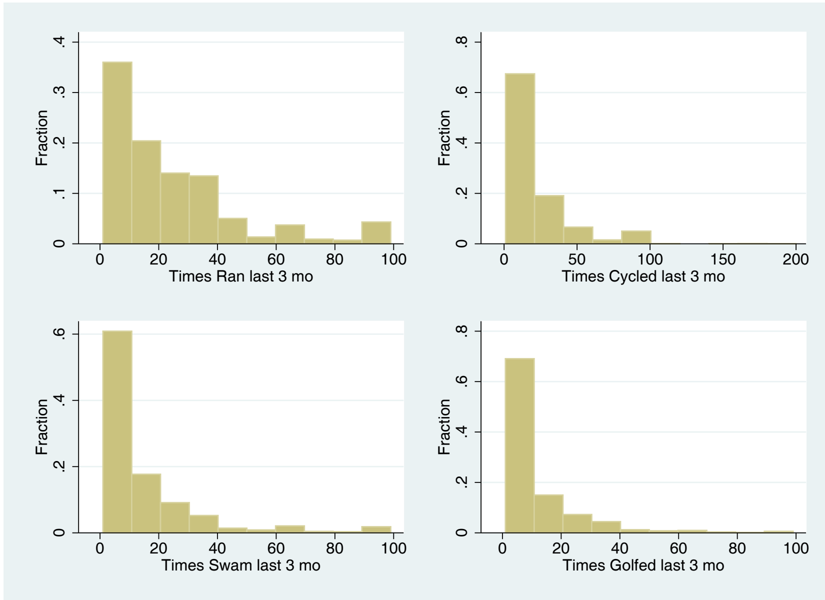


Table 3 summarizes the sample means of the economic and demographic characteristics of participants in each of the seven activities. The final column contains averages for the entire sample for comparison. We include age, gender, marital status, education, hourly wage, household income categories, and the presence of children under age 12 in the household as covariates in our statistical models. Both personal and household income are reported in ranges in the CCHS. The ranges in the survey are less than \$15,000, between \$15,000 and \$30,000, between \$30,000 and \$50,000, between \$50,000 and \$80,000 and greater than \$80,000. Following Ruhm (2005), the level of income for each individual is coded as the midpoint of the range reported, or 150% of the unbounded top range. We use personal income and hours worked per week to construct a wage variable that we use as a proxy for the opportunity cost of time.

Walkers, swimmers and home exercisers contain more females and cyclists, golfers, weight lifters and runners contain more males. Participants tend to be younger than the general population. Runners and weight lifters are the youngest groups of participants, and home exercisers the oldest. The percentage of individuals with a college degree in all of the sports and physical activities is higher than that of the general population. Similarly, individuals in white collar jobs (reported occupation "management," "professional," "technical," or "administrative") comprise a larger proportion of participants in physical activities than in the general population. Self reported physical health of

Figure 3: Frequency Distribution for Running, Cycling, Swimming and Golf



participants was better than the general population, based on a likert scale physical health measure with "excellent" equal to 5 and "poor" equal to 0. The reported personal and household incomes are above the sample average for all activities. Employment rates among participants is higher than the general population. The hourly wage of participants in all activities is higher than overall sample average hourly wage.

4.3 Econometric Methods

Table 2 shows that 82% of the individuals in the sample report participating in physical activity in the previous three months. Of the 99,322 individuals in our sample, 81,552 were physically active in the previous three months and 17,770 were not. Both the indicator variable for participation in physical activity and sport and the variable for the amount of time spent in physical activity in the previous month contain a large number of zeros. Our econometric analysis of participation in sport must account for the large number of zeros observed in the data.

We assume that the zeros present in the data represent "genuine zeros" in the taxonomy developed by Jones (2000), meaning that the observed non-participation in physical activity in this sample is the result of the utility maximizing choices, as described in our theoretical model, of sampled individuals. The alternative explanation for the zeros is non-observable response that would take place if the time period mentioned in the survey instrument was so short that some individuals would not participate in the economic activity. We assume that the three month time

Table 3: Summary Statistics on Participants

Variable	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners	Overall
% Male	40.61%	38.68%	54.74%	43.88%	68.21%	56.76%	57.55%	46.16%
Age	49.4	47.6	41.9	42.0	44.7	38.0	36.4	50.1
% Married	59.94%	58.87%	62.06%	64.82%	67.28%	54.86%	57.50%	59.94%
% HS Graduate	18.02%	17.78%	17.12%	18.32%	19.98%	17.01%	16.30%	18.07%
% College Graduate	49.87%	54.83%	59.35%	61.08%	60.87%	65.00%	65.78%	46.32%
% Employed	61.93%	65.36%	80.12%	78.16%	81.01%	87.92%	90.17%	56.86%
% in "White Collar" Jobs	34.26%	38.22%	44.28%	44.66%	46.71%	52.36%	53.70%	30.76%
Hours Worked	40.0	40.0	41.1	40.8	44.2	42.2	42.2	41.0
Personal Income (000s)	32.582	34.145	40.007	38.895	48.606	44.639	45.140	32.002
Household Income (000s)	53.114	53.302	56.455	56.069	54.147	54.285	52.929	52.488
Hourly Wage	14.2	15.3	19.0	18.4	20.9	21.2	21.7	12.7
% Young Children	23.4%	24.7%	33.3%	38.8%	25.9%	28.1%	33.0%	23.3%
Self Reported Health Status	2.66	2.73	2.95	2.92	2.94	3.10	3.19	2.57

Notes: % Young Children: children under age 12 in household
Self reported health status: 0= poor; 5=excellent
Hourly wage for employed persons only.

period referred to in the survey instrument is long enough to avoid the non-observable response problem.

Both Jones (2000) and Amemiya (1984) discuss the appropriate econometric techniques for dealing with zeros that are the result of utility maximizing decisions in survey data. In the terminology used by Jones, "genuine zeros" call for either a two-part model, when the participation and intensity decisions are independent, or a hurdle model when they are related. In the terminology used by Amemiya (1984) these are called Tobit Type I and Tobit Type II models. Define two latent variables y^*_{1i} representing (unobserved) utility from participation in physical activity and y^*_{2i} representing (unobserved) utility from time spent in physical activity. These latent variables can be interpreted as capturing the utility generated by participating in physical activity and time spent in physical activity defined by the utility function, equation (1) above. Formally, the expressions for these latent variables are

$$\begin{aligned} y^*_{1i} &= x'_{1i}\beta_1 + u_1 \\ y^*_{2i} &= x'_{2i}\beta_2 + u_2 \\ y_{2i} &= y^*_{2i} && \text{if } y^*_{1i} > 0 \\ y_{2i} &= 0 && \text{if } y^*_{1i} \leq 0 \end{aligned} \tag{7}$$

where (u_{1i}, u_{2i}) are both realizations from an independent and identically distributed, mean zero, constant variance bivariate normal distribution. The variance of these two random variables are σ_1^2 and σ_2^2 and the covariance between them is σ_{12}. By assumption, only the sign of y_{1i}^* is observed. y_{2i}^* is only observed when y_{1i}^* is positive. Also, variables in x_{1i} are observed for all i but variables in x_{2i} may not be observed when the utility of participation is negative ($y_{1i}^* \leq 0$.) Based on this latent variable representation, define an indicator variable (w_{1i}) for participation in physical activity

$$\begin{aligned} w_{1i} &= 1 \quad \text{if } y_{1i}^* > 0 \\ w_{1i} &= 0 \quad \text{if } y_{1i}^* \leq 0. \end{aligned} \tag{8}$$

In this case, the key observed variables in the sample are pairs (w_{1i}, y_{2i}) of the indicator variable for participation in physical activity and the time spent in physical activity, along with the vectors of covariates x_{1i}' and x_{2i}' The likelihood function for these two latent variables can be written

$$L = \prod_0 P(y_{1i}^* \leq 0) \prod_1 f(y_{2i}|y_{1i}^* > 0) P(y_{1i}^* > 0) \tag{9}$$

where $f(\cdot|y_{1i}^* > 0)$ is the conditional density of y_{1i}^* given that the utility from participation is positive ($y_{1i}^* > 0$.) The subscript 0 on the product operator refers to non-participants and the subscript 1 refers to participants. Note that this likelihood function can also be written

$$L = \prod_0 P(y_{1i}^* \leq 0) \prod_1 P(y_{1i}^* > 0) \times \prod_1 f(y_{2i}|y_{1i}^* > 0). \tag{10}$$

The first term on the right hand side of equation (10) is the Probit model for participation. The second term on the right hand side of equation (10) is the conditional density of the utility from consumption, given that the utility from participation is positive for the observations where positive consumption is observed. Amemiya (1984) shows that, using the definition of a conditional density function, this likelihood function can be re-written

$$L = \prod_0 \left[1 - \Phi\left(\frac{x_i'\beta_1}{\sigma_1}\right)\right] \times \prod_1 \Phi\left[\frac{\left(\frac{x_{1i}'\beta_1}{\sigma_1} + \frac{\sigma_{12}}{\sigma_1\sigma_2}(y_{2i} - x_{2i}'\beta_2)\right)}{\left(\sqrt{1 - \frac{\sigma_{12}^2}{\sigma_1^2\sigma_2^2}}\right)}\right] \frac{1}{\sigma_2}\phi\left(\frac{y_{2i} - x_{2i}'\beta_2}{\sigma_2}\right). \tag{11}$$

This is the "full double hurdle model" derived by Jones (1992) that includes correlation between the equation error terms (u_{1i}, u_{2i}). Assuming no correlation between u_{1i} and u_{2i} so that ($\sigma_{12} = 0$), this likelihood function can be written

$$L = \prod_0 \left[1 - \Phi\left(\frac{x_i'\beta_1}{\sigma_1}\right)\right] \prod_1 \Phi\left[\frac{x_{1i}'\beta_1}{\sigma_1}\right] \frac{1}{\sigma_2}\phi\left(\frac{y_{2i} - x_{2i}'\beta_2}{\sigma_2}\right) \tag{12}$$

where the first two terms on the right hand side are the Probit model for participation and the third term is a truncated normal regression model. This is commonly called the Cragg model in the literature and was first developed by Cragg (1971).

All three of these models can be applied to data that contain zeros generated by corner solutions in a utility maximizing model, and their parameters estimated by maximum likelihood. The "full double hurdle model," equation (11), allows for factors that affect participation and factors that affect time spent to have different signs and for correlation in the equation error terms, meaning that the unobservable factors affecting participation and time spent in physical activity can be correlated. The Cragg model allows for factors that affect participation and factors that affect time spent to have different signs but assumes independence of the error terms.

5 Results and Discussion

We first estimate the parameters the full double hurdle model, equation (11), assuming that the equation error terms of the participation and time spent equations are correlated, using data from the CCHS. The parameters of this model can be estimated using a standard maximum likelihood approach under the assumption that the equation error terms are drawn from a normal distribution. We test the hypothesis of independent equation errors ($H_0 : \rho = 0$). The results of the Wald test indicate that the equation error terms of the participation and time spent equations are not correlated for running, home exercise, swimming and weight lifting. The double hurdle models for these activities are estimated assuming that the equation errors are independent. The estimation results for the seven physical activities and sports are shown on Table 4. The table contains parameter estimates and asymptotic z-statistics for a two-tailed test of the null hypothesis that the parameter is equal to zero.[3]

Estimation of double hurdle models typically requires exclusion restrictions to identify participation and separate this from the decision about how much time to spend participating conditional on the decision to participate. These restrictions require excluding one or more variables from the time spent equation. These variables must affect the participation decision and be uncorrelated with the equation error term in the time spent equation. No theoretical guidance exists to aid in the determination of exclusion restrictions. Researchers choice for exclusion restrictions are also limited by the survey instrument. We use two variables, an indicator variable for individuals who walk to work, and an indicator variable for individuals who reported that their health status improved

[3] We included province-specific effects in the models but do not report the results in Table 4 in the interest of space. The results are available from the authors upon request.

Table 4: Parameter Estimates and z-statistics - Participation Equation

Variable	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners
Participation Equation							
Age	0.0131***	0.0181***	0.0203***	0.0147*	-0.000584	0.00810*	-0.0149***
	(8.37)	(7.06)	(4.23)	(2.42)	(-0.29)	(2.21)	(-3.43)
Male	-0.532***	-0.731***	-0.874***	-0.768***	-0.0352	-0.386***	-0.401***
	(-12.89)	(-10.22)	(-6.57)	(-7.66)	(-0.60)	(-4.82)	(-3.40)
Married	-0.0121	0.0302	-0.064	-0.0386	0.425***	-0.167	0.177
	(-0.31)	(0.41)	(-0.51)	(-0.31)	(8.22)	(-1.80)	(1.56)
Wage	0.807	0.302***	0.347***	0.487***	0.544***	0.0807***	0.149***
	(0.88)	(8.68)	(8.41)	(3.35)	(4.19)	(8.72)	(7.31)
Household Income (000)	0.00067	0.0017	-0.000139	0.00362**	0.00453***	0.00223**	0.00245*
	(1.34)	(1.96)	(-0.14)	(3.27)	(6.76)	(3.28)	(2.5)
White Collar Job	-2.417***	-1.941***	-1.947***	-1.849***	-1.987***	-0.344**	-1.027***
	(-23.11)	(-12.43)	(-9.42)	(-11.09)	(-9.00)	(-2.92)	(-5.94)
Education - College	0.210***	0.477***	0.302**	0.444***	0.707***	0.190*	0.188
	(4.9)	(6.1)	(3.19)	(4.15)	(12.1)	(2.21)	(1.72)
Education - High School	-0.0141	0.216*	0.147	0.301*	0.501***	-0.025	0.0172
	(-0.28)	(2.31)	(1.27)	(2.5)	(7.15)	(-0.25)	(0.13)
Young Children	-0.0802	-0.0661	-0.109	0.0216	-0.464***	-0.188*	-0.228*
	(-1.36)	(-0.65)	(-0.97)	(0.19)	(-4.75)	(-2.42)	(-2.13)
Improvement in Health Status	0.560***	0.820***	0.370**	0.418***	0.0182	0.935***	0.460***
	(8.74)	(7.1)	(3.1)	(3.49)	(0.26)	(10.59)	(4.03)
Walk to Work	4.040***	4.454	2.775***	1.892***	0.609***	0.678***	1.335***
	(5.2)	(1.06)	(6.06)	(4.92)	(11.77)	(9.43)	(9.84)
Time Spent Equation							
Age	1.780**	-9.357***	-30.20***	-17.18***	0.52	-68.93***	-50.03***
	(2.67)	(-14.58)	(-36.22)	(-20.27)	(0.54)	(-34.56)	(-29.56)
Male	-441.7***	-261.9***	553.7***	-99.05***	929.0***	831.2***	505.6***
	(-25.08)	(-14.44)	(27.26)	(-6.54)	(39.31)	(17.43)	(17.43)
Married	-4.269	-93.37***	-65.22**	56.38**	165.6***	-261.9***	-118.7***
	(-0.23)	(-4.98)	(-2.99)	(3.18)	(6.69)	(-5.10)	(-3.62)
Wage	-1.655***	-0.0443	3.418***	2.229***	2.827***	1.185	3.465***
	(-3.57)	(-0.10)	(6.99)	(5.68)	(5.85)	(1.27)	(4.97)
Household Income (000)	-0.663***	-0.725***	-0.25	-0.278	-1.855***	-2.561***	-2.787***
	(-3.42)	(-3.72)	(-1.18)	(-1.58)	(-8.40)	(-6.36)	(-10.15)
White Collar Job	5.638	110.2***	181.6***	56.70***	241.2***	391.2***	401.8***
	(0.28)	(5.29)	(8.12)	(3.38)	(10.29)	(8.07)	(13.66)
Education - College	216.4***	294.4***	270.8***	355.0***	361.7***	513.9***	408.4***
	(10.29)	(13.41)	(10.83)	(15.17)	(12.44)	(8.52)	(10.78)
Education - High School	132.7***	107.4***	55.25	177.1***	336.2***	250.2***	80
	(5.2)	(4.04)	(1.82)	(6.78)	(9.86)	(3.52)	(1.77)
Young Children	-294.2***	-119.1***	82.36***	323.5***	-231.9***	-375.8***	-114.6***
	(-13.05)	(-5.24)	(3.43)	(17.88)	(-8.67)	(-7.49)	(-3.65)
Participants	62,080	21,717	16,211	16,108	10,558	8,923	7,748
Log likelihood	-596497.6	-222800.9	-168473.6	-162617.9	-112042.7	-98010.5	-82862.6
ρ	-0.08	0.029	0.216	0.045	0.0491	0.028	-0.023
Wald Test	15.84***	0.38	16.91***	0.94	174.02***	0.23	0.1

Time spent: exercise minutes last three months

Participation: Indicator variable for participation in sport or physical activity

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

significantly or somewhat significantly over the past year, to identify the participation decision. Walking to work and experiencing improved health should both affect the decision to participate, but may not affect the decision about how long to participate in physical activity.[4]

The model identifies two economic factors, income and the opportunity cost of time as measured by hourly wage, identified in the theoretical analysis as important determinants of participation and time spent in physical activity. We begin our discussion of our empirical findings with respect to the three testable implications about changes income and the opportunity cost of time from the theoretical model:

- Testable Implication 1: $\partial a/\partial y > 0$ if $U_{za} = 0$. In words, the effect of a change in income on participation is positive if the marginal utility from participating in sport does not affect the marginal utility from other activities.
- Testable Implication 2: $\partial t/\partial y > 0$ if $U_{zt} = 0$. In words, the effect of a change in income on the optimal amount of time spent participating in sport is positive if the marginal utility of time spent participating in sport does not affect the marginal utility from other activities.
- Testable Implication 3: The effect of a change in the opportunity cost of time on both participation and time spent in sport is positive if the income effect dominates the substitution effect or negative if the substitution effect dominates the income effect. Formally, we have: $\partial a/\partial w > 0$ and $\partial t/\partial w > 0$ if the income effect of the change in the opportunity cost of time dominates the substitution effect. Similarly $\partial a/\partial w < 0$ and $\partial t/\partial w < 0$ if the substitution effect of the change in the opportunity cost of time dominates the income effect.

We then turn our attention to our empirical findings about the effect of individual characteristics like age, gender, education and family structure on participation and time spent in sports and physical activity.

5.1 Effect of Income on Participation and Time Spent

Our findings with respect to the effect of income on participation and time spent are mixed. Table 5 shows that the parameter estimates on income are mainly positive and significant in the participation equation but are mainly negative and significant in the time spent equation. We find that individuals with higher income are likely to participate in swimming, golfing, weight lifting and

[4] We estimated the double hurdle models using only improvement in health status as an exclusion restriction and achieved convergence with qualitatively similar results. The regression output for these models is available from the authors upon request.

running but income does not affect decisions about walking, home exercise or cycling. A different story emerges when evaluating the effect of income on time spent. Time spent walking, exercising at home, golfing, weight lifting and running decreases with income but income does not affect time spent cycling and swimming. Regardless of activity, the magnitude of the effect of income on time spent is not large.

Table 5: Income - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
Equation	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners
Participation	0.001	0.002	-0.0001	0.004**	0.005***	0.002**	0.002*
	(1.34)	(1.96)	(-0.14)	(3.27)	(6.76)	(3.28)	(2.5)
Time Spent	-0.663***	-0.725***	-0.25	-0.278	-1.855***	-2.561***	-2.787***
	(-3.42)	(-3.72)	(-1.18)	(-1.58)	(-8.40)	(-6.36)	(-10.15)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Our findings with respect to the effect of income on participation and time spent highlight the importance of recognizing that decisions about participation in sports and physical activity are made on two margins: the extensive margin of participation (Should I participate?); and the intensive margin of duration (How much time should I spend participating?). The empirical results indicate that the effect of a change in income on participation ($\partial a/\partial y$) is positive but negative on the optimal time spent ($\partial t/\partial y$). This finding is important for informing policy because it suggests that consumers will respond differently to economic incentives to be physically active depending on whether the extensive or intensive margin is targeted by the incentive.

5.2 Effect of Opportunity Cost of Time on Participation and Time Spent

Table 6 isolates the results for the hourly wage which is a measure of the opportunity cost of time. Recall from the model that the effect of a change in the opportunity cost of time on both participation in and duration of sports activity has an income and substitution effect. A higher opportunity cost of time makes non-work related activities more costly and reduces the amount of time spent participating in those activities; therefore, decreasing time spent participating in physical activities as the hourly wage increases indicates that the substitution effect dominates the income effect. Conversely, a positive relationship between hourly wage and time spent in physical activity is suggestive of a dominating income effect. Participation in sports entails at least some monetary costs and people with higher incomes have greater financial means to participate.

Table 6: Hourly Wage - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
Equation	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners
Participation	0.807	0.302***	0.347***	0.487***	0.544***	0.0807***	0.149***
	(0.88)	(8.68)	(8.41)	(3.35)	(4.19)	(8.72)	(7.31)
Time Spent	-1.655***	-0.0443	3.418***	2.229***	2.827***	1.185	3.465***
	(-3.57)	(-0.10)	(6.99)	(5.68)	(5.85)	(1.27)	(4.97)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

The hourly wage is generally positive and significant in both the participation and time spent equations suggesting a dominating income effect. The effect of a change hourly wage on time spent differs depending on the activity. It is positive and significant for cycling, swimming, golfing, and running; negative and significant for walking; and insignificant for home exercise and weight lifting. Regardless of sign and significance, the effect of a change in the hourly wage on time spent is small.

It is possible that some of the effect of the opportunity cost of time on the participation and time spent decisions is reflected in the education and white collar job variables. A positive relationship between income and education has been widely documented in the economics literature. Evidence shows that more educated people tend to have higher paying (and probably white collar) jobs and higher hourly wages and, therefore, higher opportunity costs of time. The results for the effects of occupation (measured as being in a white collar job) and education on participation and time spent are shown on Table 7.

We allow education to have a nonlinear effect on participation and time spent in sport by including two indicator variables. *Education - College* is an indicator variable that is equal to one if the individual completed college and zero otherwise and *Education - High School* is an indicator variable that is equal to one if the individual graduated from high school and zero otherwise. Graduating from college has a strong positive effect on the participation decision across all activities except running. People in white collar jobs are less likely to participate in all of the activities. Completing high school is not an important factor in explaining the participation decision. Conditional on participation, occupation and education have mainly strong positive effects on time spent. People with white collar jobs spend between 4.7 and 33.5 minutes more per week engaged in sport and physical activity than people in other types of jobs. People with a high school or college

Table 7: Occupation and Education - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
Equation	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners
Participation							
White Collar Job	-2.417***	-1.941***	-1.947***	-1.849***	-1.987***	-0.344**	-1.027***
	(-23.11)	(-12.43)	(-9.42)	(-11.09)	(-9.00)	(-2.92)	(-5.94)
Education - College	0.210***	0.477***	0.302**	0.444***	0.707***	0.190*	0.188
	(4.9)	(6.1)	(3.19)	(4.15)	(12.1)	(2.21)	(1.72)
Education - High School	-0.0141	0.216*	0.147	0.301*	0.501***	-0.025	0.0172
	(-0.28)	(2.31)	(1.27)	(2.5)	(7.15)	(-0.25)	(0.13)
Time Spent							
White Collar Job	5.638	110.2***	181.6***	56.70***	241.2***	391.2***	401.8***
	(0.28)	(5.29)	(8.12)	(3.38)	(10.29)	(8.07)	(13.66)
Education - College	216.4***	294.4***	270.8***	355.0***	361.7***	513.9***	408.4***
	(10.29)	(13.41)	(10.83)	(15.17)	(12.44)	(8.52)	(10.78)
Education - High School	132.7***	107.4***	55.25	177.1***	336.2***	250.2***	80
	(5.2)	(4.04)	(1.82)	(6.78)	(9.86)	(3.52)	(1.77)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

education spend between 9 and 43 minutes more per week playing sports on being physically active than people with less than a high school education. If occupation and education are picking up an opportunity cost of time effect, then these results, together with the hourly wage results, provide further evidence of a dominating income effect.

5.3 Effect of Individual Characteristics and Family Structure on Participation and Time Spent

We examine the influence of age, gender, marital status, and the presence of young children in the household on sport and physical activity. Table 8 presents the effects of age on participation and time spent.

The effect of age on participation differs across sports and physical activities, but conditional on participation, time spent tends to decline with age. The decrease in time spent varies across the sports and physical activities ranging from a decrease of 9 minutes over three months for home exercisers to 69 minutes for weight lifters. In the participation equation, older people are more likely

Table 8: Age - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
		Home				Weight	
Equation	Walkers	Exercisers	Cyclists	Swimmers	Golfers	Lifters	Runners
Participation	0.0131***	0.0181***	0.0203***	0.0147*	-0.000584	0.00810*	-0.0149***
	(8.37)	(7.06)	(4.23)	(2.42)	(-0.29)	(2.21)	(-3.43)
Time Spent	1.780**	-9.357***	-30.20***	-17.18***	0.52	-68.93***	-50.03***
	(2.67)	(-14.58)	(-36.22)	(-20.27)	(0.54)	(-34.56)	(-29.56)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

to walk, exercise at home, swim and cycle and lift weights but are less likely to run. Golfers are different in that age does not affect either the participation or time spent decisions. These results further highlight the importance of distinguishing between the extensive and intensive margins when evaluating the effect of age on being physically active. Most cross-sectional studies that examine the effect of age on only the time spent in physical activity find a negative relationship between age and participation. Treating the decision as a two-part decision suggests that the mechanisms underlying the relationship between age and physical activity are complex.

Table 9: Gender - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
		Home				Weight	
Equation	Walkers	Exercisers	Cyclists	Swimmers	Golfers	Lifters	Runners
Participation	-0.532***	-0.731***	-0.874***	-0.768***	-0.0352	-0.386***	-0.401***
	(-12.89)	(-10.22)	(-6.57)	(-7.66)	(-0.60)	(-4.82)	(-3.40)
Time Spent	-441.7***	-261.9***	553.7***	-99.05***	929.0***	831.2***	505.6***
	(-25.08)	(-14.44)	(27.26)	(-6.54)	(39.31)	(17.43)	(17.43)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Table 9 shows the relationship between gender and physical activity. Distinguishing between decisions on the extensive and intensive margins furthers our understanding of the mechanism underlying the effect of gender on physical activity. A positive association between being male and physical activity has been found in many studies. Our results indicate that the effect of gender on physical activity behavior is more complex than men simply being more physically active than woman. On the extensive margin, we find that women are more likely to participate in all of the sports and physical activities except for golf. The positive association between being male and physical activity occurs on the intensive margin, but only for some sports and activities. Women spend more time walking, exercising at home and swimming than men. Men spend more time cycling, golfing, lifting weights and running. These results are largely consistent with the results in Humphreys and Ruseski (2007). They find that males are more likely to participate in activities that take more time like group sports and outdoor recreation activities whereas females are more likely to engage in less time consuming activities.

The effect of family structure, measured by marital status and the presence of young children in the household on sport participation and physical activity are presented in Table 10.

Table 10: Marital Status and Young Children - Parameter Estimates and z-statistics

	Parameter Estimates and z-statistics						
Equation	Walkers	Home Exercisers	Cyclists	Swimmers	Golfers	Weight Lifters	Runners
Participation							
Married	-0.0121	0.0302	-0.064	-0.0386	0.425***	-0.167	0.177
	(-0.31)	(0.41)	(-0.51)	(-0.31)	(8.22)	(-1.80)	(1.56)
Young Children	-0.0802	-0.0661	-0.109	0.0216	-0.464***	-0.188*	-0.228*
	(-1.36)	(-0.65)	(-0.97)	(0.19)	(-4.75)	(-2.42)	(-2.13)
Time Spent							
Married	-4.269	-93.37***	-65.22**	56.38**	165.6***	-261.9***	-118.7***
	(-0.23)	(-4.98)	(-2.99)	(3.18)	(6.69)	(-5.10)	(-3.62)
Young Children	-294.2***	-119.1***	82.36***	323.5***	-231.9***	-375.8***	-114.6***
	(-13.05)	(-5.24)	(3.43)	(17.88)	(-8.67)	(-7.49)	(-3.65)

Participation: Indicator variable for participation in sport or physical activity

Time Spent: exercise minutes past 3 months

$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

The effect of being married and having young children in the household suggest that family structure plays an important role in decisions about sport participation and physical activity, particularly on the intensive margin. Again, golfers appear to be different. Married people are more likely to play golf and spend more time playing than single people. Otherwise, marriage does not affect the participation decision. Marriage does play a role in the time spent decision. Married people spend less time in home exercise, cycling, lifting weights and running but more time swimming and golfing than single people.

The effect of having young children in the household varies across sports and activities. We do not find a relationship between having young children and participation for walking, exercising at home, cycling or swimming but we find that people with young children are less likely to golf, lift weights and run. Conditional on participation, people with young children spend more time cycling and swimming but less time in the other activities. These results indicate that married couples and households with young children have different demands on their time and different opportunity costs of time than unmarried and childless people. The increase in time spent in cycling and swimming when there are young children in the house is not surprising since these are common activities for families to do together.

6 Summary and Policy Implications

This research examines participation and time spent in seven common sports and physical activities: walking, home exercise, cycling, swimming, golfing, weight lifting, and running by empirically examining testable implications from our consumer choice model. A number of interesting conclusions emerge from the analysis. Our findings about the effect of income on participation and time spent are mixed. Income does not have an effect on participation or time spent across all activities. However, patterns do emerge among the statistically significant variables. When significant, people with higher income are more likely to participate but, conditional on participation, spend less time. Using the wage rate as a proxy of the opportunity cost of time, we find some evidence that the income effect dominates the substitution effect as the opportunity cost of time increases.

With respect to the income, age and gender variables, we find it is important to recognize that decisions about participation in sports and physical activity are made on two different margins: the participation (extensive) margin and the time spent (intensive) margin. Cross-sectional studies that are based on single equation models consistently find a positive relationship between income and participation; that older people spend less time engaged in physical activity and the males are more likely to participate than females. Our results are consistent with these results but the new insight here is establishing where the link is occurring. In the case of income, we find that people with higher income are more likely to choose to participate in sport and physical activity (the extensive margin) but, conditional on participation, devote less time participating (the intensive margin). The positive relationship between income and physical activity is occurring in the participation decision rather than the time spent equation. Similarly, we find that the effect of age on participation differs across sports and physical activities, but that time spent declines with age suggesting that the well documented negative relationship between age and participation is occurring the time spent, rather than the participation equation. These results suggest that programs aimed at increasing participation in older populations and encouraging continued participation over the life cycle might be particularly effective. Finally, we find that, with the exception of golf, women are more likely to participate in all of the sports and physical activities but that the effect of gender on time spent differs across sports.

Distinguishing between the extensive and intensive margins is also important in examining the effect of family structure on participation and time spent decisions. We find that, with the exception of golf, marriage does not affect the participation decision. Being married does have an effect on the amount of time spent but the effect differs across activities. Married people spend less time in home exercise, cycling, lifting weights and running but spend more time swimming and playing golf than single people. The effect of having young children on participation and time spent is also complex. We find that people with young children are less likely to play golf, lift weights and run; however, conditional on participation, people with young children more time participating in family oriented activities like riding bikes and swimming. These results provide further evidence that policy interventions designed to target these sub-populations are likely to be more effective than a "one size fits all" policy.

While our analysis makes progress towards understanding the complexity of sport and physical activity participation decisions, it has the potential to be extended in many ways. One clear extension is to analyze other activities, like team sports, captured in the CCHS. Another extension is to link the CCHS data with supply side measures to permit examination of the effect of opportunities to participate in sport on participation decisions.

The decision to participate in sport can also be explicitly linked to linked to economic outcomes like employment and earnings. Previous research by Long and Caudill (1991), Barron, et al. (2000), and Eide and Ronan (2001) and Lechner (2009) show a clear link between participation in physical activity and sport and labor market outcomes and lieftime earnings. This suggests an important link between participation in sport and human capital and labor productivity. Much of the previous literature focused on participation in team sports in secondary schools and college. The importance of age in explaining observed participation and time spent in the sports examined here suggest that a closer look at the relationship between this type of activity and labor market outcomes warrants additional attention.

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