EXERCISE AS AN INVESTMENT: THE FINANCIAL BENEFITS OF STAYING ACTIVE

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Business, Economics, and Society

Abstract

This study builds on previous research on health and physical activity engagement by exploring the relationship between exercise and income. A regression analysis examines the impact of different exercise types and exercise frequencies on income, while controlling for socioeconomic variables. The results indicate that individuals who participate in vigorous physical activities, rather than light or moderate activities or strength training, are more likely to earn a higher income. These results are consistent with previous literature that investigates the positive effects of exercise on the labor market.

KEYWORDS: (Health behaviors, Exercise, Income)
JEL CODES: (I12, I15, D31)

ON MY HONOR, I HAVE NEITHER GIVEN NOR RECEIVED
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Signature

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Introduction

The CDC recommends that adults should participate in moderate-intensity exercise or physical activity for at least 150 minutes per week, which could be broken down to 30 minutes, 5 days a week. Although the benefits of exercises are widely researched and shared with the public, the CDC conducted an analysis of the 2020 National Health Interview Survey and found that only 28% of adults in the United States meet the recommended combined aerobic and strength training guidelines. They also discovered that individuals in rural and nonmetropolitan areas were less likely to meet these requirements than individuals in metropolitan areas (Abildso et al., 2023). Barriers that individuals face when it comes to exercising include a general dislike of exercise, scarcity of time, and lack of knowledge of the extensive health benefits of exercise due to either ignorance or a limited educational background.

In addition to exercise's physical and mental benefits, studies (Kosteas, 2012 and Tovar-García 2021) have researched if regular exercise has a positive effect on an individual's wage or income. Researchers hypothesize this is a result of exercise improving mental cognition and focus, reducing the chances of obesity, mitigating effects of job burnout, and making employees seem more attractive to employers as motivated individuals (Bretland and Thorsteinsson, 2015). Individuals with higher income may also have greater knowledge on the overall physical and cognitive benefits of exercise from higher education or have easier access to ways of exercising. Lastly, individuals who earn enough to finance their personal and family's necessary expenses have more time and flexibility to dedicate their energy to activities like working out while those living paycheck to paycheck struggle to find time to maintain a balanced lifestyle between work and their personal lives.

Researchers are still exploring the relationship between exercise and wages, as studies on this topic remain limited. There is ongoing investigation into which types of exercise have the greatest impact on an individual's earnings. The unanswered question asks whether exercise habits influence income or if income influences exercise habits. My research will be using an updated study on National Longitude Survey of Youth data from the 2014 wave, and I will try to model a linear relationship between exercise, including strength training, light aerobic training, and vigorous aerobic training, and wage income, while accounting for socioeconomic and various control variables.

Literature Review

This literature review provides context and relevance for the relationship between regular exercise and physical activity and wage by exploring previous research and findings on exercise and economic outcomes. Exercise has been proven to benefit the output of youth and adults in educational and labor market settings (Lechner, 2009; Lechner and Sari, 2021). The following studies encompass various areas of research which explore the meaning behind the relationship between exercise and income.

Exercise and Income

Two studies (Kosteas, 2012 and Tovar-García, 2021) found a positive and strong correlation between frequency and intensity of exercise and income using longitudinal survey data. Other studies included in this review provide background on occupational burnout, obesity, and cognitive function, which are important factors that determine an individual’s income. This review sets a clear connection and establishes an argument for why individuals should prioritize exercise and physical activity by highlighting the potential wage penalties resulting from neglecting regular exercise.

Regular exercise and physical activity may yield labor market benefits in the form of higher earnings. Exercise also leads to improved mental function, psychological conditions, and higher energy levels (Lechner, 2009). These are each employee and work-related traits that indirectly lead to higher long-term earnings through increased productivity and a general perception as a highly competent and reliable employee. Exercise has also been proven to increase overall enthusiasm and job satisfaction (Meltzer and Jena, 2010). Kosteas (2012) explores three of his own potential explanations for this theory in depth. First, exercise leads to higher wages by enhancing mental cognition and well-being. Second, higher wages affect an individual's level of physical activity and exercise by providing easier access to exercise gear or equipment, more time to exercise, and an increased awareness of the health benefits of exercise. Third, unobserved factors cause differences in both exercise frequency and earnings (Kosteas, 2012). Using a survey from NLSY that asked about individuals' activities, frequency of vigorous physical exercise and sports, and body composition variables, Kosteas (2012) found a positive and significant correlation between engaging in frequent exercise and labor market earnings, specifically that, "engaging in regular exercise yields a 6 to 10% wage increase…[and] while moderate exercise yields a positive earnings effect, frequent exercise generates an even larger impact" (Kosteas, 2012). Using data from the Canadian National Population Health Survey, Lechner and Sari (2015) similarly found that more strenuous exercises show the most substantial changes and that the positive earnings effects increase to more than 10% in the long run. Kosteas (2012) also notes that considering that the NLSY survey did not inquire on specific types of exercises completed or the duration, these factors should be further explored.

After observing positive outcomes from participation sports and performance in school, researchers deducted that there should be a relationship between exercise or sports engagement

and positive performance in the labor market due to factors previously mentioned, including cognitive function, higher energy levels, reduced absenteeism, etc. Edgar Demetrio Tovar-García conducted a study using data from the Russian Longitudinal Monitoring Survey (2000-2019) to explore this theory. He begins by discussing the Soviet Union's history of widespread physical education programs and how, more recently, the Development of Physical Culture and Sports in the Russian Federation federal program has introduced policies to encourage sports and exercise for the physical and emotional well-being of Russian citizens. Like much research which discusses exercise and wage, Tovar-García (2021) writes that, "little is known about the links between specific types of sports/exercise and earnings…literature claims a positive association between sports/physical exercise and wages, regardless of the kind of activity" (Tovar-García, 2021). The dependent variable in his study, wage income, asked respondents about how much money they received in the last 30 days from their primary job after taxes. Variables on sports and activities were developed by asking about frequency, intensity, and types of exercise and physical activities. The list of activities ranged from walking, basketball, soccer, tennis, boxing, and using exercise equipment. Education, work experience, and health conditions were accounted for in the regression. Just as Kosteas' 2012 study did, Tovar-García (2021) established that individuals who participate in sports and exercise earn 6-10% higher wages than sedentary individuals, and that the intensity of the workout is also positively linked to wages. Using exercise equipment, swimming, dancing, and aerobics were most positively linked with higher wage income, while activities such as basketball, boxing, and soccer had no significant link to wage income. Regardless, participation in regular exercise and physical activity is associated with higher wages as a positive outcome. Using data from a 2008 Brazilian National Household Sample Survey, Godoy and Triches (2017) also analyzed information on physical activity,

socioeconomic, demographic, health, and household conditions. They found that household income per capita and average salaries for both men and women who participated in regular physical activity was nearly double compared to men and women who were sedentary or inactive.

The Opportunity Cost of Exercise

Aside from access to exercise or a dislike for exercise, specifically intense exercise, time may be an individual's greatest barrier to participating in exercise. Research on the opportunity cost of exercise was conducted by Maruyama and Yin (2012) using the Australian National Health Survey to revisit the hypothesis created by Meltzer and Jena (2010) which reasoned that individuals with higher wages exercise more intensely than those who earn lower wages, "as wages increase, individuals will shift toward less time-intensive, but more physically intensive, forms of exercise" (Maruyama and Yin, 2012). Exercising more intensely accomplishes the desired workout within a shorter period of time. Maruyama and Yin's 2012 study concluded that wealthier Australians exercise more regardless of demographic factors, indicating that income is positively correlated, but not causal, to exercise. Meltzer and Jena (2010) concluded the same from their study, finding that 67% of individuals with family income greater than $75,000 report moderate exercise in the past month, and individuals among the higher income group spent on average 7 more hours per month exercising than the lowest income group. Supporting this time cost hypothesis, Meltzer and Jena (2010) found that higher income Australians choose to exercise more often and at a higher level by increasing the intensity of the exercise, and at times, the duration. They suggest that there is a causal relationship where higher-income individuals face a higher opportunity cost of time, which affects their exercise behavior. Meltzer and Jena (2010(investigate a similar issue by exploring the time cost of exercise for higher income

individuals, the challenges of engaging in intense physical activity, and the overall economic benefits gained from exercise-related health improvements.

Obesity and Wage

In relation to the labor market, researchers have investigated whether obesity is associated with or directly causes lower wages for both men and women due to an obesity wage penalty which stems from discrimination against poor health and physical appearance. Exercise can help prevent or reduce obesity. Long-term, regular exercise can improve, "insulin sensitivity, lipid and lipoprotein profile, and blood pressure, as well as reduced risk of death" (Bouchard, Depres, and Tremblay, 1993). Exercise is most effective for weight control, weight loss, and increases resting metabolic rate (RMR) which are important for the treatment of obesity. Overall, individuals that participate in regular physical activity and exercise are more likely to be of a healthy and normal weight than those who do not. Many the studies investigating these hypotheses use National Longitude Study of Youth (NLSY) data. There exists a social stigma that obese individuals possess less social, intellectual, and economic skills, and this stigma can cause these individuals to endure a social and wage penalty.

Obesity can cause workers to earn less than non-obese workers because their chronic condition may limit their productivity. Obese workers may also be economically myopic, or short-sighted on immediate financial gains or costs at the expense of long-term economic gains, and therefore experience less future earnings potential (Noh and Jung, 2024). This may be because obese individuals tend to possess a present-focused orientation which values immediate rewards rather than focusing on long-term benefits and future optimization. Lastly, employers might discriminate against obese people in hiring, promoting, or compensation processes. One study found that long-term wage disparity between obese and non-obese workers does exist, and

that obese workers experience a flatter earnings profile, which may be because obese workers tend to be more economically myopic and less interested in career advancement and developmental training (Baum and Ford, 2004). Additionally, the study found that there is no evidence that obesity negatively affects wages through health limitations or customer discrimination. Various other studies also concluded that the obesity wage penalty significantly affects women more compared to men (Cawley, 2004). Additionally, physical appearance can impact the hiring process and preferences of employers, starting salaries, promotions, and long-term income.

Occupational Burnout: Exercise as a Mitigation

Exercise and physical activity interventions play a crucial role in reducing occupational burnout, which in turn can positively impact job performance and productivity, and therefore positively affect income. Occupational burnout, if unaddressed, often leads to reduced productivity and job dissatisfaction, potentially affecting wages and career advancement over time. By mitigating burnout, exercise may contribute to sustained productivity and a better professional outlook, factors that employers value and that can ultimately support an employee's wage growth (De Moraes, Calais, and Verardi, 2019). Burnout is related to chronic mental and physical exhaustion and fatigue. It can even be related to absenteeism through the increase of diseases and conditions like the common cold, the flu, and gastrointestinal disorders. Like depression, burnout can be treated with antidepressants and remedies such as vitamin supplements, reducing alcohol consumption, and exercise and physical activity (CDC). It can appear in work settings due to high workload and perceived stress from working conditions. Job burnout can be defined, "by three dimensions: exhaustion, cynicism, and a sense of inefficacy" (Moraes et al., 2019). Exercise can be a positive distractor and a mode of self-efficacy and

confidence for individuals. These traits can specifically help employees perform better at their workplace. Aerobic exercises specifically have shown to improve physical recovery times against illness.

Studies have consistently shown that engaging in physical activity, particularly cardiovascular exercises, helps reduce occupational burnout by alleviating stress and emotional exhaustion. Bretland and Thoresteinsson (2015) found that participants in their study showed less emotional exhaustion symptoms, and that exercise increases well-being by reducing perceived stress and burnout. Specifically, cardiovascular exercises such as biking, swimming, and running were more effective at reducing psychological distress among participants than resistance exercises such as strength training. Although, resistance training was more effective in increasing feelings personal accomplishment. Gerber et al. (2013) investigated the effects of a three-month aerobic exercise training program on levels of burnout and stress perceptions for males suffering from occupational burnout. Participants could use a variety of exercise equipment, including a cross trainer, running ergometer, stepping ergometer, bicycle ergometer, and rowing ergometer. Participants reported a decrease in emotional exhaustion and a reduction in feelings of depersonalization, but no significant changes were observed in their sense of personal accomplishment. Overall, employees that participate in physical activity and exercise experience reduced symptoms of occupational burnout which negatively impact their performance at work. While these benefits are frequently explored and highlighted, the underlying mechanisms behind these improvements remain unclear.

Exercise and Enhanced Cognitive Function

The psychological benefits of regular exercise, including its effects on stress reduction, mood enhancement, and cognitive functioning, have been widely documented, along with the social

and motivational factors that influence exercise behavior. Participation in physical activity, exercise, and sports makes people more motivated and productive, which is rewarded in the labor market (Seraganian, 1993). Seraganian (1993) examines how various forms of exercise influence mental processes and emotional well-being. His findings bring together research and theories from multiple disciplines, including psychology, physiology, and behavioral science, to understand the role of physical activity in relation to mental health.

Physical activity enhances key skills that contribute to productivity, potentially leading to higher earnings and long-term wage growth. Lechner (2009) states that, "Engaging in sports and exercise can boost an individual's productivity by improving health and fostering cognitive and non-cognitive skills, including self-discipline, stress management, and teamwork," (Lechner, 2009). He hypothesizes that these qualities both indirectly and directly result in increased individual earnings and long-term wage. Cognitive ability and function are closely correlated with job performance, influencing both the early and late stages of an individual's career. Overall job performance involves understanding how individuals engage in work behaviors that either contribute to or detract from achieving the goals associated with their jobs (Murphy, 1989). In addition to cognitive abilities, physical and psychomotor skills play a significant role in determining job performance.

Exercise has a positive effect on general psychological processes. McMorris et al. (2009) explain the relationship between physical exercise and cognition using an analytical approach and experimental results. Their book, *Exercise and Cognitive Function,* compiles previous research on cognitive performance subcategories such as memory, attention, executive function, and processing speed. The physiological, neurological, and psychological processes are each affected by exercise. First, exercise increases blood flow to the brain, supporting brain health and

function and increasing brain metabolism (Querido and Sheel, 2012). Exercise also reduces neurodegeneration and improves the brain's ability to form synaptic connections in relation to learning and memory.

Given the existing research highlighting a positive relationship between exercise and wage income, it is crucial to further test these findings, particularly focusing on the frequency and intensity of different types of exercise. While previous studies have explored this relationship, they have often generalized exercise types or relied on limited data, leaving gaps in the understanding of the subject. Specifically, the effects of various forms of exercise, from aerobic to strength training, on income remain underexplored. This gap provides an important opportunity to investigate how different exercise activities, their frequency, and intensity may shape earnings potential. Therefore, my study aims to address these gaps by testing the relationship between exercise variables and income, employing a more nuanced approach to categorize and quantify exercise behaviors. The methodology outlined below will explore these dimensions in depth.

Methodology and Data Summary

My study uses data derived from the National Longitudinal Survey of Youth conducted by the US Bureau of Labor Statistics to study life-course information of men and women in the United States. The topics included in the survey are: Education, Training, & Achievement Scores, Employment, Household, Geography & Contextual Variables, Family Background, Dating, Marriage & Cohabitation: Sexual activity, Pregnancy & Fertility, Children, Income, Assets & Program Participation, Health, Attitudes & Expectations, and Crime & Substance Use. The NLSY is an excellent data source because it enables the inclusion of covariates relevant to labor-market success, such as social class, background of respondents' parents, geography, age,

ethnicity and race, sex, and highest degree of education attained. I will specifically be using the dataset titled NLSY79 (National Longitudinal Survey of Youth 1979), data which initially surveyed 12,686 men and women in 1979 born between 1957 and 1964. The sample includes socially and economically disadvantaged groups such as women, Hispanics, Black people, etc. It also includes members of the military, although after the 1984 wave, 1,079 members of the military were not considered eligible for interview, and only 201 respondents remained in the survey. I use the data collected from the 2014 wave, which is the most recent year that includes substantial information on income, exercise, and covariate variables. The respondents in the 2014 wave are between 50 and 58 years old. The survey was sent to 12,686 individuals to be completed.

This study is a replication of one by Vasilios (Billy) D. Kosteas which analyzes data from the 1998 and 2000 waves of the NLSY79. His analysis accounts for body composition variables, highest grade completed, age, log tenure with the current employer in years, log tenure in years squared, sex, race, and number of hours per week. He includes explanatory variables such as: the armed forces qualifying test score percentile, information on athletics participation in high school, whether the individual watches/attends sporting events as part of his leisure activities, the individual's height, and a proxy for the discount rate.

Dependent Variable: Wage Income

The dependent variable is wage income. This variable is calculated from the survey question "TOTAL INCOME FROM WAGES AND SALARY IN PAST CALENDAR YEAR (TRUNC)", or specifically "During [PAST_CALENDAR_YEAR], how much did you receive from wages, salary, commissions, or tips from all (other) jobs, before deductions for taxes or anything else?" (NLSY79 Survey Year: 2014).

Independent Variables: Frequency of and Time Spent Doing Exercise

The independent variable is exercise and physical activity. The NLSY79 contains a vast "Health" section of questions with multiple primary variables surveying different types of exercise. Running analyses on these different types of aerobic and anaerobic exercises may reveal how different types of exercise and time spent doing exercise influence wage. The survey questions included in this regression ask about frequency and time spent doing activity each time. The first question for frequency is "FREQUENCY R ENGAGES IN VIGOROUS ACTIVITIES FOR AT LEAST 10 MINUTES" or "How often do you do vigorous activities for at least 10 minutes that cause heavy sweating or large increases in breathing or heart rate?" The second question is "HOW FREQUENTLY DO YOU ENGAGE IN LIGHT OR MODERATE ACTIVITIES FOR AT LEAST 10 MINUTES?" or "How often do you do light or moderate activities for at least 10 minutes that cause only light sweating or slight to moderate increase in breathing or heart rate?" The third question is "HOW FREQUENTLY DO YOU ENGAGE IN STRENGTH TRAINING ACTIVITIES FOR AT LEAST 10 MINUTES?" or "How often do you do physical activities specifically designed to strengthen your muscles such as lifting weights or doing calisthenics?" (NLSY79 Survey Year: 2014). Respondents classified their activity levels by answering: "Per day", "Per week", "Per month" or "Per year". I refer to these frequency variables as frequency of vigorous activity, frequency of light or moderate activity, and frequency of strength training.

The first question for time spent exercising is "LENGTH OF TIME OF VIGOROUS ACTIVITIES EACH TIME" or "About how long do you do these vigorous activities each time?". The second question is "LENGTH OF TIME OF LIGHT OR MODERATE ACTIVITIES EACH TIME" or "About how long do you do these light or moderate activities

each time?". There is no survey question regarding length of time spent performing strength training activities. Respondents classified time spent doing physical activities each time in minutes ranging from "1-9", "10-19" … to "100 to 100+".

Control Variables

Control variables or covariates in this analysis are necessary to account for other factors aside from exercise that may influence income. Including these variables allows me to isolate the specific effect of exercise on income. Employment status at the time of survey is incorporated in the model. The wage model in labor economics describes the empirical returns on education and work experience. It is often expanded to include factors like gender, race, health status, and industry-specific effects, such as unemployment rates, which can help explain wage disparities. This model is very useful for wage determination because it accounts for various demographic characteristics to account for wage differences and the complexity of wage determination based on sexism, racism, and systematic disparities. Sex and race are included in the model. Highest grade completed or education level is also necessary to include because education generally gives individuals access to higher paying jobs and opportunities for specialized skill development.

Based on previous literature explaining the negative relationship between obesity and wage, weight is a necessary control variable. Obesity is often associated with health limitations and an increase in job strenuousness, which could negatively impact wage. Additionally, an obese individual is less likely to exercise due to health concerns and limitations. Height influences wage and is also controlled for, as taller people tend to have a higher income than shorter people.

Household information such as marital status, family size, number of children in a household, and age of youngest child in the household is included. Married men often earn a higher wage compared to unmarried individuals. Parenthood and the demands of a household may influence a caregiver's salary and their ability to exercise due to time constraints and family dynamics. The age of respondent during interview date is also included.

This analysis includes a control variable for geographic location, asking if respondents live in an urban or rural area and which region of the United States they live in. Wages vary significantly between geographic regions due to cost of living, economic conditions, and local labor market demands. Wages of urban areas are typically much higher than those of rural areas. Urban areas also see higher levels of exercise than rural areas.

Analysis and Results

The 2014 survey data was loaded into the statistical computing software R and the necessary missing values, outliers, and abnormal values were removed from the regression code. Cleaning the data was relatively straightforward. Values (-1= Refusal), (-2= Don't know), (-3= Invalid skip), (-4= Valid skip), and (-5= Non-Interview) were coded as "NA" and omitted from the regression. The original 12,686 observations gathered from the survey was reduced to 850 observations once these "NA" variables were excluded. The INCOME variable included several exceptionally high values, such as 40 entries of $370,314, which were subsequently removed. The EDUCATION variable contained a section titled "Ungraded", and was therefore also removed due to irrelevance. Necessary variables (RACE, SEX, REGION, MARITAL STATUS, URBAN/RURAL, EMPLOYMENT) were coded as a factor to allow categorical data to be properly incorporated into the analysis and to ensure that the data was not interpreted by the software as continuous. The first two regressions did not code any frequency of exercise

variables as a factor. Another set of log and robust regressions was performed with the frequency of vigorous activity variable coded as a factor.

Originally, I conducted a standard OLS regression, but regression assumptions including homoscedasticity, no multicollinearity, and autocorrelation were not met. Following Kosteas' model, I conducted another regression using the natural log of INCOME in my analysis (Model 1). Taking the natural log of the dependent variable can help normalize the distribution of data and meet the necessary assumptions for the regression model. The coefficients of independent variables then represent the approximate percentage change in income for a one-unit increase in that variable, making the interpretation more intuitive and meaningful. Additionally, I ran a robust regression (Model 2). Robust regression techniques are less sensitive to outliers and influential data points and provide valid results without meeting certain assumptions of an OLS regression, such as normal distribution, homoscedasticity, and linearity. The results for both my log income regression and robust regression are presented in Table 1.

Table 1
Regression Outputs For Income and Exercise

	Model 1. Log Income				Model 2. Robust Regression			
Variable	*b*	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Intercept	1.74	0.96	1.81	0.07	-23.00	34.72	-0.66	0.51
Frequency of vigorous activity	0.16	0.07	2.14	0.03	5.65	2.50	2.26	0.02
Time spent doing vigorous activity	0.12	0.00	0.74	0.46	0.13	0.07	1.93	0.05
Frequency of light/moderate activity	-0.01	0.07	-0.74	0.46	-0.82	2.55	-0.32	0.75
Time spent doing light/moderate activity	0.00	0.00	0.94	0.35	0.01	0.08	0.08	0.93
Frequency spent strength training	0.00	0.03	0.08	0.94	0.20	1.10	0.19	0.85
Race (Black)	-0.29	0.10	-2.77	0.01	-9.45	4.06	-2.33	0.02
Race (Non Black and Non Hispanic)	-0.03	0.10	-0.31	0.76	-1.65	3.88	-0.42	0.67
Family size	-0.14	0.06	-2.49	0.01	-0.36	1.58	-0.23	0.82
Sex (Female)	-0.60	0.08	-7.69	0.00	-26.11	3.10	-8.42	<2e-16
North Central Region	-0.03	0.09	-0.35	0.73	-1.16	3.84	-0.30	0.76
Southern Region	0.01	0.09	0.14	0.89	-0.71	3.43	-0.21	0.84
Western Region	-0.15	0.10	-1.52	0.13	-6.77	4.38	-1.55	0.12
Marriage status (married)	-0.04	0.16	-0.24	0.81	-3.71	5.16	-0.72	0.47
Marriage status (separated)	-0.41	0.23	-1.76	0.08	-6.38	5.78	-1.10	0.27
Marriage status (divorced)	-0.14	0.17	-0.79	0.43	-3.68	5.31	-0.69	0.49
Marriage status (widowed)	-0.55	0.32	-1.69	0.09	-13.24	8.11	-1.63	0.10
Education	0.10	0.01	7.59	0.00	3.75	0.53	7.09	0.00
Urban residence	0.17	0.09	1.92	0.06	8.26	3.03	2.72	0.01
Employed	0.32	0.13	2.39	0.02	36.89	2.35	15.72	<2e-16
Number of children in household	0.13	0.07	1.71	0.09	-1.15	2.43	-0.45	0.64
Age of youngest child in household	0.01	0.01	1.42	0.16	0.09	0.20	0.45	0.65
Height in feet	0.02	0.09	0.19	0.85	-1.45	3.82	-0.38	0.70
Weight	0.00	0.00	0.16	0.87	0.00	0.00	-0.05	0.96
Age	0.01	0.01	0.55	0.58	-0.04	-0.04	-0.08	0.94
R^2			0.21				0.37	

R-squared: Results

The adjusted R-squared value for the log income regression (Model 1) is 0.21 which indicates that this model explains about 21% of the variance of INCOME accounting for the number of predictors. The adjusted R-squared value for the robust regression (Model 2) is 0.3741, indicating that approximately 37% of the variance in INCOME is explained by the predictors in the model. Even though these values do not explain a large portion of the variance or provide precise predictive accuracy, it captures various meaningful patterns regardless. These R-squared values are slightly lower than Kosteas' values for both men and women, which are 0.4596 and 0.4374 respectively.

Control Variables: Results

As expected, these estimates suggest a statistically meaningful relationship between race, sex, education, and income. The negative estimates for Race (Black) and Sex (Female) indicate

that individuals coded as Black and individuals coded as female are expected to have a lower predicted income compared to individuals in the reference group. For females, the reference group is males and for Black people, the reference group is non-Hispanics and Hispanics. The positive estimate for Education suggests that individuals that attain higher levels of education, like university, are expected to earn more than individuals with little to no education. Employed is also a variable that is statistically significant in both models, meaning individuals who reported being employed are associated with higher income levels. Marital status is marginally significant in relation to income, with separated and widowed respondents being associated with lower income levels. The Urban Residence variable is also mildly statistically significant, indicating that respondents from urban areas earned slightly more than those from rural areas. Lastly, in Model 1, family size appears to be significant with a negative p-value, suggesting that as family size increases, income decreases. Other variables such as number of children in a household and marital status have limited significance in Model 1 and no significance in Model 2.

Frequency of and Time Spent Doing Exercise: Results

In Model 1, frequency of vigorous activity is statistically significant in predicting INCOME by having a p-value of 0.0330. The estimated coefficient for the exercise variable is 0.1574, indicating that for each unit increase in exercise frequency, income is expected to increase by 15.74%. As frequency is coded as “Per day”, “Per week”, “Per month” or “Per year”, respondents that have higher frequency of vigorous activity, such as “Per day” or “Per week” rather than “Per month” or “Per year” are more likely to have higher income. Time spent doing vigorous activity, frequency of light or moderate activity, time spent doing light or moderate

activity, and frequency of strength training activities all resulted in high p-values and were not statically significant in this model.

In Model 2, frequency of vigorous activity is statistically significant in predicting income, with a p-value below 0.05. Its coefficient estimate of 5.65 suggests that higher frequency of vigorous physical activity, such as daily or weekly activity compared to monthly or yearly, is associated with increased income levels. This means that individuals that engage in vigorous activity more frequently, income is expected to increase by $5,653. Time spent doing vigorous activity is marginally statically significant in Model 2. The coefficient estimate of 0.13 indicates that as individuals spend more time vigorously exercising, their income will increase by $13 dollars. The variables frequency of light or moderate activity and frequency of strength training have high p-values, indicating they are not statistically significant predictors for income in this model as well.

Factor Regressions: Results

Coding frequency of vigorous activity as a factor allows for a more flexible analysis of how different levels, “Per day”, “Per week”, “Per month” or “Per year”, are related to income. Treating this variable as a factor rather than a continuous variable in separate regressions can capture non-linear affects more accurately. Each category can be interpreted separately and provide a clearer comparison across the different levels of exercise frequency. Table 2 is the regression outputs for the two regressions, log income and a robust regression, with the frequency of vigorous activity variables coded as a factor with the reference level being “Per year”.

Table 2

Regression Outputs For Income and Frequency of Vigorous Activity as a Factor

	Model 1. Log Income: Frequencies as a Factor				Model 2. Robust Regression: Frequencies as a Factor			
Variable	*b*	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Intercept	1.76	1.33	1.55	0.12	-31.25	39.99	-0.78	0.44
Frequency of vigorous activity (Per week)	0.23	0.57	0.41	0.68	14.55	6.37	2.27	0.02
Frequency of vigorous activity (Per month)	0.16	0.59	0.27	0.79	7.74	8.97	0.86	0.39
Frequency of vigorous activity (Per day)	-0.06	0.57	-0.10	0.92	-0.40	6.34	-0.06	0.95
Time spent doing vigorous activity	0.00	0.00	0.63	0.53	0.15	0.08	1.98	0.05
R^2			0.21				0.27	

Note. Reference level is "Per year"

In Model 2, exercising vigorously “Per week” is statistically significant compared to “Per year” . This result suggests that individuals who engage in vigorous exercise on a weekly basis are expected to make $14,550 more than individuals who exercise on a yearly basis. In the robust model depicted in Model 2, time spent on vigorous activity remains statistically significant, further reinforcing the importance of both the frequency and duration of exercise in influencing the outcome variables. When re-running the regression for Model 1, none of the frequency of vigorous activity variables showed significance when compared to the "Per year" reference level.

Discussion

In both analyses examining the relationship between exercise and income, it was found that engaging in vigorous activity emerged as the only statistically significant variable among all included exercise variables from the 2014 NLSY survey. This indicates that individuals who participate in vigorous physical activities—such as running, intense cycling, or competitive sports—demonstrate a notable correlation with higher income levels compared to those who engage in lower-intensity exercises or moderate activities. Kosteas (2012) found a positive and significant correlation between regular physical exercise and higher earnings, specifically how more frequent exercise yields a stronger wage increase. My results also align with Maruyama and Yin’s 2012 research titled “The opportunity cost of exercise: Do higher-earning Australians exercise longer, harder, or both?” which explores the utility-maximizing agent of choosing the optimal level of exercise for the most beneficial health capital investment. Higher wage earners

rely on higher intensity of exercise that is less time intensive. The significance of vigorous activity suggests that not only is it essential for physical health, but it may also be indicative of lifestyle choices and socioeconomic factors that contribute to overall well-being and financial success. This finding highlights the potential impact of high-intensity exercise on an individual's economic status and emphasizes the need for further exploration into how such activities influence both personal health and economic outcomes. The significance of frequency of vigorous activity in the analysis suggests a potentially unique interaction between high-intensity physical engagement and economic outcomes. Beyond physical health, vigorous exercise may correlate with qualities such as discipline, resilience, and time management, traits often valued in higher-paying jobs. This aligns with the "non-cognitive skills" theory, which suggests that personality traits developed through physical activity, such as persistence, self-control, and stress management, contribute to professional success.

This analysis relies on data from the 2014 wave of the NLSY survey. Repeating this analysis with data from other time periods could reveal whether the relationships between income, exercise, and demographic factors are stable over time. For instance, changes in the labor market, societal attitudes toward exercise, or economic policy could influence the association between vigorous activity and income in ways not captured in a single year of data. Examining multiple waves of NLSY data could strengthen the argument that these findings hold across different economic conditions and different age groups. Investigating exercise habits during and after the COVID-19 pandemic would be insightful as well. The positive association between vigorous activity and income could also reflect socioeconomic factors like job type or lifestyle choices. Higher-income earners may have jobs that require less physical labor but allow more control over work hours and environments, enabling them to invest time and resources into

engaging in vigorous activities. A comparison of the exercise-income relationship across different occupational categories might reveal whether job flexibility or other job-related benefits also contribute to this trend.

My sample size was reduced from 12,686 observations to 850 after cleaning, which may affect representation. This decline is attributable to the fact that respondents initially joined the survey in 1979, and by 2014, they were likely less motivated to continue their participation or may have been unable to do so. Excluding respondents with missing or extreme values could introduce bias if these individuals systematically differ in ways related to income and exercise if they have unique socioeconomic or regional characteristics. Conducting an analysis on a broader sample, perhaps by including missing values or re-evaluating the exclusion criteria, could help verify whether these excluded cases affect the overall findings.

Conclusion

The objective of this research was to confirm and develop previous claims which investigate the relationship between different types and frequency of exercise and income while considering socioeconomic factors. Exercise is both a personal choice and public health concern, especially in the United States where obesity affects a large portion of the population, and many people remain inactive. The effect of physical activity on overall health is well-researched and understood, but the personal economic benefits strengthen the argument for its importance. Exercise positively benefits productivity in labor market settings by improving cognition, reducing stress, and fostering a greater sense of job satisfaction. This information could encourage individuals to invest in their health as a form of human capital, potentially enhancing their earnings potential.

The primary insight of my research is that individuals that engage in more frequent and vigorous physical activity are significantly more likely to earn a higher income in comparison to those who engage in light or moderate activities and strength training or rarely engage in any form of exercise. This conclusion aligns with previous research which has investigated that higher income individuals prioritize workouts which deliver maximum benefits in terms of fitness and efficiency.

The relationship between frequent vigorous exercise and higher income stems from one of two hypotheses. First, individuals who engage in vigorous physical activity on a more frequent basis could develop qualities, such as discipline, resilience, and time management skills, which enhance their earnings potential. In this case, exercise may contribute to their ability to earn more than those who either do not exercise or exercise lightly or moderately. Alternatively, those who already earn higher incomes may have greater access to resources, time, and environments that encourage intense physical activity, enabling them to participate in more rigorous exercise routines. The tendency for higher income individuals to favor high intensity or vigorous workouts potentially arises from a greater awareness of health benefits through higher levels of education and health literacy. Additionally, these individuals may tend to favor high-performing lifestyles associated with intense, results-oriented exercise. However, due to the nature of this study's design, it is only possible to establish correlation rather than causation. The data does not allow for a definitive conclusion about whether vigorous exercise directly leads to higher income or if individuals with higher income are more likely to engage in vigorous exercise.

Regardless, this study, along with many others which have explored the economic benefits of exercise, finds that higher-income individuals tend to engage in exercise with greater

frequency and intensity than those with lower incomes. Considering the benefits associated with regular, vigorous exercise, these findings highlight the importance of ensuring that individuals across all social, economic, and ethnic demographics have access to resources and opportunities which allow them to engage in physical activity. Further research examining diverse populations and longitudinal data could enhance the understanding of how the relationship between income and exercise has evolved over time.

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