Confidence Interval Estimates of the Average Time Americans 15 Years and Older Spend per Day by Engaging in Physical Activities

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Abstract
Regular physical activity is one of the most important things people can do to keep healthy. Engaging in physical activity at an early stage is recommended to prevent future occurrence of chronic health conditions. In this study, we utilize American Time Use Survey 2018 data to determine confidence interval estimate of average time Americans 15 years and older spend by engaging in physical activities. This study allows us to investigate the average time engagement discrepancies due to socio-demographic factors of the survey participants. We utilize SAS proc surveymeans and proc surveyreg for doing weighted and other factors adjusted estimate of the specified phenomena using the available survey data.

Key Words: Confidence interval, Survey data, Average time, Physical activity, American Time Use Survey

1. Introduction

The American Time Use Survey (ATUS, [1]), sponsored by the Bureau of Labor Statistics (BLS) and conducted by the U.S. Census Bureau, provides useful activity information of Americans 15 years and older. It collects the activity information, for each reported activity in a 24-hour day in 17 broad categories. They are (1) Personal care, (2) Household activities; (3) Caring for and helping household members; (4) Caring for and helping non-household members; (5) Work and work related activities; (6) Education; (7) Consumer purchases; (8) Professional and personal care services; (9) Household services; (10) Government services and civil obligations; (11) Eating and drinking; (12) Socializing, relaxing, and leisure; (13) Sports, exercise, and recreation; (14) Religious and spiritual activities; (15) Volunteer activities; (16) Telephone calls; and 17) Traveling. The detailed information of the activity categories and the coding of collected data are well documented by ATUS [2-4].

In this study, we concentrate in Americans time usage by engagement in physical activity. Physical activity refers to any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level [5, 6, 7]. It includes any subset of physical activity that enhances health. The physical activity will be measured from the participation of respondents in active sports, exercise and recreational activities, which exclude any utilitarian physical activity such as physical effort as part of work or household tasks.

As per the physical activity guidelines for Americans [5], regular physical activity is one of the most important things people can do to improve their health. Physical activity results in many health benefits such as lowering risk and severity of chronic diseases (including heart disease, diabetes, and some cancers), lowering mortality rates, and improving mental health and physical well-being [5, 6]. However, many Americans do not comply with the guideline recommendations. In this study, we utilize the ATUS 2018 data to evaluate

physical activity of Americans 15 years and above who engage in such activities. We investigate the average time use discrepancies due to gender, ethnicity, income and other socio-demographic factors. We also investigate the average time due to sports specific engagement of those who engage in such activities. This approach will allow us to supplement estimation certainty to BLS approach of accommodating point estimates of the underlying parameters [8].

2. Methods

We analyze ATUS 2018 data from the 1,746 qualifying respondents aged 15 years or older to estimate Americans average time engagement in sports and exercise activities. We carry out subpopulation analysis via Proc Surveyfreq, Proc Surveymeans and Proc Surveyreg due to sociodemographic characteristics by incorporating appropriate survey weights. This study extends the BLS approach that provides the point estimate of the average time 15 years and older spend per day by engaging in various sports and exercise activities [8]. The BLS also provides percent engagement on various activities via point estimates. The point estimate of any parameter, the average time spent, or percent engaged in a given activity is a single number estimated from a sample. While a point estimate provides a quick snapshot of an underlying parameter, it is subject to the estimation uncertainty due to the sampling error. The confidence interval (CI) estimate, on the other hand, provides estimation certainty by taking into the margin of error of the point estimate and capturing the unknown parameter with a specified certainty or confidence. Therefore, we wish to supplement the BLS point estimates by confidence interval estimates, along with test of hypothesis. To be consistent with the BLS approach, we also provide the sports specific confidence interval of estimates of average engagement in sports specific activities. The Americans engagement in sports and exercise activities may depend on the characteristics of the survey participants. Therefore, for the completeness of the study, we investigate average time engagement in sports and exercise activities due to various sociodemographic factors.

We utilize ATUS data dictionary and coding book to create categorical data similar to BLS for computing CI estimates and study the socio-demographic discrepancies of those engaged in sports and exercise activities. We hypothesize that there will be significant discrepancies in the average time engagement of Americans 15 years and older in sports and exercise activities due to income, education, gender, labor force participation status, age, etc.

3. Results

The ATUS 2018 had 9593 respondents with only 1746 respondents qualifying for the study due to their engagements in active sports and exercise. In Tables 1-5, we provide analysis of Americans engaged in sports and exercise activity due to different socio-demographic factors. As we see, from the results of Table 1, the participation discrepancies in sports and exercise activities among Americans 15 years and older are statistically significant due to gender, geographical region, participation in labor force, income, and other factors under consideration in the study. In Table 2, unadjusted time engagement in hour/per day, whereas Tables 4-5, provides adjusted time engagement in hour/day due to multiple regression, where an effect is adjusted for the effects of other factors in the model. Table 3 reports sports specific engagement in hour/day which supplements the BLS point estimates of sports specific engagement.

Table 1. Analysis of socio-demographic discrepancies of respondents engaged in sports and exercise activities

Characteristics	Frequency	Percent	StdErr	chisq	pvalue
All	N=1746	100			
Gender					
Male	895	53.19	1.61		
Female	851	46.81	1.61	3.93	0.0476
Geographical Region					
Northeast	279	17.23	1.29		
Midwest	362	19.76	1.23		
South	604	35.46	1.55		
West	501	27.55	1.43	77.59	<.0001
Participation in labor force					
Yes	1067	59.94	1.61		
No	679	40.06	1.61	36.55	<.0001
Family income					
< 25,000	275	13.64	1.13		
2: 25,000-49,999	340	17.38	1.13		
3: 50,000-74,999	341	21.66	1.38		
4:75,000+	790	47.32	1.61	269.99	<.0001
Race ethnicity					
White only	1200	65.80	1.57		
Black only	162	9.73	0.93		
Hispanic only	243	16.83	1.35		
Others	141	7.65	0.80	856.03	<.0001
Age group					
15-24	167	20.06	1.63		
25-60	994	53.74	1.63		
60+	585	26.21	1.24	160.02	<.0001
Marital status					
Married	880	52.25	1.62		
Widowed	151	5.02	0.49		
Divorced/Separated	276	9.36	0.75		
Never married	439	33.37	1.67	724.09	<.0001
Educational status					
Below HS dip	180	15.15	1.35		
HSGrad or GED	290	20.15	1.34		
Some college or Associate degree	391	20.89	1.33		
Bachelor's degree	487	25.63	1.33		
Master or Higher	398	18.18	1.11	27.56	<.0001
Nativity					
Native	1433	82.59	1.18		
Naturalized citizen	184	9.71	0.89		
Not a citizen	129	7.70	0.85	1133.18	<.0001

Table 2. Estimate of average time Americans 15 years and older spend engaging in sport and exercise activities

Characteristics	Mean	StdErr	95% CI
All sports	1.5	0.05	(1.4, 1.6)
Gender			
Male	1.6	0.07	(1.5, 1.8)
Female	1.3	0.05	(1.2, 1.4)
Geographical Region			
Northeast	1.5	0.1	(1.3, 1.7)
Midwest	1.5	0.1	(1.3, 1.7)
South	1.5	0.08	(1.3, 1.6)
West	1.4	0.09	(1.3, 1.6)
Participation in labor force			
Yes	1.4	0.05	(1.3, 1.5)
No	1.6	0.08	(1.4, 1.7)
Family income			
< 25,000	1.4	0.14	(1.2, 1.7)
25,000-49,999	1.5	0.09	(1.3, 1.6)
50,000-74,999	1.7	0.13	(1.5, 2.0)
75,000+	1.4	0.06	(1.3, 1.5)
Race ethnicity			
White only	1.5	0.05	(1.4, 1.6)
Black only	1.3	0.12	(1.1, 1.6)
Hispanic only	1.6	0.15	(1.3, 1.9)
Others	1.1	0.09	(0.9, 1.3)
Age group			
15-24	2.1	0.15	(1.8, 2.4)
25-60	1.3	0.05	(1.2, 1.4)
60+	1.3	0.06	(1.2, 1.4)
Marital status			
Married	1.3	0.05	(1.2, 1.4)
Widowed	1.1	0.11	(0.9, 1.3)
Divorced/Separated	1.6	0.11	(1.4, 1.8)
Never married	1.8	0.1	(1.6, 2.0)
Educational status			
Below HS dip	1.7	0.12	(1.5, 1.9)
HSGrad or GED	1.5	0.14	(1.3, 1.8)
Some college or Associate's degree	1.8	0.11	(1.5, 2.0)
Bachelor's degree	1.3	0.06	(1.1, 1.4)
Master or Higher	1.2	0.06	(1.1, 1.3)
Nativity			
Native	1.5	0.05	(1.4, 1.6)
Naturalized citizen	1.2	0.08	(1.0, 1.4)
Not a citizen	1.4	0.18	(1.0, 1.7)

Table 3. Estimate of average time (in hour) Americans 15 years and older spend in sport specific activity upon engagement of such activities in 2018

Sports and exercises	Mean	StdErr	ci
All sports	1.5	0.05	(1.4, 1.6)
Aerobics	1.0	0.19	(0.6, 1.3)
Baseball/softball	2.0	0.61	(0.8, 3.2)
Basketball	2.0	0.26	(1.5, 2.5)
Cycling	1.3	0.17	(1.0, 1.7)
Others	1.8	0.11	(1.5, 2.0)
Boating	3.5	0.88	(1.8, 5.2)
Bowling	2.1	0.34	(1.5, 2.8)
Dancing	2.2	0.25	(1.7, 2.7)
Football	2.0	0.37	(1.3, 2.7)
Golfing	3.4	0.46	(2.5, 4.3)
Hiking	2.3	0.35	(1.7, 3.0)
Racquet sports	2.8	0.36	(2.1, 3.6)
Running	1.0	0.06	(0.9, 1.1)
Soccer	1.8	0.25	(1.3, 2.3)
Cardiovascular equipment	1.0	0.10	(0.8, 1.2)
Walking	1.0	0.06	(0.9, 1.1)
Swimming, surfing, water skiing	2.4	0.23	(1.9, 2.8)
Weightlifting	1.4	0.19	(1.0, 1.8)
Yoga	1.0	0.08	(0.8, 1.1)

Table 4. Tests of multiple regression model effects for the analysis of time engagement of Americans 15 years and older in sport and exercise

Effect	Num DF*	F Value	Pr > F
Model	22	4.28	**<.0001**
Intercept	1	289.17	**<.0001**
Gender	1	19.7	**<.0001**
Age group	2	7.96	**0.0004**
Geographical Region	3	0.15	0.9279
Marital Status	3	1.71	0.1624
Family income	3	1.31	0.2678
Participation in labor force	1	1	0.3168
Educational Status	4	3.56	**0.0067**
Nativity	2	0.72	0.4885
Race/ethnicity	3	3.34	**0.0186**

*Num DF=The numerator degrees of freedom; the denominator degrees of freedom for the F tests is 1745.

Table 5. Multiple regression analysis of time engagement of Americans 15 years and older in sport and exercise

Parameter	Estimate	StdErr	tValue	Probt	ci
Intercept	0.6	0.25	2.58	0.0099	(0.2, 1.1)
Gender					
Male	0.4	0.08	4.44	**<.0001**	(0.2, 0.5)
Female	-	-	-	-	-
Age group					
15-24	0.8	0.20	3.99	**<.0001**	(0.4, 1.2)
25-60	0.1	0.11	1.13	0.2588	(-0.1, 0.3)
60+	-	-	-	-	-
Geographical Region					
Midwest	-0.1	0.13	-0.41	0.6833	(-0.3, 0.2)
South	0.0	0.12	-0.08	0.9351	(-0.3, 0.2)
West	-0.1	0.13	-0.51	0.6136	(-0.3, 0.2)
Northeast	-	-	-	-	-
Marital status					
Divorced/Separated	0.4	0.16	2.21	**0.0269**	(0.0, 0.7)
Married	0.2	0.14	1.16	0.2447	(-0.1, 0.4)
Never married	0.2	0.16	1.07	0.2867	(-0.1, 0.5)
Widowed	-	-	-	-	-
Family income					
<25,000	0.1	0.15	0.39	0.7001	(-0.2, 0.4)
25,000-49,999	0.0	0.11	0	0.9968	(-0.2, 0.2)
50,000-74,999	0.3	0.13	1.91	0.056	(-0.0, 0.5)
75,000+	-	-	-	-	-
Participation in labor force					
Yes	-0.1	0.11	-1	0.3168	(-0.3, 0.1)
No	-	-	-	-	-
Educational status					
Below HS dip	-0.1	0.19	-0.28	0.7789	(-0.4, 0.3)
HSGrad or GED	0.2	0.13	1.4	0.161	(-0.1, 0.4)
Some college or Associate's degree	0.3	0.12	2.92	**0.0035**	(0.1, 0.6)
Bachelor's degree	0.0	0.09	0.03	0.9776	(-0.2, 0.2)
Master or Higher	-	-	-	-	-
Nativity					
Native	-0.1	0.20	-0.75	0.4511	(-0.5, 0.2)
Naturalized citizen	-0.2	0.17	-1.16	0.2462	(-0.5, 0.1)
Not a citizen	-	-	-	-	-
Race/ ethnicity					
White only	0.4	0.15	2.57	**0.0101**	(0.1, 0.7)
Black only	0.1	0.17	0.75	0.4504	(-0.2, 0.5)
Hispanic only	0.3	0.17	1.94	0.0521	(-0.0, 0.6)
Others	-	-	-	-	-

4. Discussions and Conclusions

A point estimate of a parameter is not always desirable to researchers and policy makers because it is subject to the estimation uncertainty due to the sampling error. A confidence interval (CI) estimate, on the other hand, reduces the estimation uncertainty by taking into account the margin of error of the point estimate and capturing the unknown parameter with a specified confidence. In this study, we provide confidence interval estimates of average time Americans 15 years and older spend by engaging in sports and exercise activities, which supplement BLS point estimates (Table 2 and Table 3). Also, unadjusted estimate could be misleading to researchers unless other socioeconomic factors are not included in the analysis. Therefore, we perform adjusted analysis of different significant factors from the bi-variate analysis via multiple regression analysis. While socio demographic factors such as gender, race/ethnicity, education, labor force participation status, income, etc. are found significant via a chi-squared tests, reported in Table 1, only gender, race/ethnicity, education and marital status are found significant factors via regression analysis of the time engagement (Tables 4-5) in sport and exercise activities.

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