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Sports Participation and Happiness: Evidence from U.S. Micro Data

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Abstract

We investigate the relationship between participation in physical activity and self reported happiness in the United States. IV estimates based on data from the Behavioral Risk Factor Surveillance System between 2005 and 2009 and County Business Patterns indicate that individuals living in a county with greater access to sports facilities are more likely to participate in physical activity and also report higher life satisfaction. Both men and women gain happiness from participation, and men appear to benefit more from participation than women.

JEL classification: L83, I18, C39, D60
*Keywords:*Happiness, physical activity, instrumental variables

1 Introduction

How does participation in physical activity benefit society? Policy makers around the world have implemented programs to increase participation in physical activity in order to promote health, fight rising obesity, deter crime, impart important life skills on youth, and achieve other important societal goals over the past few decades (Schoppe et al. (2004)). This wide scale adoption of policies aimed at increasing participation in physical activity and the broad range of outcomes from these interventions highlights the importance of physical activity in modern society. In this paper, we address a related question that has received relatively little attention to date: does participation in physical activity and sports enhance quality of life? Some previous research hints at an answer. Both exercise and sports have been identified as a cause of joy.[1] Experiments on American and Italian teenagers showed they tended to be the happiest when engaging in sports and games (Csikszentmihalyi and Wong (1991)).[2] Does the happiness generated from sport participation extend beyond the duration of the activity? There are good reasons to expect it does, since physical activity promotes health, which is important for a happier life. Furthermore, participation in sport provides opportunities for socialization and helps develop communication and cooperation skills, all of which may lead to a more fruitful life. It is thus possible that participating in sports produces not just transitory, but long-lasting happiness.

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[1]For example, Argyle and Martin (1991) list "Physical activity, exercise, sport" as one of the seven main causes of joy.

[2]The measurement of happiness in Csikszentmihalyi and Wong (1991) is "based on repeated self-reports of happiness that each respondent provides eight times each day, whenever signaled by an electronic pager, for one week."

Prior research using micro-level data suggests a positive correlation between sports participation and self-reported quality of life (Fox (1999)). The interpretation of this correlative relationship, however, is not straightforward: individuals choose to participate in physical activity; those who choose to do so may be naturally healthier, more active and sociable, and therefore happier even without participating in physical activity. It is difficult to firmly establish a causal link between sport participation and quality of life using micro-level data. One way to overcome this problem is to combine micro-level data with information describing the proximal environment surrounding individuals in a sample of data. Differences in environmental factors such as access to sports facilities and peer influence may affect participation in sport and, in turn, affect happiness. If there is no reason to suspect a causal link between the presence of nearby sports facilities and self reported well-being, and these two factors exhibit statistical correlation, then the correlation likely arises through participation in sport and physical activity. Some existing research has taken this approach. One example is Forrest and McHale (2009)'s analysis of participation in physical activity and happiness in British adults. The environmental factor they exploit is proximity to a sports facility, defined as the ability to travel to such a facility from home in twenty minutes or less. They find that British females who have such access are more likely to participate in sports, and report a higher level of happiness.

In this paper, we adopt a similar approach and apply it to micro data from the US. We focus on two research questions: does participating in sports lead to a higher reported quality of life, and if so, what mechanisms convey this effect? We combine data from a nationally representative survey of individual Americans with a data set that describes the local sports environment in US counties. We use the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) survey data for the years 2005 through 2009 as the primary source of data on self-reported life satisfaction. In these five years, the BRFSS sampled two million respondents and the survey contained questions on both self-reported life satisfaction and information on participation in physical activity and exercise. The environmental factor we exploit to establish a causal relationship between participation in sport and happiness is the number of sports facilities and instruction providers per person in the county of residence. We collected data on the number of sports establishments from the US County Business Patterns data and merged this with the BRFSS survey data using geographic descriptors contained in both data sets. The combined data set has a usable sample of 1.6 million individuals living in 2,345 US counties. There are large differences in the number of sports establishments per person across counties in the sample, ranging from zero to 1.6 per thousand residents. Such differences in the availability of sports facilities likely reflect differences in residents' demographic characteristics and economic conditions, the local sports culture, and government provision of sports infrastructure. We posit that, for individuals with similar demographic backgrounds and income, these environmental differences, either in terms of access to facilities or in peer influence, are exogenous to individuals' tendency to participate in physical activity and to self reported well-being; thus the number of local sports facilities can be used as an instrument to explain observed individual participation in sport to analyze the causal relationship between sport participation and self-reported happiness. Our empirical model also includes an extensive list of demographic and personal control variables, as well as county level characteristics.

Our results show that individuals, despite having similar demographic and personal backgrounds, participate more actively in sports and physical activity if they live in counties that have a larger number of sports facilities per resident. These physically active individuals also report higher levels of life satisfaction. Since the number of sports establishments is unlikely to affect well-being directly, we interpret the influence on well-being as due to sports participation.

The second research question addresses the mechanism through which participation in sports and physical activity affects self reported well-being. We find that the number of sports facilities

in a county is significantly correlated with individuals' self-reported health status in the BRFSS after controlling for demographic characteristics, income and other factors. Based on this result, we interpret causation as running from participation in physical activity to health. Since self-reported health status has been consistently found to be a strong correlate of subjective well-being (Helliwell (2003)), we interpret the evidence as suggesting that part of the well-being benefit from participation in physical activity arises from the latter's ability to promote physical health, or at least the feeling of being healthy.

2 The literature on sports and happiness

Research on happiness has exploded in recent years, especially in psychology and economics. Despite this increased research, little attention has been given to the relationship between sport participation and happiness. A large literature indicating that participation in physical activity has a positive effect on mental well being exists; Fox (1999) surveyed this literature and found that exercise improves mental well-being through improved mood and self perception and is an effective treatment for clinical depression and anxiety. If exercise enhances mental well-being and mitigates the effects of depression and anxiety, then it could also affect happiness.

Economists have recently begun to explore the economic determinants of happiness, proceeding from the central role of utility, a concept closely related to happiness. Frey and Stutzer (2002) reviewed the literature and elaborates on areas where economists can learn from happiness research. A recent review, Dolan, Peasgood and White (2008), identified the effect of exercise on happiness as an important area for future research. Relatively little economic research has focused on the relationship between physical activity and happiness. Ferrer-i-Carbonell and Gowdy (2007) found that gardening, which can be a physical activity and is listed among the categories of physical activity in the BRFSS, was associated with greater self reported happiness in a reduced form regression model using data from the British Household Panel Survey. Forrest and McHale (2009) found that women who participated in sport reported higher well-being than women with similar characteristics who did not participate in sport, using data from the National Survey of Culture, Leisure and Sport in the UK in 2005-2006. Forrest and McHale (2009)'s evidence comes from a structural instrumental variables model that identifies sport participation using proximity to sports facilities as an instrument, and thus represents causal evidence about the relationship between sport participation and happiness.

Kavetsos and Szymanski (2010) investigated the effect of hosting major sporting events like the Olympic Games, the FIFA World Cup, and the UEFA European Football championship, on self reported happiness in twelve European countries over the period 1974-2004. The data used by Kavetsos and Szymanski (2010) came from the Euro-Barometer Survey Series conducted biannually by the European Commission. While hosting major sporting events differs from individual participation in sport, many host countries conduct programs aimed at increasing sport participation in conjunction with hosting major sporting events, and the ability to view major sporting events live may have some effect on sport participation. Kavetsos and Szymanski (2010) found that hosting the FIFA and UEFA championships increased happiness in the host countries, but national success in these events had no effect on reported happiness.

Clearly, research on the relationship between sport and happiness has just begun. The existing evidence comes primarily from Europe and only a handful of studies have been done. Given the expanding number of large data sets containing both happiness data and data on participation in physical activity, this literature will likely expand. The key issue for empirical analysis of the relationship between happiness and participation in physical activity is econometric identification

of participation in sport in order to eliminate the possibility of reverse causality from happiness to participation in physical activity and the other associated econometric problems associated with reverse causality. Like Forrest and McHale (2009) we use proximity to sports facilities to identify participation in physical activity in a large survey of US residents.

3 Data and empirical analysis

3.1 Data

Our data source is the The Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a state-based system of surveys that collect information on health risk behaviors, preventive health practices, and health care access in the United States. The CDC is responsible for conducting the random digit dial telephone surveys that constitute the BRFSS. The BRFSS contains information from more than 350,000 American adults age 18 and over in each year. The survey includes a question on self-reported life satisfaction beginning in 2005. In the five years since this question was added, the BRFSS has collected survey information from more than 1.9 million Americans. The BRFSS survey data are publicly available from the CDC website. Life satisfaction in the BRFSS is a measured on a 4-step scale. The survey asks: "In general, how satisfied are you with your life?" Respondents choose one of the following four answers: very satisfied, satisfied, dissatisfied, or very dissatisfied. Oswald and Wu (2010) used these data to look for objective confirmation of subjective measures of human well-being; they concluded "[a]cross America, people's answers trace out the same pattern of quality of life as previously estimated, from solely nonsubjective data ... There is a state-by-state match ($r = 0.6, P < 0.001$) between subjective and objective well-being."

Table 1 contains the descriptive statistics from the pooled 2005-2009 BRFSS sample for variables that will be used in our empirical analysis. After dropping observations with missing values, the final sample contains data on 1,589,266 respondents out of a total of 1,988,331 in the BRFSS universe. Some of the observations were dropped because they lacked valid county identifiers. All the summary statistics reported in Table 1 use the BRFSS sample weights, because the survey is unbalanced in its unweighted form (for example, it heavily samples from females).

Table 1: Summary Statistics - BRFSS data

Variable	Mean	Std. Dev.
Self-reported satisfaction: Very Dissatisfied	0.01	0.102
Self-reported satisfaction: Dissatisfied	0.044	0.205
Self-reported satisfaction: Satisfied	0.495	0.5
Self-reported satisfaction: Very Satisfied	0.451	0.498
Participation in Physical Activity	0.765	0.424
Annual household income less than $10,000	0.041	0.198
Annual household income $10,001 to $15,000	0.042	0.202
Annual household income $15,001 to $20,000	0.059	0.236
Annual household income $20,001 to $25,000	0.074	0.262
Annual household income $25,001 to $35,000	0.099	0.299
Annual household income $35,001 to $50,000	0.133	0.339
Annual household income $50,001 to $75,000	0.154	0.361
Annual household income more than $75,000	0.284	0.451

Continued on next page...

... table 1 continued

Variable	Mean	Std. Dev.
Income is unknown	0.114	0.318
Male	0.485	0.5
Age	46.015	17.529
High School education or less	0.383	0.486
Edu: Some post-secondary	0.267	0.442
College or University Degree	0.35	0.477
Single/never married	0.187	0.39
Married	0.643	0.479
Divorced/Separated/Widowed	0.169	0.375
LFS: Work for pay	0.522	0.5
Self Employed	0.085	0.279
Long term unemployed	0.023	0.148
Recently unemployed	0.037	0.189
LFS: Home maker	0.079	0.27
LFS: Student	0.048	0.213
LFS: Retired	0.159	0.365
Unable to work	0.048	0.214
Limitation on activity	0.191	0.393
Black	0.1	0.299
Hispanic	0.135	0.342
Other, non-Hispanic	0.052	0.223
Race: Multiracial; non-Hispanic	0.016	0.124

Note: These are weighted statistics in our final sample of 1,589,266 observations.

In the weighted sample, 1% of the respondents to the happiness question reported they were "very dissatisfied," 4.4% reported they were "dissatisfied," 49.5% reported they were "satisfied," 45.1% reported they were "very satisfied." The BRFSS also contains information related to sports participation. Unlike some previous year's surveys, the BRFSS from 2005 to 2009 did not ask detailed questions about participation in physical activity and sport. We use a proxy for sport participation, based on a question about leisure-time physical activity or exercise: "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" The responses are yes, no, or refused to answer; almost all responded yes or no. About 77% of respondents said they participated in physical activity or exercised in the past month. While more detail on the nature of participation in physical activity would be ideal, we believe this question contains sufficient information about participation in physical activity and sport for our purpose.

The county-level sports establishment data come from the yearly County Business Patterns (CBP) reports from the US Census Bureau. CBP "contains data covering establishments with paid employees ... in more than 3,100 counties" in the United States.[3] The CBP defines an establishment as a "single physical location at which business is conducted or services or industrial operations are performed." The CBP reports the number of establishments for most of the 1,100 industries identified in the North American Industrial Classification System (NAICS). From the

[3]Press release, U.S. Census Bureau News, "U.S. Business Employers Add 100,000 Establishments in 2007, Census Bureau Reports," THURSDAY, JULY 30, 2009. URL: http://www.census.gov/Press-Release/www/releases/archives/county_business_patterns/014105.html

NAICS we identify all establishments that provide sports facilities or sports instruction. We ignore marinas and snow skiing facilities because their specific geographic requirements (mountains and water) make them relatively rare in most counties. The establishments identified come from NAICS codes 713910 "Golf Courses and Country Clubs," 713940 "Fitness and Recreational Sports Centers," 713950 "Bowling Centers," and 611620 "Sports and Recreation Instruction." Our results are not sensitive to this relatively broad definition of sports facilities or on the inclusion of instruction providers in the establishments. Using only establishments from the "Fitness and Recreational Sports Centers" NAICS industry group produces quantitatively similar results that are all statistically significant at conventional levels.[4] We prefer the broader definition of sports establishment because it minimizes the effect of judgement about which type of establishment promotes participation in physical activity and which one does not.[5] Our use of the CBP establishment count data follows Rupasingha, Goetz and Freshwater (2006), who used CBP data to construct a county-level database of social capital. Our data, however, differs from what they have made available on line. We use more recent County Business Patterns reports to better match our sample period.

As of mid 2010, the most recent County Business Patterns (CBP) report was for 2007. We merge the yearly CBP report data between 2005 and 2007 to the BRFSS survey data by the year of interview and a county FIPS code identifier. For the surveys in 2008 and 2009, we use the 2007 CBP statistics as if they were the 2008 and 2009 statistics. There is little variation in the number of sports establishments over time in this sample period. The correlation coefficient between the 2005 establishment count per thousand residents and the 2006 count is 0.94 across counties. It is 0.92 between 2006 and 2007.

Table 2 contains descriptive statistics for the county level data that used in our analysis. The establishment count comes from the CBP reports. Other county-level data come from the county profile in the 2000 Census. We express all establishment counts in terms of number of establishments per 1,000 residents in the county. The national mean is 0.2 facilities (and sport instruction providers) per one thousand county residents; the standard deviation is 0.08.

Table 2: Summary Statistics - County Level Data

Variable	Mean	Std. Dev.	Min.	Max.
County: Sports facilities per 1000 residents	0.2	0.08	0	1.61
County: Median Household income	52009.77	13074.2	20252	107200.03
County: Population per square mile land	1949.53	6307.21	0.98	66951
County: Percent pop. in urban areas	81.34	22.52	0	100
County: Percent owner-occupied housing	66.29	10.94	19.5	89.40
County: Percent black population	11.72	12.38	0	84.7
County: Percent Hispanic population	12.49	14.73	0	98.10
County: Percent all minority	30.43	20.6	0.6	98.40

[4]In fact, the estimated well-being effect of participation is slightly larger using with the narrower definition of a sports establishment.

[5]We still must make certain choices. The NAICS contains other industry classifications related to sports that we decided not to use, because they do not appear to be closely linked to participation in sports and exercise. These industry classifications are: NAICS code 451110 "Sporting Goods Stores," 711211 "Sports Teams and Clubs," 711212 "Racetracks," 711219 "Other Spectator Sports," 711310 "Promoters of Performing Arts, Sports, and Similar Events with Facilities," and 711320 "Promoters of Performing Arts, Sports, and Similar Events without Facilities." Our results are robust to including all these establishments in the analysis.

Note: These are weighted statistics in our final sample after the county-level statistics have been merged into the BRFSS. There are 2,345 different counties in the final sample of 1,589,266 observations.

The average of the median household income level across counties is just over $52,000 in 2009 dollars. Note the substantial variation in the median level of income, population density, degree of urbanization, and composition of the population across the counties in the sample. US counties are quite heterogenous in their economic, geographic, and demographic characteristics.

We mentioned above that our empirical work is not limited by the fact that the BRFSS question on leisure-time physical activity is broader than sports. This is because we focus on the correlation between responses to these questions and the number of sports establishments in the county of residence. To the extent that such correlation exists, it most likely reflects exogenous sports-related activity, and not unobservable individual specific factors. Of course, there is potential for spurious correlation. Differences in the availability of sports facilities may reflect differences in population density, urbanization, population composition, neighborhood amenities and other factors. For this reason, we include in our empirical work an extensive list of controls at the county level.

3.2 Empirical Approach and Results

Our empirical analysis contains four steps. In step one we estimate a reduced-form regression model explaining observed variation in self reported life satisfaction; we regress self reported life satisfaction on the number of sports establishments in the county and a vector of other explanatory variables typically used in empirical happiness research. Once we establish the existence of reduced-form conditional correlation between participation in sport and physical activity and sports establishments, we proceed to a second structural approach in order to identify causality in the relationship. In step two we show that the county sports establishment count correlates positively with the probability of participation in physical activity and sport. In the third step, we use a two-stage instrumental variables approach, like that used by Forrest and McHale (2009), to examine the well-being effect of participation in sport and physical activity. Specifically, we use county establishment counts to predict the probability of participation in physical activity and sport in the first stage, and use the fitted values from this first stage as an instrumental variable for participation in the second stage. Finally, we explore health benefits as a channel through which participation in physical activity and sports affects well-being. Together these four steps provide answers to our two primary research questions: does participation in physical activity and sport raise well-being, and if so, what mechanism is at work in forging this relationship?

3.2.1 Reduced-form regression models

First, were we determine if individuals living in a county that has a larger number of sports establishments per resident reports greater life satisfaction. The empirical models control for both personal characteristics and county-level differences in important factors related to happiness. The reduced form regression model is

$$WB_{i,j} = X_i\alpha + Z_j\gamma + \beta e_j + u_i, \tag{1}$$

where the dependent variable $WB_{i,j}$ is self-reported well-being for individual i in county j. The right-hand side of the model includes a vector of demographic and personal control variables X_i, and a vector of county-level controls Z_j. The sports-establishment count in county j is e_j.

Again, the well-being measure is the answer to a standard 4 response life satisfaction question in the BRFSS. We reversed the original order of the BRFSS responses, so that 1 indicates the least

satisfied response and 4 indicates the most satisfied response. The four-step responses, strictly speaking, are not cardinal measures of happiness. But such responses are often treated as cardinal in happiness research, thus OLS or similar methods are often used to explain variation in these variables. Examples taking this approach include Di Tella et al. (2001), who used responses to a 4-step life satisfaction question from the Euro-Barometer survey to study preferences over inflation and unemployment, Ferrer-i-Carbonell and Frijters (2004) who reported that the choice of probit versus OLS makes virtually no differences in detecting the relationship between an ordinal measure of happiness and several key explanatory variables, and Helliwell and Huang (2009) who used an ordered probit approach to estimate compensating differentials for workplace characteristics and reported that probit and the linear probability model gave similar results, because changing regression methods tends to affect the estimated coefficients on right-hand side variables proportionally. The compensating differential measure used by Helliwell and Huang (2009) was based on the ratio of coefficient estimates, which remains robust to different regression methods. We make similar comparisons to assess the effect of alternative estimators. Based on OLS estimates of Equation (1), the estimated coefficient on the sports establishment count variable is 71% of the impact of moving an individual from the sixth income bracket to the seventh bracket (from $35,001-$50,000 to $50,001-$75,000). The ratio is 73% if we switch to an ordered probit model. Because the size of the estimated coefficients in well-being models does not have an easy interpretation, when using either OLS or probit, the estimated size of the effect based on ratios of coefficients appears to be consistent and sensible. Since the choice of OLS or probit models makes little difference on these ratios of estimated parameters, we use OLS, following Oswald and Wu (2010), who use the same self-reported life satisfaction question responses from the BRFSS and also use OLS.

The demographic and individual control vector, X_i, includes age, age squared, gender, marital status, educational attainment, household income, racial/ethnicity indicators, and detailed employment status variables. All are commonly used explanatory variables in empirical happiness research. Oswald and Wu (2010) use the same vector of explanatory variables. We expand the vector of explanatory variables to include a dummy variable derived from the response to the BRFSS question: "Are you limited in any way in any activities because of physical, mental, or emotional problems" because activity limitations likely affects participation in sports as well as well-being; later we will use the same set of individual explanatory variables to explain variation in participation, so it is useful to include the variable here. In our sample 20% of respondents reported activity limitations. One additional variable in X_i also reflects activity limitations, the employment status "unable to work;" 4% of the sample reported they were unable to work. Individuals unable to work may also be unable to participate in sport and physical activity.

The county-level vector of control variables, Z_j, contains the log of the county population density, the percentage of the county population living in urban areas, the racial composition of the county, the percentage of owner-occupied housing (to measure the stability of the population and wealth) in the county, the log of median household income (to measure economic conditions), and state dummy variables to capture unobservable state specific factors that affect sport participation like climate. All of the county-level control variables come from the year-2000 census profile except for median household income, which is from the 2005-07 USA Counties data file. The median income is not available for the year 2008 and 2009 yet; we use the 2007 value for these latter two years. Note that it is particularly important to control for population density in this setting. Higher population density is correlated with a smaller number of sports facilities per capita. But it is likely related to a lack of other facilities and low provision of public services that may adversely affect well-being in the county. Existing research has already shown a negative relationship between population density and well-being (Dolan et al. (2008)). By controlling for population density, we reduce the chance that the correlation between sports facilities and well-being is spurious. We

experimented with the population density in linear, logarithmic, and quadratic forms. The logged transformation minimizes the size of the estimated coefficient on the sports establishment count variable and the t-statistics. All regressions allow the errors term to cluster at the county level, and use the overall weighting variable in the BRFSS, which allows us to draw conclusions about the entire population of the US from the results.

Table 3 contains the regression results for the reduced form model. The model explains about 13% of the observed variation in self reported happiness. The parameter estimate on the count of sports facilities and instruction providers in the county is positive and statistically significant at the 1% level; individuals in counties with more sports facilities report greater happiness, other things equal.

Table 3: Regression Results - Dependent Variables are Self-reported Life Satisfaction and Participation in Physical Activity, Respectively

	LifeSatisfaction	**Participation**
Variables	(1)	(2)
Sports facilities per 1000 residents	0.078	0.092
	(0.023)***	(0.012)***
Omitted group: income b/w $35,001 to $50,000		
Annual household income less than $10,000	-.134	-.071
	(0.008)***	(0.006)***
Annual household income $10,001 to $15,000	-.114	-.075
	(0.012)***	(0.005)***
Annual household income $15,001 to $20,000	-.093	-.058
	(0.005)***	(0.004)***
Annual household income $20,001 to $25,000	-.073	-.052
	(0.005)***	(0.004)***
Annual household income $25,001 to $35,000	-.038	-.023
	(0.005)***	(0.004)***
Annual household income $50,001 to $75,000	0.06	0.023
	(0.004)***	(0.002)***
Annual household income more than $75,000	0.152	0.055
	(0.004)***	(0.002)***
Income is unknown	0.021	-.021
	(0.004)***	(0.003)***
Omitted group: Female		
Male	-.025	0.034
	(0.002)***	(0.002)***
Age	-.009	-.0005
	(0.0004)***	(0.0003)*
Age squared/100	0.011	-.002
	(0.0004)***	(0.0003)***
Omitted group: Some college or tech. school		
High School education or less	-.023	-.077
	(0.003)***	(0.002)***
College or University Degree	0.064	0.047
	(0.002)***	(0.002)***
Omitted group: Single never married		
Married	0.15	-.015
	(0.004)***	(0.003)***

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	LifeSatisfaction	Participation
Variables	(1)	(2)
Divorced/Separated/Widowed	-.016	-.020
	(0.004)***	(0.003)***
Omitted group: Employed for wages		
Self Employed	0.017	0.029
	(0.004)***	(0.002)***
Long term unemployed	-.207	0.007
	(0.008)***	(0.007)
Recently unemployed	-.184	0.016
	(0.007)***	(0.005)***
LFS: Home maker	0.031	0.031
	(0.004)***	(0.003)***
LFS: Student	0.068	0.065
	(0.007)***	(0.004)***
LFS: Retired	0.067	0.065
	(0.003)***	(0.003)***
Unable to work	-.210	-.117
	(0.006)***	(0.005)***
Limitation on activity	-.242	-.119
	(0.003)***	(0.002)***
Omitted group: White		
Black	-.019	-.049
	(0.004)***	(0.004)***
Other, non-Hispanic	-.060	-.061
	(0.009)***	(0.004)***
Hispanic	0.011	-.075
	(0.006)**	(0.003)***
Race: Multiracial; non-Hispanic	-.045	0.004
	(0.01)***	(0.006)
County: Log Median Household income	-.036	-.0006
	(0.008)***	(0.006)
County: Log pop. per square mile	-.009	0.0006
	(0.002)***	(0.001)
County: Percent pop. in urban areas	0.00003	0.0002
	(0.00008)	(0.00006)***
County: Percent owner-occupied housing	0.0001	-.0002
	(0.0002)	(0.0002)
County: Percent black population	0.0003	-.0006
	(0.0003)	(0.0003)**
County: Percent Hispanic population	0.0002	-.0007
	(0.0003)	(0.0003)**
County: Percent all minority	-.0003	0.0002
	(0.0003)	(0.0003)
State effects	included	included
Obs.	1589266	1589266
R^2	0.129	0.1

*Notes: (1) the variables shown on the top row are dependent variables. (2) The numbers in the parentheses are standard errors. (3) *, **, and *** indicate statistical significance at 10%, 5% and 1% levels.*

Other than the coefficient on sports facilities, most parameter estimates in Table 3 are similar to those found in empirical happiness research. Self reported life satisfaction increases with individual income. However, it also decreases with county-level income, suggesting that relative income

also affects happiness. Married couples are happier than never-married singles, while the latter are happier than the divorced/separated/widowed. Being unemployed is associated with a large reduction in self reported well-being. Whites report higher happiness than minorities; but this may not be robust to using different measures of well-being. Males report lower happiness than females, consistent with other results in the empirical happiness literature and with the much higher suicide rate among males. These results establish existence of reduced form conditional correlation between county-level establishments counts and the self reported happiness of individuyals in those counties. Next, we turn to an analysis of the determinants of participation in physical activity and sport.

3.2.2 Sports establishments and participation in physical activity

In this section, we further explore the relationship between the number of sports establishments in a county and individual participation in physical activity and sport. We hypothesize that the establishments affect well-being primarily by encouraging individual residents to participate in physical activity and sports. A larger number of sports establishments implies easier access to facilities and/or more importance placed on sports and exercise in the community. We again emphasize our exogeneity assumption. At the aggregate level, the number of sports establishment is not exogenous to features specific to geographic areas. A county that has larger numbers of young, male, and affluent residents naturally has greater demand for sports facilities. The supply of facilities will respond and the number of sports establishments in the area will increase. But at the individual-level, variation in these environmental factors are exogenous to an individual's incentive to participate in sport and physical activity, controlling for individual demographic and personal characteristics such as age, gender, income, marital status, labor force status, race, and activity limitations.

Are establishment counts and participation in physical activity and sport correlated? To answer this question, we estimate the following linear probability model

$$P_{i,j} = X_i\alpha + Z_j\gamma + \beta e_j + v_i, \tag{2}$$

The dependent variable in Equation (2), $P_{i,j}$, is a dummy variable that indicates the response to the BRFSS physical activity question. We use a linear probability model, as opposed to a probit model, because we plan to use the predicted probability of participation in the instrumental variables approach in the next step of the analysis. The literature on instrumental variables does not recommend using the predicted probability from a non-linear probit or logit model as an instrument in the second stage regression (see for example Angrist and Krueger (2001)). For that approach to generate consistent estimates in the second stage, the non-linear model in the first stage has to be specified exactly right; the danger of misspecification of a non-linear first stage regression model is high. Following the recommendations in Angrist and Krueger (2001), we use the OLS estimator to generate the first-stage estimated probability of participation, since the consistency of the estimates in the second stage IV estimation does not require the first stage functional form to be right. A linear probability model is often criticized for generating predictions outside the 0 and 1 range. In our sample, this is not a problem, because 99.7% of the predicted values from the first stage linear model lie between 0 and 1; there are no outliers below zero, and the maximum predicted value is 1.11.

The explanatory variables in Equation (2) are the same as those in the reduced-form well-being equation, Equation (1). The demographic and personal controls are contained in X_i, which includes age, gender, marital status, educational, income, racial/ethnicity, employment status, and limitation on activity. The vector of county-level control variables, Z_j, includes logged population

density, an urbanization indicator, population racial composition variables, county home ownership rate, the log of median county household income, and state dummy variables. The establishment count at the county level is e_j.

The right-hand column of Table 3 contains the parameter estimates from Equation (2). These results show that the more sports establishments in a county, the higher the probability that an individual living in that county will participate in physical activity or sport. In Equation (2), the coefficient estimate on the total establishment count is positive and significantly different from zero at the 1% level.[6] The F statistic for excluding the establishment count variable is 55, indicating that this variable provides a good exclusion restriction for the IV estimator used in the next section. The coefficient on the establishment count variable is rather small. An increase of one establishment for every 10,000 residents, about a standard deviation, is associated with about 0.9% higher probability of participation.

The estimated parameters on the other variables in Equation (2) are consistent with results in other research on the economic determinants of participation in physical activity (Humphreys and Ruseski (2007, 2009)). Participation in physical activity rises with income and education and falls with age; males participate more than females, and whites participate more than minorities. The results from this model form the basis of a structural IV approach to examining the relationship between participation in physical activity and happiness in the following section. The fitted values from this regression will be used as an instrument in the second stage regression of the determination of self reported happiness.

3.2.3 Participation in physical activity and subjective well-being: IV results

Next, we use a two-stage instrumental variable (IV) approach to estimate the effect of participation in physical activity on well-being. We use the IV approach to identify participation in physical activity using environmental factors exogenous to unobservable individual-specific factors affecting participation. Specifically, we use the predicted participation probability from estimates of Equation (2) as a right-hand side variable to explain self reported well-being. The coefficient on the fitted probability of participating in physical activity can be interpreted as the effect of participation on well-being. The consistency of this estimate hinges on two factors: the exogenous environmental factors cannot affect well-being directly, and affect individuals' participation in physical activity and sport. The number of sports establishments in the county of residence should satisfy these conditions.

The second stage regression model is

$$WB_{i,j} = X_i\alpha + Z_j\gamma + \beta\hat{P}_{i,j} + u_i, \tag{3}$$

where the fitted values from the first stage regression are $\hat{P}_{i,j}$, which comes from Equation (2). The vector of variables X_i contains demographic and personal characteristics including age, gender, marital status, educational, income, racial/ethnicity, employment status, and an indicator variable for limitation on activity. The vector of county-level control variables, Z_j, includes the log of population density, an urbanization indicator variable, population racial composition variables, the county home ownership rate, the log of median county household income, and state dummy variables. Standard errors have been corrected for clustering at the county level.

[6] The same sign and similar statistical significance are also found in a probit model.

Table 4: IV Estimates, Self-reported Life Satisfaction and Participation in Physical Activity

Variable	Pooled	Male	Female
Predicted participation probability	0.851	1.162	0.541
	(0.246)***	(0.394)***	(0.211)**
Omitted group: income b/w $35,001 to $50,000			
Annual household income less than $10,000	-.074	-.032	-.107
	(0.019)***	(0.031)	(0.017)***
Annual household income $10,001 to $15,000	-.051	-.001	-.093
	(0.021)**	(0.036)	(0.017)***
Annual household income $15,001 to $20,000	-.044	-.007	-.080
	(0.015)***	(0.024)	(0.014)***
Annual household income $20,001 to $25,000	-.029	0.002	-.059
	(0.014)**	(0.022)	(0.012)***
Annual household income $25,001 to $35,000	-.018	-.005	-.032
	(0.007)**	(0.011)	(0.007)***
Annual household income $50,001 to $75,000	0.041	0.036	0.047
	(0.007)***	(0.011)***	(0.006)***
Annual household income more than $75,000	0.105	0.091	0.121
	(0.014)***	(0.023)***	(0.013)***
Income is unknown	0.038	0.053	0.024
	(0.006)***	(0.01)***	(0.006)***
Omitted group: Female			
Male	-.054		
	(0.009)***		
Age	-.008	-.010	-.006
	(0.0004)***	(0.0006)***	(0.0005)***
Age squared	0.012	0.014	0.01
	(0.0006)***	(0.001)***	(0.0006)***
Omitted group: Some college or tech. school			
High School education or less	0.042	0.067	0.016
	(0.019)**	(0.03)**	(0.017)
College or University Degree	0.024	0.006	0.043
	(0.012)**	(0.019)	(0.01)***
Omitted group: Single never married			
Married	0.164	0.197	0.127
	(0.006)***	(0.008)***	(0.006)***
Divorced/Separated/Widowed	0.001	0.012	-.018
	(0.006)	(0.011)	(0.007)***
Omitted group: Employed for wages			
Self Employed	-.008	-.025	0.02
	(0.008)	(0.013)*	(0.008)**
Long term unemployed	-.213	-.253	-.171
	(0.008)***	(0.014)***	(0.008)***
Recently unemployed	-.198	-.206	-.188
	(0.008)***	(0.014)***	(0.01)***
LFS: Home maker	0.005	-.094	0.029
	(0.008)	(0.025)***	(0.008)***
LFS: Student	0.013	0.001	0.027
	(0.018)	(0.028)	(0.017)
LFS: Retired	0.011	-.003	0.032
	(0.016)	(0.027)	(0.014)**

Continued on next page...

Variable	Pooled	Male	Female
Unable to work	-.110	-.080	-.139
	(0.029)***	(0.047)*	(0.026)***
Limitation on activity	-.141	-.089	-.190
	(0.029)***	(0.047)*	(0.026)***
Omitted group: White			
Black	0.023	0.053	-.007
	(0.013)*	(0.02)***	(0.011)
Other, non-Hispanic	-.009	0.012	-.029
	(0.018)	(0.029)	(0.015)*
Hispanic	0.075	0.12	0.027
	(0.019)***	(0.03)***	(0.017)
Race: Multiracial; non-Hispanic	-.048	-.038	-.059
	(0.01)***	(0.014)***	(0.012)***
County: Log Median Household income	-.036	-.041	-.033
	(0.008)***	(0.011)***	(0.01)***
County: Log pop. per square mile	-.009	-.010	-.009
	(0.002)***	(0.003)***	(0.002)***
County: Percent pop. in urban areas	-.0001	-.0003	1.00e-05
	(0.0001)	(0.0001)**	(0.0001)
County: Percent owner-occupied housing	0.0003	0.0004	0.0001
	(0.0002)	(0.0003)	(0.0003)
County: Percent black population	0.0008	0.0007	0.0008
	(0.0003)**	(0.0004)*	(0.0005)*
County: Percent Hispanic population	0.0007	0.001	0.0003
	(0.0003)**	(0.0004)***	(0.0004)
County: Percent all minority	-.0004	-.0003	-.0006
	(0.0003)	(0.0003)	(0.0004)
State effects	included	included	included
Obs.	1589266	600040	989226
R^2	0.129	0.128	0.132

*Notes: (1) the variables shown on the top row are dependent variables. (2) The numbers in the parentheses are standard errors. (3) *, **, and *** indicate statistical significance at 10%, 5% and 1% levels.*

Table 4 reports the estimates. The contribution to self reported well being from participating in sports is 0.85.[7] The estimated coefficient is four times as big as the coefficient on being unemployed. Note that the coefficient measures the well-being impact of a change in the predicted probability from zero to one, a large jump that is equivalent to 7 standard deviations in these data. From Table 3 in Forrest and McHale (2009) we observe that the coefficient on the same fitted value is two times of the size of the coefficient on unemployment in their sample. Why is our estimate twice as big? We speculate that the difference in the definition of participation is important. Our study has a much broader definition of participation in physical activity; the percentage of people who are not participating at all is 23%, as opposed to 52% reported by Forrest and McHale (2009) in the UK. With a broader definition of participation, the consequence of not participating may be more severe. The hypothesis, unfortunately, can only be tested with data that have detailed information on sport participation, which the BRFSS between 2005 and 2009 do not contain.

We also estimated this IV model separately for males and females, since Forrest and McHale (2009) report a differences in the effect of sport participation on happiness by gender. These results

[7]The estimated coefficient is 0.91 if we use the narrowest definition of sports facilities including only the "Fitness and Recreational Sports Centers."

are shown in the last two columns on Table 4. The male subsample had 600,040 observations and the female subsample had 989,266. We find that both genders benefit from participating in sports; both samples produce positive and significant coefficients on the participation variable. Furthermore, male Americans appear to gain more happiness from participating in physical activity than females. Our findings regarding gender differ from those in Forrest and McHale (2009), which finds a significant beneficial effect only for females in a British sample. However, the types of physical activities that males in the UK participate in, like football and rugby, may differ from the type of physical activities that males in the US participate in.

The other parameter estimates on Table 4 are similar to the reduced form estimates from Equation (1) reported on the first column of Table 3. Happiness rises with income and education and falls with age. Married people report being happier than singles, and the employed report being happier than the unemployed. Note that people living in higher income counties are not as happy as people living in lower income counties, holding individual income constant. This result is consistent with the idea that relative income affects happiness. In counties with a higher median income, an individual is more likely to observe or interact with someone who earns more than they do, reducing the individual's happiness. Clark et al. (2008) provides an extensive review on economists' effort to document and understand the source for relative income's effects on self reported happiness. Dolan et al. (2008) also provide a relevant review of this literature.

3.2.4 Health benefits as transmission mechanism

How does participating in physical activity and sports affect self reported well-being? One hypothesis is that participation improves the quality of life by improving health. Happiness research generally finds health to be an important correlate of well-being. Helliwell (2003), for example, finds that self-reported health is always the most significant of all of the explanatory variables for life satisfaction across alternative model specifications. It is also well-accepted that active life styles are conductive to better physical health. At the individual level, participation in physical activity and health are positively correlated, although such association may arise from common factors; it is also likely that the causation flows from unobserved physical capability to participation in physical activity. As a result, it is not easy to interpret the simple conditional correlation between physical activity and health. Again, we believe that exploring differences in the external sports environment overcomes such problems. In this section, we explore determine if the presence of sports establishments in a county is correlated with individuals' self-reported health status.

A reduced form regression model captures the relationship between the sports environment and self-reported health status

$$H_{i,j} = X_i\alpha + Z_j\gamma + \beta e_i + u_i. \tag{4}$$

The dependent variable is self reported health status, derived from the response to the BRFSS question "Would you say that in general your health is: Excellent, Very good, Good, Fair, or Poor?" We assign the five responses to this question values from 1 to 5 in an ascending order. We treat it as cardinal; treating them as ordinal and using ordered probit generated similar positive and significant coefficient estimates on the sports establishment count variable. The regression model controls for the same sets of individual and county level factors as used above. These controls include age, gender, activity limitation, race, income at the individual, among others, and median income and logged population density at the county level, among others.

We focus on estimates of β, the coefficient on the county level establishment count variable. A positive estimate of β suggests that, despite similar backgrounds, people tend to say they are healthier if they live in an area that has more sports establishments. How does the causation

run in this case? We interpret the causation as flowing from sports establishments, via sports participation, to self reported health. The reverse causality interpretation, where causality flows from individual health to the county sports environment, requires that individuals' unobservable health characteristics, independent of their age, gender, income, activity limitation, race and others, somehow tend to live together and have greater demand for local sports facilities. We regard such an interpretation as implausible, especially after controlling for county-level differences in income, population composition, population density, and unobservable state-specific effects.

The parameter estimates of Equation (4) are not reported, but they are available from the authors on request. The results show that the coefficient on the sports establishment count variable is positive and significantly different from zero with a t-statistic of 8.1 and an F-statistic of 65. The estimates from Equation (4) indicate a statistically significant link between participation in physical activity and sport and self reported health status. In addition to these results, we looked for evidence linking participation in physical activity and health at the aggregate level. The Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute published U$\dot{S}\dot{C}$ounty Health Rankings in 2010. They measured health outcomes based on premature deaths, birth outcomes, and health-related quality of life (the latter is from the same BRFSS data as we use here). We found that the county level sports establishment count per person is a strong predictor of cross-county differences in the ranking of health outcomes as reported in this ranking. Such analysis at the aggregate level suffers from the fact that population compositions differ across counties: a younger population is healthier and also demands more sports facilities. This contrasts to the approach taken here; we overcome the confounding effects of county population composition by focusing on similar individuals and exploit differences in proximity to sports facilities. Taken together, these results suggest that health plays an important role in the relationship between participation in physical activity and sport and happiness, and suggests an important area for future research on this topic.

4 Conclusion

We address two research questions: does participating in physical activity and sports improve happiness, and if so, what is the underlying transmission mechanism? Obtaining causal evidence to help answer the first question requires some care. Simply regressing individuals' reported happiness on an indicator of participation in physical activity suffers from endogeneity problems and possible reverse causality. We address this problem by exploiting differences in proximal environmental factors that influence participation in physical activity to statistically identify participation. Specifically we used the number of sports facilities and instruction providers in the county of residence as an instrument in an IV model of the determination of happiness and participation in physical activity. The results of this IV estimation indicate that otherwise-similar individuals are more likely to participate in physical activity and sport if living in a county that has greater access to sports establishments; those individuals also report higher life satisfaction. The estimated contribution to life satisfaction from a 0 to 1 change in the probability of participation is four times the size of the coefficient on unemployment status. Both men and women gain happiness from participating in physical activity, and men appear to benefit more. Our results control for demographic and personal characteristics including age, gender, education, income, marital status, limitation on physical activity, races, and employment status. We also control for cross-county differences in income, density, urbanization, population stability, and population's racial composition. We also develop evidence that the relationship between participation in physical activity and happiness relates to the effect of physical activity on health.

Our results suggest that the effects of increased participation in physical activity extend beyond previous boundaries; in addition to previously documented reductions in obesity and improvements in health, participation in physical activity also appears to increase happiness in the general population. This broader impact of physical activity provides additional evidence supporting government policies to increase participation in physical activity in the general population. In addition, our results suggest that the ongoing discussion about policies designed to increase participation in physical activity should not be isolated from the discussion on spending on public health. The key role played by access to establishments related to physical activity and sport also highlights the importance of the supply of sports facilities in any policy intervention designed to increase participation in physical activity, and suggests that additional research should focus on this poorly understood topic.

Our results differ in several important ways from existing studies in this area, suggesting several important avenues for future research. We find that both men and women in the US gain additional happiness from participating in physical activity, while Forrest and McHale (2009) in a similar study using data from the UK find that only females gain additional happiness from participation in physical activity. This observed difference in the effect of physical activity on happiness in two similar populations suggests that important economic, cultural, or environmental differences may exist between the US and the UK. Understanding the role these differences play would move the happiness literature, and the literature on participation in physical activity, forward in an important way. Also, we develop evidence that the relationship between participation in physical activity and happiness is mediated by health. This result suggests that physical activity may play a role in the production of health, and also be related to happiness. Models of health production, and the related empirical research on health production, would appear to be a good jumping off point for additional research in this area.

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Appendix A: Data

All data used in this paper are from public sources as described in the text. More information, including the STATA codes used to compile the final sample, is available at

http://www.ualberta.ca/~haifang/index.htm, which also provides the link to the alternative set of tables produced using the narrowest definition of sport facilities. (Note: please type the address on your web browser; clicking the link in the PDF does not work due to some quirks with the Latex).

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