Income and Health Choices: Physical Activity Evidence from China

Xiaowen Hu, University of Kentucky

C. Jill Stowe, University of Kentucky

Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas, February 6-9, 2016

Abstract: This paper investigates the relationship between household income level and individual physical activity participation behavior. We investigate this issue through the lens of time preference. Our model considers income as a budget constraint of today as well as a component of future utility, and those with lower income discount future utility more heavily. Data from China Health and Nutrition Survey (CHNS) are tested utilizing a random effects method. The results show that both the likelihood to participate in physical activity and the time spent on physical activity are positively correlated with income. In general, these findings support the hypothesis that low-income individuals are more likely to make poor choices with regard to future health, since they discount future utility relatively heavily.
Key words: health choices, income, physical activity participation, time preference.

Introduction

The overall health of the population depends on many health behaviors including smoking, alcohol consumption, diet and physical activity. The field of agricultural economics has examined these behaviors, investigating how consumers make choices related to their health. One important determinant of health-related choices is household income: a low-income household might not be able to afford healthy goods, which is usually more expensive. However, low-income individuals are less likely to participate in physical activity either, which is health-beneficial and non-costly; this should not attribute to a budget consideration. One explanation for the finding is related to the idea of time preference. Briefly, the benefit of future good health appears to be valued less by those with low income, and hence they discount their future health more heavily.

In the view of neoclassical economics, rational consumers choose between consumption and leisure to maximize their utility function subject to budget and time constraints. Becker (1965) develops a model assuming that households combine time and market goods to produce commodities that increase their utility. Subsequently, Becker and Murphy (1988) state that the demand for addictive goods can also be analyzed by the same demand theory as for any other commodity. They present a consumer choice model of rational addiction and time preference, proposing that people weigh the total costs and benefits of an addictive behavior and make consumption decisions to maximize their lifetime aggregate utility. According to their theory, people determine their optimal consumption of goods based on their utility function; current prices and income; expected prices and income; initial stock of consumption capital; depreciation rate of consumption capital; and their time preference rate. The full cost of current consumption includes possible negative consequences occurring at later period of life, but, with heavy discounting, these negative consequences are valued less. Thus, people with high preferences for the present are more likely to initiate addiction. The authors make important assumptions about consumer time preferences: time preferences are stable; a stronger time preference, which means discounting future utility more heavily, is a contributory cause to addiction.

Physical activity insufficiency, for example, can be seen as one kind of additive good. People sacrifice exercising time for non-exercising leisure activities which provide more pleasure at current period; however, physical activity insufficiency brings harmful effects on human health in the next period and undermines future utility. The time preference model implies that when faced with a trade-off between long-term health and an immediate pleasure that might cause the detriment of their health, consumers who discount the future more tend to select immediate pleasure, even though rationality suggests that individuals are planning to maximize utility over their entire life span. Higher income increases the future cost of being physical inactive, since its negative effects on health would cause a greater loss in future income and thus lifetime income.

Becker and Murphy’s time preference theory has great influence on consumption study in the past decades. A most comprehensive empirical analysis of economic determinants on physical activity participation based on their theory attributes to Humphreys and Ruseski in 2006. Their study employs recreation and leisure demand models to investigate the relationship between physical activity and economic factors like income. The model generates prediction that the effect of income on participation decision and the effect on the amount of time spent on physical activity may work in opposite directions. Results from empirical analysis on

BRFSS (Behavioral Risk Factor Surveillance System) data support the prediction that the likelihood of participation increases with income, but time spent on physical activity declines with income.

In accordance with Humphreys and Ruseski, a statistical investigation on England population utilizing random-effects probit models indicates that household income has a positive and significant effect on physical activity participation (Farrell & Shields, 2002). Another study in Spain leads to a result that gender difference exists in the determinants of physical activity participation. Non-labor income barriers females to participate in physical activity; nonetheless, this effect is not significant for males. Overall, a majority of available literature shows consistent results that physical activity participation is positively related to household income (Anokye et al., 2012; Breuer & Wicker, 2008; Farrell & Shields, 2002; Garcia et al., 2011; Meltzer & Jena, 2010).

Studies on other socioeconomic characteristics such as education and employment, which usually positively related to income, is another area of interest. A higher level of education may imply better perception of the health benefits from an adequate amount of physical activity. Therefore, a positive relationship between education and physical activity participation is shown (Downward & Riordan, 2007; Humphreys & Ruseski, 2007). However, employment status seems to be negatively associated with the amount of time that individual spends on physical activity (Farrell & Shields, 2002), probably because the occupational time limits the leisure time to spend on sports and exercise.

Other than the subtle co-function of income, education and employment, the effects of age and gender on physical activity participation are widely discussed in economic literature. Most of the studies agree that the probability of sports participation decreases with age (Breuer & Wicker, 2008; Downward, 2007; Downward & Riordan, 2007; Farrell & Shields, 2002; Humphreys & Ruseski, 2006; Meltzer & Jena, 2010). Males are always more likely to participate in exercise or sports and spend more time on it than females (Farrell & Shields, 2002; Humphreys & Ruseski, 2006, 2007; Meltzer & Jena, 2010). Other health related behavior might also affect the choice of physical activity participation. Interestingly, alcohol consumption tends to increase participation; while cigarette consumption shows a negative relationship with it (Farrell & Shields, 2002). People consistently choose their lifestyle to be healthy - drink moderately, exercise more, or unhealthy - smoke a lot and exercise little. Race, household profile (household size, children presence, etc.), marital status, physical and mental health status are some more factors that widely considered in empirical investigation; however, the discussion is controversial and no common results have been reached.

Although previous research has provided different perspective on economic determinants of participation and time spent on physical activity, there is still considerable space for improvement. One clear extension is to link the effect of income with the concept of time preference in theoretical model. This allows us to interpret the income influence in a different way: in addition to function as a budget constraint, income implies a rational expectation for future life, which affects physical activity decision potentially. Secondly, while studies on physical activity are more often conducted in Europe and in developed countries, we will carry empirical investigation on China population.

This paper investigates the relationship between household income level and individual consumption choice on a health-beneficial and non-costly good, leisure-time physical activity. We expect that physical activity participation correlate with income positively. Our study focuses on leisure-time physical activity choice of more than 17,000 individuals who are interviewed from 1997 to 2011. It aims to provide a descriptive comparison along with explanatory models of physical activity participation among the population according to annual household income, age, educational background, marital status, with the emphasis on the first factor. The latter part of analysis employs random effects models and the empirical study shows consistent results with theoretical predictions. Ambiguities from previous research are resolved to some extent.

The first section below presents a theoretical model that can be used to generate specific hypotheses. Then section 2 describes the data used and section 3 presents the empirical methodology. Section 4 reports the empirical results and provides brief discussion. Finally, section 5 makes a conclusion including research limitations and policy remarks.

Theoretical Model

According to Becker's theory, individuals see their lifetime utility as the aggregation of two periods: the utility of current period and the expected utility of future period. They make consumption decisions to maximize their lifetime aggregate utility as equation (1).

$$U = U_0(c_0(I_0), s_0(t_0)) + \beta_0(I_0) f(s_0) U_1\big(g(I_0)\big) \qquad (1)$$

The first part of the equation represents the utility of current period. The current utility U_0 is determined by the consumption of ordinary goods c_0, which provides utility without having any potential health effects, as well as consumption of s_0 that contains positive or negative health consequence, such as cigarettes, alcohol and physical activity. c_0 subjects to an income budget I_0 with $c_0'(I_0) > 0$. We assume that physical activity does not involve monetary cost, so s_0 only subjects to a time budget t_0 and $s_0{}'(t_0) > 0$.

Utility U_0 increases with ordinary goods consumption, so $U_{0,c}{}' > 0$. We assume that s_0 causes current disutility, $U_{0,s}{}' < 0$. This assumption is intuitive because if it benefits both current utility and future health at no monetary cost, a rational person will definitely choose to make consumption on it and we have no need to discuss this.

The second component of equation (1) represents the current value of expected future utility. U_1 is future utility function. β_0 is the discount factor at current period in which consumption decision is made. The term of β_0 is assumed to increase with income level I_0. A smaller β_0 suggests a heavier discounting of future utility, and consequently a stronger current time preference; and vice versa.

Assume s_0 culminates in a long-run positive health effect, the utility in future period will be further affected by an additional term $f(s_0)$, which measures how the chosen level of s_0 in current period encourages health and utility in the future period, with $f'(s_0) > 0$ and $f(0) = 1$. In this paper, we investigate how consumer decisions are made in the current period; we are not interested in how consumer decisions are made in future period. Therefore, the utility in future period could be modeled as depending solely on expected income, which is assumed to be a function of the income today, $U_1 = U_1(g(I_0))$. I_0 is today's income, and $g'(I_0) > 0$.

We focus on the decision in the first period whether to consume s_0 or not. Incomes, prices, and preferences are assumed to be fixed within that period. We follow the model in Binkley (2010) to determine the optimal consumption level of s_0 by comparing the utilities with different quantities of consumption. Given $t_0^l < t_0$, the difference in lifetime utilities under two different consumption levels D can be expressed as equation (2).

$$D = \left[U_0(c_0(I_0), s_0(t_0)) + \beta_0(I_0) f(s_0(t_0)) U_1(g(I_0))\right]$$
$$- \left[U_0(c_0(I_0), s_0(t_0^l)) + \beta_0(I_0) f(s_0(t_0^l)) U_1(g(I_0))\right]$$
$$= \left[U_0(c_0(I_0), s_0(t_0)) - U_0(c_0(I_0), s_0(t_0^l))\right]$$
$$+ \beta_0(I_0) U_1(g(I_0)) \left[f(s_0(t_0)) - f(s_0(t_0^l))\right]$$
$$= D_0 + D_1 \qquad (2)$$

Equation (2) reconstructs the utility difference to be a current utility variation D_0 plus a variation of expected future utility D_1.

The expected utility gained in the future period D_1 attributes to higher level of consumption of s_0 in the current period. $\left[f(\mathrm{s}_0(t_0)) - f(\mathrm{s}_0(t_0^l))\right]$ has a positive sign because $f'(s_0) > 0$ and $\mathrm{s}_0'(t_0) > 0$. A higher I_0 implies both a higher $\beta_0(I_0)$ and a higher $g(I_0)$ and consequently a larger U_1, which means D_1 is increased with income I_0. Hence, the utility gained from more consumption of s_0 is larger for those with higher income. Now, the analysis of D_0 and the comparison between D_0 and D_1 become a key focus.

The utility change in current period consists of two components: the utility change due to the change of consumption on ordinary goods c_0, and the utility change coming from the change of consumption on s_0. Since we assume s_0 does not cause monetary cost, the different levels of $s_0(t_0)$ and $s_0(t_0^l)$ should not affect the ordinary goods consumption $c_0(I_0)$, so the utility change due to ordinary goods consumption change is zero. Remember we assume $s_0'(t_0^s) > 0$ and $U_{0,\mathrm{s}}' < 0$. Therefore, for $t_0^l < t_0$, we have $\mathrm{s}_0(t_0^l) < \mathrm{s}_0(t_0)$ and D_0 is negative. In conclusion, a higher consumption of s_0 results in utility loss in current period.

In all, with a higher level of consumption $s_0(t_0)$ that has a positive health consequence, D_1 is a positive term and increases with income while D_0 is negative and doesn't change with income. Hence, with a higher income, the expected future utility benefit is more likely to compensate the utility loss in the current period, and the lifetime aggregate utility increases.

Conclusively, our model predicts that the consumption of healthy and non-costly goods increases with income, because higher-income individuals value future health more. The example analyzed in this paper is the participation in physical activity in China.

Data

The data for this study comes from the China Health and Nutrition Survey (CHNS). CHNS is an international collaborative project led by the Carolina Population Center at the University of North Carolina at Chapel Hill investigating nutrition and health behaviors in China. It is a longitudinal study first launched in 1989 and followed in 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011. This project consists of different surveys such as household survey, child survey, adult survey and community survey; the questions regarding physical activity was first introduced in the Household Survey in 1997, became part of the Physical Examination in 2000, and was included in adult surveys in 2004 and the following years. Our study utilizes the data from 2004 to 2011, which is obtained from the longitudinal dataset released in 2015. The panel is unbalanced because not every individual is observed in every year; the minimum number of observation times for an individual is one and the maximum is four.

A random effects Logit model and two random effects models are estimated; the models will be described in the next section. The first model is a random effects

Logit model with the dependent variable representing whether the respondent participated in some level of leisure time physical activity or not in a typical day. The original survey includes an individual activity table recording all kinds of physical activities taken in leisure time for each respondent. Based on this, we create a new binary variable as the dependent variable to assess the participation choice; the new variable takes the value 1 if the response to either of those physical activities in that table is positive. In other words, participation in any physical activity is counted as participation in physical activity.

In the second step, two random effects models are estimated and the dependent variable is the logarithm of time spent on physical activity in a typical day during the week (Monday through Friday) and on weekends respectively. Again, according to the detailed information of leisure time physical activity from the individual activity table, by summing up the time that an individual spent on each physical activity, we have the total time spent on physical activity during a typical day; furthermore, we take the natural log of the time to have the dependent variable more closely follow a normal distribution. Our random effects Logit model has 17,765 observations with 12.0% of the observations reporting as having participated in physical activity. In the second step, we have 2,002 observations for time spent on physical activity in a typical day during the week and 2,006 for that on weekends, since respondents who did not participate in physical activity are truncated.

The analysis includes a broad set of independent variables. First, we include annual household income as a potential factor in determining physical activity behavior. The CHNS data measures the annual household income with exact amount. We take the natural log of the income to have the variable more closely follow a normal distribution. Other demographic variables are also considered as explanatory variables, including age, gender, educational attainment, marital status, employment status, and whether the respondent resides in urban or rural area. Other than income and demographic variables, consumption towards cigarette, alcohol and sugary drinks are also considered in the empirical analysis. These consumption behaviors are health related and assumed to influence individual risk behaviors and consequently are included in this physical activity analysis.

Table 1 describes and defines the categorical variables used in the study. Since approximately 20% of the respondents have never been in school, we set illiteracy as one category of education attainment. Compulsory education means having completed 9 years of China's compulsory education of primary school and junior middle school. The other two education variables are completing high school, and completing college or graduate school. Any amount of cigarette consumption has a negative effect on health and is considered as a health-related consumption, while only an excessive amount of alcohol and sugar intake becomes detrimental to health and therefore a consumption of alcoholic beverage, soft drinks or sugary drinks for more than twice a week is included in our empirical model.

A comprehensive set of summary statistics are provided in Table 2, Table 3 and Table 4, which include overall, between and within summary statistics. The overall summary statistics are the means, standard deviations, minimums and maximums of the pooled data. Between summary statistics are based on variation between individuals, whereas within summary statistics are based on individual variation over time from own averages.

The overall mean of physical activity participation choice is 0.12, which means only 12% of the sample did participate in physical activity. The overall mean of time spent on physical activity in a typical day during the week is 75 minutes, slight lower than 80 minutes on weekends. About half of the observations are males, and about half of the observations have completed 9 years of compulsory education. Nearly one third of the observations reside in urban area, and nearly one third of the observations are employed for wages. Finally, a majority of 85.9% of the observations are married.

Empirical Methodology

According to the standard neoclassical theory of consumer utility maximization, assume that an individual has preferences over his health and physical activity participation, which affects the health condition and the length of life. To determine the optimal participation frequency and the time spent on physical activity, the individual maximizes utility taking a set of factors into account, including the income level, the demographic profile, the risk preference and so forth. We are particularly interested in whether income level significantly relates to physical activity participation. Based on the theoretical discussion before, a reasonable expectation is that high income would contribute to physical activity participation, whether through an increasing likelihood of participation in physical activity or a greater amount of time spent on physical activity in a typical day, or both.

We investigate this relation empirically by utilizing a panel data model. The advantage of using panel data is the ability to account for changes across time and individuals while controlling for unobserved individual effects. Our first model is a random effects Logit model with the binary response measuring whether the individual participated in physical activity or not. Our second model and third model are random effects (linear) models investigating the time spent on physical activity in a typical day during the week and on weekends. To start with, the random effects linear model takes the specification as equation (1).

$$y_{it} = x_{it}'\beta + \varepsilon_{it} \qquad (1)$$

In equation (1), y_{it} is a continuous dependent variable for individual i over time t, x_{it} is a matrix of independent variables, and β is a matrix of unknown coefficients. The error term ε_{it} can be decomposed as equation (2).

$$\varepsilon_{it} = u_i + e_{it} \qquad (2)$$

where u_i are the individual-specific effects which are distributed independently of the regressors and e_{it} is the composite error term.

Note that $Var(\varepsilon_{it}) = \sigma_u^2 + \sigma_e^2$ and $cov(\varepsilon_{it}, \varepsilon_{is}) = \sigma_u^2$, so the interclass correlation of the error is $\rho_\varepsilon = cor(\varepsilon_{it}, \varepsilon_{is}) = \sigma_u^2/(\sigma_u^2 + \sigma_e^2)$, which is the fraction of the variance in the error due to the individual-specific effects. ρ_ε will approach 1 if the individual effects dominate the idiosyncratic error. STATA reports the estimates of σ_u, σ_e and ρ_ε, which will be presented in our next section.

Our second model and third model take the form of random effects linear regression as described above. In our models, the dependent variable y_{it} is the time spent on physical activity in a typical day during the week and on weekends, and x_{it} is a matrix of independent variables which includes annual household income, age, gender, educational attainment, marital status, employment status, residence area and the consumption level of cigarette, alcohol beverage and sugary drinks.

Move beyond linear regression, a random effects Logit model used for our first model is written as equation (3).

$$Prob(y_{it} \neq 0|x_{it}) = Prob(x_{it}'\beta + u_i + e_{it} > 0|x_{it}) = \Phi(x_{it}'\beta + u_i) \qquad (3)$$

Here we have y_{it} as the dependent variable taking the binary response whether the individual participated in physical activity or not, and x_{it} is a matrix of independent variables same as in model2 and model3. The term Φ is the cumulative distribution function of logistic regression. u_i are independent and identically distributed following $N(0, \sigma_u^2)$, and the value of σ_u will be given by STATA. Finally, e_{it} are independent and identically logistic distributed with mean zero and variance σ_e^2, where σ_e^2 is constant and equals to $\frac{\pi^2}{3}$, which is independent of u_i.

Empirical Results and Discussion

The section reports three sets of estimates: the coefficients estimates for physical activity choice, and the time spent on physical activity during the week and on weekends. The estimation results for the random effects models are presented in Table7. The first column reveals the results from the random effects Logit model on physical activity choice. Annual household income is positively correlated with physical activity participation choice. Married people, and those who had been married but do not have a partner right now, are both less likely to participate in physical activity than people who have never married. Older people are more likely to exercise. Males are more likely to participate in physical activity. Education shows a positive relationship with physical activity participation. People are more likely to participate in physical activity if they live in an urban area. People who are employed for wage are more likely to take part in physical activity than the self-employed.

The decision to make other unhealthy choices may also be related to decisions regarding physical activity. Cigarette consumption is negatively associated with physical activity participation, while alcohol consumption and consumption of sugary drinks are both positively related to the probability of physical activity participation. In a developing country such as China, the health detriment of cigarettes is better understood in recent years; however, the detrimental effects of alcohol and sugary drinks, especially sugary drinks, have been poor received. In addition, the fact that the CHNS is conducted mainly in rural areas and surrounding suburbs, where the consumption of alcohol and sugary drinks is more a symbol of wealth and therefore less likely among low income groups, this finding is reasonable. In other words, consumption of alcohol and sugary drinks might not be good indicators of time preference in less developed countries.

The determinants on the time spent on physical activity are quite different from the above model. The first model analyzes the time spent on physical activity during the week (Monday to Friday). Household income plays a positive role, while people who are employed for a wage tend to spend less time on physical activity. These two factors function the same in determining the time spent on physical activity on the weekend. An additional determinant in the model analyzing weekend exercise time is that urban people are likely to spend more time on physical activity on the weekend, but there is no link with time spent on physical activity during the week.

To summarize, the probability of participating in physical activity, as well as the time spent on physical activity both during the week and on weekends, increases with income. As we discussed previously, low-income individuals discount expected future utility and hence diminish the cost of reduced longevity. Therefore, the consumption of beneficial goods for a low-income person tends to be smaller. The effect of education functions similar to income. Higher education increases the probability of choosing physical activity. This can be easily interpreted by the same mechanism that education raises the possibility of future utility because education is an investment in human capital (Becker et al, 1977). However, employment status affects physical activity in a different way. Those employed for wages have a higher probability of choosing physical activity, but spend less time on it. In China, being employed for a wage implies a relatively higher and more stable income source, which further implies a greater weight on future utility and therefore induces a positive consumption towards beneficial goods. Nevertheless, being employed for a wage might also limit the time people have for leisure activities such as physical activity, and thus lead to a smaller amount of time spent on it.

The determinants for time spent on physical activity during the week and on weekends are almost identical except one factor, residing in an urban area. This variable is positively related to weekend exercising time. One possible explanation is that urban people usually work during the week, and they might have more leisure time for activities including physical activity during the weekend. It is also interesting to note that many variables that affect the probability of participating in physical activity have no significant relationship with the time spent on it. This may suggest that the choice to be active represents the attitude towards time preference; however, the amount of consumption on health goods might not be the best descriptor of time preference.

Conclusion

Nowadays physical activity participation becomes a major public health concern as it affects both physical health and psychological well-being, and physical inactivity is rated among the top ten leading causes of death in high-income countries (WHO, 2002). Between 1991 and 2006, average weekly physical activity among adults in China fell by 32% (Ng et al., 2009). Physical activity is one example of health choices that attract a lot of research interests in recent years. It includes a wide range of activities such as occupational activity, housework, and most important, sports and exercise, which is the focus of this study. Agricultural economists contribute to interpret consumer decision on physical inactivity by taking account for budget (i.e. income and time constraint) and perceived benefits among other factors.

In this study, we are interested in the relationship between income and physical activity participation, and what those imply about time preference. We investigate how the household income level influences their participation in physical activity. Our hypothesis is that a rational individual has to balance his choice between current utility from not participating in physical activity and the disutility caused by impending health damage. Individuals with stronger time preference, which is a present time perspective and means more heavily discounting the future, place more weight on current utility; those with future time perspective value future utility more and are willing to sacrifice the present utility to maintain better health in future. The cost of utility loss increases as income increases, since utility depends in part on income. Hence, a higher income makes physical activity participation more likely to occur, while a lower income makes one less likely to participate in physical activity, because the low income discounts their expectation for future and thus they are less willing to invest on goods that brings future utility such as health.

We estimate a random effects Logit regression for physical activity participation choice and two random effects linear regressions for time spent on physical activity, employing data from the 1997-2011 China Health and Nutrition Survey (CHNS). Empirical results are mostly consistent with theoretical findings. Annual household income is positively correlated with physical activity participation as well as the time spent on it. This is a strong signal that the low-income group discounts expected future utility and thus cuts back the cost of being unhealthy. Males, being single, older people, people with higher education level, people who live in an urban area and people who are employed for a wage are more likely to take part in physical activity; however, only employed for a wage plays a negative role in determining time spent on physical activity and residing in urban positively correlates with time spent on physical activity on the weekend. Our study also introduces other health-related consumption decision as explanatory variables. Cigarette consumption is negatively associated with physical activity participation, while alcohol consumption and consumption of sugary drinks are both positively related to the probability of physical activity participation.

This study analyzes the relationship of income and physical activity participation from a new perspective, and empirically supports the discussion of time preference proposed by previous researches. A prime advantage of this paper is that it explains the effect of income on health choice through the lens of time preference theoretically and conducts empirical analysis on a developing country which has seldom been examined before. However, shortcomings remain for further investigation. Our assumption of time preference rate only includes the consideration of income level, but it may be affected by various factors far more than this. Future study incorporating the endogeneity of time preference should yield a better prediction. In addition, having time constraint served not only as the constraint for physical activity choice but also as a component determining income and furthermore the consumption on other commodities might provide more comprehensive theoretical prediction. Finally, since we are considering the lifelong aggregate utility, another modification could be obtained by replacing one single year’s income with an index that can carry the income information of a larger range of years.

Table1. Definitions of Categorical Variables		
Variable	Value	Definition
Participation Choice	1	Participated in physical activity during a typical day.
Widowed/Divorced/Separated	1	Marital status is widowed or divorced or separated.
Single	1	Marital status is never married.
Married	1	Marital status is married.
Illiteracy	1	Have not been in school at all.
Compulsory Education	1	Education level is 9-year compulsory education.
High School	1	Education level is high school.
College and Above	1	Education level is college graduate and above.
Urban	1	Reside in urban area; otherwise in rural area.
Smoke	1	Consume cigarettes.
Alcohol	1	Consume alcoholic beverage more than twice a week.
Sugary Drinks	1	Consume soft drinks or sugary drinks more than twice a week.
Male	1	Gender is male; otherwise female.
Employed	1	Primary occupation is paid worker for enterprise or other person.

Table2. Sample Descriptive Statistics for China Health and Nutrition Survey Data					
Variable		Mean	SD	Min.	Max.
Participation Choice	Overall	0.120	0.325	0	1
	Between		0.314	0	1
	Within		0.183	-0.680	0.953
Exercise Time on Weekday	Overall	75.402	69.043	2	1202
	Between		68.087	2	1202
	Within		21.755	-209.599	360.402
Log Exercise Time on Weekday	Overall	4.048	0.737	0.693	7.092
	Between		0.719	0.693	7.092
	Within		0.236	2.16	5.84
Exercise Time on Weekend	Overall	80.461	63.326	1	600
	Between		60.431	1	600
	Within		22.65	-209.539	370.461
Log Exercise Time on Weekend	Overall	4.139	0.725	0	6.397
	Between		0.702	0	6.397
	Within		0.238	2.092	6.186
Widowed/Divorced/Separated	Overall	0.064	0.245	0	1
	Between		0.236	0	1
	Within		0.099	-0.736	0.897
Single	Overall	0.077	0.266	0	1
	Between		0.302	0	1
	Within		0.103	-0.673	0.910
Married	Overall	0.859	0.348	0	1
	Between		0.365	0	1
	Within		0.138	0.026	1.659
Age	Overall	47.166	14.489	18	97.100
	Between		15.260	18	95.150
	Within		3.448	38.316	55.632
Annual Household Income	Overall	29850.37	37840.66	0	900600
	Between		38090.33	0	900600
	Within		20869.91	-347969.6	469527.2
Log Household Income	Overall	9.793	1.052	1.775	13.711
	Between		0.978	4.129	13.711
	Within		0.591	4.52	14.049
Illiteracy	Overall	0.202	0.401	0	1
	Between		0.363	0	1
	Within		0.153	-0.631	1.035
Compulsory Education	Overall	0.520	0.500	0	1
	Between		0.477	0	1
	Within		0.190	-0.314	1.353
High School	Overall	0.204	0.403	0	1
	Between		0.396	0	1
	Within		0.142	-0.629	1.038
College and Above	Overall	0.070	0.254	0	1
	Between		0.280	0	1
	Within		0.085	-0.73	0.903
Urban	Overall	0.326	0.469	0	1
	Between		0.487	0	1
	Within		0	0.326	0.326
Smoke	Overall	0.301	0.459	0	1
	Between		0.435	0	1
	Within		0.170	-0.533	1.134

Alcohol	Overall	0.256	0.436	0	1
	Between		0.397	0	1
	Within		0.210	-0.578	1.089
Sugar Drinks	Overall	0.110	0.312	0	1
	Between		0.302	0	1
	Within		0.159	-0.640	0.860
Male	Overall	0.505	0.500	0	1
	Between		0.500	0	1
	Within		0	0.505	0.505
Employed for Wage	Overall	0.331	0.471	0	1
	Between		0.457	0	1
	Within		0.195	-0.502	1.165

Table3. Physical Activity Participation Choice and Time Spent among China Population			
Determinants	Choice (N=17,765)	Time on Weekday (N=1,748)	Time on Weekend (N=1,759)
Log Household Income	0.524***	0.039*	0.050**
Widowed/Divorced/Separated	-1.297***	-0.090	-0.112
Married	-1.171***	-0.045	-0.025
Age	0.025***	0.001	-0.002
Male	0.348***	0.021	0.047
Illiteracy	-0.819***	NS	NS
High School	0.813***	NS	NS
College and Above	1.104***	NS	NS
Urban	1.368***	0.046	0.103***
Employed for Wage	0.553***	-0.287***	-0.209***
Smoke	-0.465***	-0.056	-0.054
Alcohol	0.247***	-0.014	-0.012
Sugary Drinks	0.538***	0.027	0.066
R^2 *Within*		*0.032*	*0.007*
R^2 *Between*		*0.043*	*0.030*
R^2 *Overall*		*0.044*	*0.027*
σ_u	*1.720*	*0.367*	*0.249*
σ_e		*0.622*	*0.649*
ρ	*0.474*	*0.258*	*0.128*

Reference

Anokye, N. K., Pokhrel, S., Buxton, M., & Fox, J. 2012. The Demand for Sports and Exercise: Results from an Illustrative Survey. European Journal of Health Economics, 13:277–287.

Becker, G. S. 1965. A Theory of the Allocation of Time. The Economic Journal, 75: 493-517.

Becker, G. S., and K. M. Murphy. 1988. A Theory of Rational Addiction. Journal of Political Economy, 96: 675-700.

Binkley, J. 2010. Low Income and Poor Health Choices: The Example of Smoking. American Journal of Agricultural Economics, 92: 972-984.

Bretteville-Jensen, A.L. 1999. Addiction and Discounting. Journal of Health Economics, 18: 393-407.

Breuer, C., & Wicker, P. 2008. Demographic and Economic Factors Concerning the Inclusion in the German Sport System. A Micro-analysis of the Years 1985 to 2005. European Journal for Sport and Society, 5: 35-43.

Brownson, R. C., Boehmer, T. K., & Luke, D. A. 2005. Declining Rates Of Physical Activity in the United States: What Are the Contributors? Annual Review of Public Health, 26:421–443.

Cawley, J. 2004. An Economic Framework for Understanding Physical Activity and Eating Behaviours. American Journal of Preventive Medicine, 27: 117-125.

Downward, P. 2007. Exploring the Economic Choice to Participate in Sport: Results from the 2002 General Household Survey. International Review of Applied Economics, 21: 633-653.

Downward, P., & Riordan, J. 2007. Social Interactions and the Demand for Sport: an Economic Analysis. Contemporary Economic Policy, 25: 518-537.

Farrell, L., & Shields, M. A. 2002. Investigating the Economic and Demographic Determinants of Sporting Participation in England. Journal of Royal Statistics Society A, 165: 335-348.

Garcia, J., Lera, F., & Suarez, M. J. 2011. Estimation of a Structural Model of the Determinants of the Time Spent on Physical Activity and Sport: Evidence for Spain. Journal of Sports Economics, 12(5) 515-537.

Humphreys, B. R., & Ruseski, J. E. 2006. Economic Determinants of Participation in Physical Activity and Sport. IASE Working Paper No. 06-13.

Humphreys, B. R., & Ruseski, J. E. 2007. Participation in Physical Activity and Government Spending on Parks and Recreation. Contemporary Economic Policy, 25: 538-552.

Meltzer, D. O., & Jena, A. B. 2010. The Economics of Intense Exercise. Journal of

Health Economics, 29: 347–352.

Ng, S. W., Norton, E. C. & Popkin, B. M. 2009. Why Have Physical Activity Levels Declined among Chinese Adults? Findings from the 1991–2006 China Health and Nutrition Surveys. Social Science & Medicine, 68: 1305–1314.

Slade, A. N. 2012. Health Investment Decisions in Response to Diabetes Information in Older Americans. Journal of Health Economics, 31: 502-520.

World Health Organization: World health report. 2002.