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Physical Activity During the Transition from Adolescence to Adulthood

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Background: We examine how age, life course roles, and contextual variables relate to both the composition and the overall level of physical activity in late adolescence and early adulthood. *Methods:* Data on respondents age 15 to 29 y in the 2003 American Time Use Survey are used to estimate multivariate logistic regressions that assess what factors are associated with meeting the recommended level of physical activity. *Results:* The proportion of respondents who do 30 min or more of team sports declines over the 15 to 29 y age range even after controlling for life course and contextual covariates. Parenthood, employment status, and school enrollment have selective effects on the odds of meeting physical activity recommendations. *Conclusions:* Given the declines in team sports activities, schools and public health officials should consider the potential benefits of promoting other options such as cardiovascular activities, strength training activities, and/or active transportation.

Key Words: time use, active leisure, team sports, active transportation

The evidence of declining levels of physical activity as adolescents transition into adulthood is undisputed.[1-4] These lower levels of physical activity coupled with trends toward greater caloric intake[5] have contributed to the growing fraction of young adults who are overweight in the United States.[6] The Surgeon General's Report[7] emphasizes the need to understand the economic and environmental factors that contribute to inappropriate weight gain during critical developmental stages. This article focuses on identifying factors that are associated with physical activity levels in adolescence and early adulthood by capitalizing on new, nationally representative time diary data to investigate how life course and contextual factors relate to shifts in both the composition and the overall level of physical activity by age.

Our analysis is informed by the life course framework.[8,9] Proponents of this framework argue that the transition from adolescence to adulthood is complex and typically involves various events such as leaving school, getting married, entering full-time employment, and becoming a parent. Both the events and their sequencing can vary by age, period, and birth cohort. It is the interplay of these life transitions that we hypothesize are associated with time spent in physical activity. For example,

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a young mother may spend less time engaged in physical activities than an otherwise similarly aged woman who is not a mother. Likewise, a young man who is both employed and going to school may allocate less time to physical activities than a similarly aged man who is going to school but not employed.

Prior research suggests that the multiple role changes in late adolescence and early adulthood may be associated with declines in physical activity. For example, demanding new roles for women who marry and/or become mothers have been linked with less physical activity.[10] Unemployment has also been associated with less physical activity, even though unemployed persons should have fewer time demands.[10,11] Finally, leaving school may be a key transition. High school and college physical education classes often emphasize team sports which may be challenging to organize and participate in once individuals leave school.[12] In the current study, we examine the association between these key life course events in late adolescence and early adulthood and the likelihood of meeting recommended physical activity thresholds, holding age and a range of contextual factors constant.

Methods

The Data

Data for the current investigation come from the 2003 American Time Use Survey (ATUS).[13] The 2003 ATUS is the first in a series of nationally representative American time-diary surveys undertaken by the US Bureau of Labor Statistics. The University of Utah's Institutional Review Board judged the current study to be exempt because the 2003 ATUS is a public use data set.

The ATUS sample is drawn from the universe of households that have completed a final interview for the Current Population Survey (CPS). The ATUS consists of a stratified sample from the CPS. The stratification adjustments include 1) reducing the over-sampling of less-populated areas that is done in the CPS, and 2) adjusting for race/ethnicity of the household, the presence and age of children, and the number of adults in adults-only households. Once a household is identified, the ATUS respondent is randomly selected from among each household's members who are age 15 or older. The 2003 ATUS response rate is 57%. In all of the analyses that follow, our sample is weighted using the appropriate ATUS weights to enhance the generalizability of the results to the larger population.

The current analysis was done in the spring of 2006, and it uses those ATUS respondents age 15 to 29 who report no significant health limitations in order to capture the physical activity patterns of healthy individuals during the years of transition from adolescence to adulthood. Age 29 is used as a cut off under the assumption that most individuals have established adult patterns of time use by this age. These age and health restrictions limit the samples to 1669 males and 2080 females.

Measurement

A 24-h time diary is generally considered to be the most valid and reliable measure of individual time use.[14] The time diary survey, completed by phone using a

recall format, asks respondents to describe all of their primary activities sequentially beginning at 4 AM the previous day and ending at 4 AM on the day of the interview. Half of the respondents completed a diary for a weekday, and half of the respondents completed a diary for a weekend day. Their activities, duration, location, and who, if anyone, the respondent was with at the time, are then coded using the ATUS coding rules and activity lexicon. In addition to the time diary survey, respondents answer questions regarding selected household demographic and socioeconomic characteristics.

ATUS interviewers do not ask about the intensity of physical activity. For the purposes of the current analyses, only those ATUS activity categories that are known to meet or exceed the threshold for moderate physical intensity are selected (i.e., those generating at least 3.0 metabolic equivalents (METS) or more according to a compendium of physical activity metabolic ratings).[15] The Centers for Disease Control and Prevention (CDC) recommends that adults engage in moderate intensity physical activity for at least 30 min on at least 5 d per week and that children and adolescents engage in at least 60 min of moderately intense physical activity on most days of the week.[16,17] The analyses that follow make use of the adult threshold of 30 min or more of physical activity because it allows for the assessment of how the likelihood of meeting the adult standard relates to age.

Physical Activity. Three types of physical activities (i.e., those that typically require 3.0 or more METS) are used in this study. They are respondents' diary reports of time spent in a) team sports, b) non-team sports (i.e., sports that can be done alone and moderately active recreation and leisure activities), and c) active transportation. Team sports is measured as the sum of diary reports of time spent in baseball, basketball, football, hockey, rugby, soccer, softball, and volleyball. Non-team sports includes diary reports of time spent in aerobics, biking (for recreation rather than transportation), bowling, rock climbing, dancing, riding horses, fencing, golfing, gymnastics, hiking, hunting, martial arts, racquet sports, rodeo, rollerblading, running/jogging, snow skiing, cardiovascular training, walking (for recreation rather than transportation), water skiing, weight lifting, wrestling, yoga, and "other" (not specified). Active transportation is the sum of diary reports of time spent walking or bicycling as a form of transportation. In addition, we examine an overall measure of physical activity which is the sum of these three categories of time use. Physical activity done as part of housework, paid employment, or formal schooling is not included because the ATUS coding schemes for these activities are not sufficiently nuanced to allow us to differentiate the sub-activities in these larger categories by whether they require 3.0 or more METS. For the multivariate logistic regressions, we transform these continuous measures of time into qualitative measures of whether the 30-min threshold is satisfied for each of the three types of activities and for the overall measure.

Life Course Covariates. Our life course covariates include marital/residential status, parental status, schooling status, and employment status. Marital/residential status is measured by a sequence of dummy variables that capture whether the respondent is married and living with her/his spouse, single and living away from her/his parents, or single and living with her/his parents. Parental status is captured by a dummy variable that takes on a value of 1 if the respondent is a parent and 0 if otherwise. Schooling status and employment status are measured by three dummy

variables. The first takes on a value of 1 if the respondent is enrolled in school. The second takes on a value of 1 if the respondent is employed. The third dummy takes on a value of 1 if the respondent is both enrolled in school and employed. This latter variable is included to assess the potential interactive effects on physical activity of simultaneously assuming these two time-consuming roles.

Contextual Covariates. Our contextual covariates include season of the year that the time diary was recorded, region of residence, whether the respondent lives in a metropolitan area, and whether the diary day was a weekend day or a weekday. In addition, we have several sociodemographic contextual measures including the respondent's gender and race/ethnicity (white, Hispanic, or black). Economic resources are assessed by taking the household's total income and dividing it by the 2003 federal poverty threshold for a given household size. We then create a dummy variable that takes on a value of 1 if the household's total income divided by this threshold is less than 1.5, and 0 if otherwise. Households with ratios of 1.5 or less are typically classified as living in poverty or near poverty.[18] Finally, we include the respondent's chronological age in the multivariate analyses to assess whether age-related declines in physical activity persist once we control for life course and contextual covariates.

Statistical Analysis

The analysis begins with descriptive information on the time respondents report spending in team sports, non-teams sports, and active transportation over the 24-h period. Focusing only on those respondents who report spending at least 30 min or more per day in any physical activity, we next look at the most common types of activities in which they engage. These descriptive analyses are done separately by gender and by 5-y age groupings so that one can compare and contrast physical activity across the groups.

Multivariate logistic regression equations are estimated for whether the respondent spends 30 min or more per day in physical activities. We estimate multivariate models for whether the respondent meets the 30-min threshold by engaging in team sports, non-team sports, and active transportation. Independent variables in these logistic regressions, described earlier, include the respondent's age, the life course variables, and the contextual covariates. All analyses are done separately for males and females to allow for gender differences in the effects of the independent variables on the likelihood that the respondent meets the 30-min physical activity recommendations.[17,18]

By estimating multivariate logistic regression equations, we are able to assess the effects the life course variables have on an individual's likelihood of meeting the recommended level of physical activity holding other factors, in particular age of the respondent, constant. For example, we can assess the effect of being a parent on the likelihood of meeting the threshold, *ceteris paribus*. In this context, it provides us with insights about whether changing roles are associated with the shift in physical activity that is typically observed as adolescents move into adulthood. By estimating separate equations for specific categories of physical activity as well as overall physical activity, we are also able to see if these roles affect certain types of activities but not others.

All descriptive analyses are done using SAS (SAS Institute, Inc., Cary, NC), and these analyses are weighted using the 2003 ATUS final weights to insure the generalizability of the daily physical activity results to the US population age 15 to 29 in 2003. Multivariate analyses are estimated using the replicate weights provided by the Bureau of Labor Statistics and the US Census Bureau to insure accurate estimation of the standard errors given the ATUS's complex sampling design.[13] The Stata software program (StataCorp, College Station, TX) is used for the multivariate analyses that make use of the replicate weights.

Results

Table 1 shows the proportion of respondents who report doing 30 min or more of physical activity on the diary day by age and gender. Consistent with prior work, the ATUS data show that a higher proportion of males than females meet the 30-min threshold.[4,19,20] Table 1 also reveals a rather precipitous decline in the proportion of males who meet the 30-min threshold across the 15-y age span. Moving from the youngest to the oldest age group, males' rates of walking/biking as a form of transportation are cut in half, participation in non-team sports drops by over 40% and participation in team sports declines by over 85%. Females experience a more modest decline over this same age range in large part because they begin with a much smaller proportion meeting the 30-min threshold. Assessment of the individual components reveals that most of the decline in the proportion of females who meet the 30-min threshold is attributable to the drop off in team sports participation.

Table 1 Physical Activity Descriptive Statistics by Activity Type, Gender, and Age

	Males age (y)			Females age (y)		
	15-19	20-24	25-29	15-19	20-24	25-29
Percentage doing 30 min or more of team sports per day	0.13	0.04	0.02	0.04	0.01	0.00
Percentage doing 30 min or more of non-team sports per day	0.19	0.13	0.11	0.14	0.14	0.14
Percentage walking/biking for transportation for 30 min or more per day	0.08	0.04	0.04	0.06	0.06	0.06
Percentage doing any physical activity for 30 min or more per day[a]	0.37	0.20	0.16	0.23	0.20	0.19
Mean physical activity time (min/d)	50	25	21	28	17	15
Non-zero physical activity mean time (min/d)	103	87	84	78	51	60
N	703	424	551	685	592	803

[a] The proportions engaged in team sports, non-team sports and exercise, and walking/biking for transportation will not sum to "any physical activity" because respondents can report spending 30 min or more in more than one of these three categories.

Source: 2003 American Time Use Survey

Table 1 also shows the mean time spent in moderate and vigorous physical activity across all respondents and for those who report doing at least some moderate to vigorous physical activity. These figures show that while there is a downward trend in the overall mean time spent in physical activity across this age range, among those who are doing some physical activity, the average time spent in the activity exceeds the 30 min recommendation for adults regardless of age.

To gain a better sense of the roles that various types of activities may play in the overall level of physical activity, Table 2 shows the mean minutes by activity type, age group, and gender. This table suggests that as time spent in team sports declines with age, it is not compensated for by an increase in time spent in other physical activities or in walking/biking as a form of transportation.

Table 2 Mean Minutes Spent in Physical Activity per Day by Type

	Males age (y)			Females age (y)		
	15-19	20-24	25-29	15-19	20-24	25-29
Team sports	19	5	3	7	0	1
Non-team sports	24	16	15	16	11	11
Active transportation	6	5	4	6	5	4

Source: 2003 American Time Use Survey

Table 3 Top Five Forms of Physical Activity Among Those Reporting 30 Minutes or More of Physical Activity per Day for Respondents Age 15 to 29

	Males age (y)			Females age (y)		
Ranking	15-19	20-24	25-29	15-19	20-24	25-29
1	walking (26%)	weight training (39%)	walking (31%)	walking (34%)	walking (47%)	walking (51%)
2	basketball (22%)	walking (25%)	weight training (19%)	basketball (10%)	cardio-vascular[a] (16%)	cardio-vascular[a] (15%)
3	weight training (13%)	basketball (16%)	boating (7%)	running (7%)	running (10%)	weight training (15%)
4	football (9%)	running (11%)	running (5%)	other sports[b] (6%)	weight training (6%)	sports with child (4%)
5	running (6%)	cardio-vascular[a] (5%)	basketball (4%)	dancing (5%)	bowling (5%)	yoga (3%)
N	*259*	*82*	*91*	*156*	*93*	*133*

[a]Cardiovascular activities include using a Stairmaster, treadmill, or rowing machine.
[b]Other sports include a wide variety of activities such as ping-pong, horseshoes, archery, Frisbee golf, tai chi, and cricket.
Source: 2003 American Time Use Survey

Table 3 shows the top five types of physical activity done by those respondents who record 30 min or more of physical activity classified by gender and age. Almost one-third of the males under age 20 who are physically active for at least 30 min on the diary day meet the activity threshold by playing basketball or football. Similarly, for females under age 20, 10% meet the requirement by playing basketball. For older males, football is not in the top five and basketball accounts for only 16% of those age 20 to 24 who meet the threshold, and a mere 4% of those age 25 to 29 who meet the threshold. For females in the two older age groups, no team sport is among the top five. While participation in team sports appears to drop off markedly with the transition to adulthood, walking, weight training, and running remain relatively popular modes of engagement regardless of gender or age.

Adjusted odds ratios and the associated 95% confidence intervals for the multivariate estimates are presented in Table 4. The estimates reveal that the likelihood of meeting the recommended physical activity time by engaging in team sports declines with age even after controlling for other potentially important life course and contextual covariates. The decline in the odds of meeting the 30-min threshold by participating in team sports is similar for both females and males. The odds decline by 14% to 15% with each advancing year, *ceteris paribus*. In addition, each year males experience a 6% reduction in the odds of doing *any* physical activity for 30 min or more.

Turning to the life course covariates, for the females the estimates reveal that living arrangements and employment status do not affect the odds that 30 min or more per day will be spent in physical activity. But, having one or more children has a consistent negative effect on the odds that females will meet the 30-min threshold overall or by doing non-team sports activities, *ceteris paribus*. Specifically, mothers are about half as likely to spend 30 min or more per day in any type of physical activity or in non-team sports when compared to otherwise similar non-mothers.

Females' participation in team sports is dramatically affected by school enrollment. Females enrolled in school (high school or college) are almost 22 times more likely to do at least 30 min of team sports on the diary day than are those who are not in school. This relative likelihood drops to 8.8 if the female is enrolled in school and employed (taking the product of the odds ratios associated with school enrollment, employment, and the interaction of the two, i.e., $21.78 \times 13.45 \times 0.03 = 8.8$). Employment alone raises the odds that a female will meet the 30-min threshold for team sports by 13.45 relative to otherwise similar non-employed females, *ceteris paribus*.

Unlike females, males' parental status and poverty status are not associated with the measures of physical activity used in this study. A male's marital status is associated with lower odds of the likelihood of meeting the 30-min threshold only for active transportation. Enrollment in school, however, has a consistent positive effect on the odds that males will meet the 30-min threshold, holding everything else constant. Specifically, males who are enrolled in school are 4.34 times more likely to spend 30 min or more per day in any type of physical activity. They are also almost three times more likely to spend 30 min or more engaged in non-team sports, five times more likely to spend at least 30 min engaged in a team sport (outside of regular school hours), and over six times more likely to either walk or bike for at least 30 min as a form of transportation relative to otherwise similar males who are not enrolled in school. The odds of doing at least 30 min of any physical

Table 4 Adjusted Odds Ratios for Engaging in 30 Minutes or More of Physical Activity (95% CI in parentheses)

	Females				Males			
	All physical activity	Non-team sports	Team sports	Active transportation	All physical activity	Non-team sports	Team sports	Active transportation
Married[a]	1.11	0.98	0.39	1.63	0.67	0.81	0.65	0.32*
(1 = yes)	(0.69–1.77)	(0.57–1.68)	(0.06–2.54)	(0.72–3.72)	(0.38–1.18)	(0.40–1.62)	(0.22–1.89)	(0.11–0.96)
Single[a]	1.13	1.13	0.68	1.35	0.95	0.75	0.79	1.57
(1 = yes)	(0.78–1.64)	(0.71–1.80)	(0.26–1.78)	(0.63–2.88)	(0.68–1.31)	(0.50–1.13)	(0.45–1.41)	(0.82–3.01)
Parent	0.45*	0.50*	0.28	0.52	0.99	0.76	0.63	3.22
(1 = yes)	(0.33–0.63)	(0.34–0.72)	(0.05–1.64)	(0.27–1.03)	(0.55–1.78)	(0.38–1.48)	(0.11–3.68)	(1.30–7.96)
In school, not employed	1.24	0.83	21.78*	2.06	4.34*	2.83*	4.96*	6.13*
(1 = yes)	(0.79–1.96)	(0.45–1.50)	(3.78–125.53)	(0.98–4.34)	(2.08–9.03)	(1.15–6.94)	(1.66–14.79)	(1.58–23.76)
Employed, not in school	1.09	0.97	13.45*	1.06	1.89	1.40	2.98	2.18
(1 = yes)	(0.70–1.70)	(0.57–1.63)	(1.90–95.05)	(0.52–2.15)	(0.93–3.80)	(0.61–3.22)	(0.99–8.96)	(0.54–8.89)
Employed and in school	0.88	1.13	0.03*	0.89	0.32*	0.50	0.25*	0.33
(1 = yes)	(0.47–1.61)	(0.57–2.22)	(0.00–0.275)	(0.30–2.58)	(0.148–0.70)	(0.20–1.25)	(0.07–0.87)	(0.07–1.53)
Poor (i.e., income/needs < 1.50)	1.10	0.57*	1.42	2.89*	1.13	0.92	1.48	1.38
(1 = yes)	(0.76–1.59)	(0.38–0.84)	(0.56–3.61)	(1.37–6.08)	(0.78–1.64)	(0.62–1.39)	(0.79–2.78)	(0.76–2.53)
Hispanic[b]	1.07	0.81	0.57	2.31*	1.37	1.06	1.62	1.60
(1 = yes)	(0.73–1.59)	(0.51–1.27)	(0.18–1.82)	(1.20–4.46)	(0.90–2.10)	(0.63–1.78)	(0.83–3.18)	(0.76–3.39)
Black[b]	0.69	0.46*	0.92	2.30	1.20	0.43*	2.24*	2.41*
(1 = yes)	(0.42–1.12)	(0.25–0.84)	(0.27–3.19)	(0.67–3.50)	(0.78–1.86)	(0.21–0.88)	(1.19–4.22)	(1.15–5.09)
Other[b]	0.90	0.78	0.54	1.34	1.07	0.76	1.51	1.09
(1 = yes)	(0.51–1.59)	(0.39–1.57)	(0.05–5.99)	(0.38–4.72)	(0.55–2.05)	(0.32–1.79)	(0.70–3.28)	(0.27–4.32)

	Females				Males			
	All physical activity	Non-team sports	Team sports	Active transportation	All physical activity	Non-team sports	Team sports	Active transportation
Age	1.01	1.02	0.85*	1.04	0.94*	0.98	0.86*	0.99
(y)	(0.97–1.06)	(0.97–1.08)	(0.73–1.0)	(0.97–1.11)	(0.90–0.98)	(0.92–1.03)	(0.77–0.96)	(0.93–1.06)
Fall[c]	1.25	1.31	1.69	1.27	1.15	1.37	0.93	1.34
(1 = yes)	(0.82–1.89)	(0.79–1.18)	(0.49–5.83)	(0.59–2.71)	(0.75–1.77)	(0.86–2.19)	(0.49–1.75)	(0.62–2.93)
Spring[c]	1.11	1.04	0.69	1.46	1.51	1.40	1.25	1.22
(1 = yes)	(0.74–1.67)	(0.62–1.75)	(0.18–2.60)	(0.73–2.91)	(1.04–2.20)	(0.85–2.33)	(0.66–2.36)	(0.53–2.81)
Summer[c]	1.87*	2.17*	1.53	1.22	2.16*	2.28*	1.51	1.91
(1 = yes)	(1.27–2.74)	(1.37–3.45)	(0.47–5.01)	(0.58–2.54)	(1.38–3.40)	(1.37–3.81)	(0.84–2.73)	(0.85–4.26)
Northeast[d]	1.05	0.79	0.26	2.86*	0.60	0.62	0.83	0.99
(1 = yes)	(0.69–1.59)	(0.48–1.29)	(0.05–1.41)	(1.51–5.42)	(0.39–0.94)	(0.37–1.03)	(0.41–1.68)	(0.45–2.20)
Midwest[d]	0.90	0.75	1.39	1.37	0.91	0.82	1.02	1.40
(1 = yes)	(0.61–1.34)	(0.49–1.16)	(0.46–4.2)	(0.63–2.98)	(0.56–1.46)	(0.47–1.43)	(0.55–1.88)	(0.64–3.07)
South[d]	0.91	0.69	1.97	1.44	0.48*	0.55*	0.76	0.44*
(1 = yes)	(0.63–1.31)	(0.47–1.03)	(0.71–5.50)	(0.68–3.04)	(0.32–0.74)	(0.33–0.94)	(0.43–1.33)	(0.21–0.91)
Metro area	1.10	0.84	0.83	1.43	1.04	0.93	1.31	1.35
(1 = yes)	(0.73–1.64)	(0.52–1.38)	(0.25–2.79)	(0.62–3.32)	(0.76–1.43)	(0.61–1.42)	(0.71–2.40)	(0.56–3.26)
Weekend or holiday	0.67*	0.85	0.85	0.44*	1.04	1.12	1.25	0.85
(1 = yes)	(0.51–0.87)	(0.62–1.17)	(0.37–1.94)	(0.26–0.72)	(0.79–1.35)	(0.85–1.50)	(0.79–2.00)	(0.51–1.41)
Chi–square	71.4*	87.7*	66.5*	82.4*	179*	85.9*	115*	74.0*

*Statistically significant at the 0.05 level.

[a] The omitted respondents in this sequence of dummy variables are those individuals who live with their parents.

[b] The omitted respondents in this sequence of dummy variables are white respondents.

[c] The omitted respondents in this sequence of dummy variables are those with diary days recorded in the winter.

[d] The omitted respondents in this sequence of dummy variables are those indivduals who live in the West.

Source: 2003 American Time Use Survey

activity or doing team sports are reduced to 1.39 (i.e., 0.32 × 4.34) and 1.24 (i.e., 0.25 × 4.96) respectively, if the male is both in school and employed.

A pattern of racial differences in physical activity is also observed for the males. Black males have significantly lower odds of engaging in 30 min or more of non-team sports and significantly higher odds of engaging in team sports and active transportation compared to otherwise similar white males. However, there are no statistically significant differences between black and white males in the likelihood of engaging in any type of physical activity for at least 30 min or more per day.

Finally, there are noteworthy relationships between season, residential location, poverty status, and physical activity. Not surprisingly, summer, relative to winter, is a time when both males and females are more likely to engage in physical activity. Although team sports participation is not significantly different between winter and summer, non-team sports participation is different. Both females and males are about twice as likely to engage in 30 min or more of non-team sports in the summer compared to the winter, *ceteris paribus*. In addition, relative to males who live in the West, males who live in the South have consistently lower odds of engaging in 30 min or more of non-team sports, active transportation, and overall physical activity. Living in poverty or near-poverty significantly reduces the odds that female respondents spend at least 30 min in non-team sports and significantly increases the odds that they will spend at least 30 min in active transportation.

Discussion and Conclusions

The 2003 American Time Use Survey provides a rare opportunity to look at the time typically spent in various physical activities by individuals in the transition from adolescence to adulthood. Nevertheless, it is important to note the caveats in our findings before discussing their implications. First, the estimates of physically active time presented in this article are somewhat conservative because they exclude time spent in physical education classes for those respondents enrolled in high school and time spent doing physically demanding housework or physically demanding paid employment. The primary source of the under-estimation for this age group is likely to be the omission of physical education class time. It should be noted, however, that in 2003, only 26.4% of high school girls and 30.5% of high school boys attended a physical education class daily during the average school week in the United States[21] and participation in physical education classes declines with age. Indeed, only 12% of US high school seniors reported taking daily physical education classes in 1995.[12] Thus, the exclusion of physical education class time likely leads to only modest underestimation for the sub-set of school-age respondents.

Second, our dichotomized measure of employment status could mask important employment-related thresholds that are associated with physical activity. That is, classifying an individual who works 5 h per week in the same category as someone who works 40 h per week does not allow for the differentiation of work intensity. If it is work *intensity* rather than the work *role* that influences physical activity, then our measure may be imprecise.[22] When data are available, future research should focus on exploring the possibility of threshold effects.

Third, it is important to remember that the ATUS is a cross-sectional study. As a consequence, we cannot separate age, period, and cohort effects. Thus, while we take note of declines in physical activity when comparing younger respondents to

older respondents, the differences we observe may be attributable to their chronological age, their birth cohort, the time period for the survey, or some combination of the three.

Our analyses support past research that has found late adolescence and early adulthood to be a time when the probability of engaging in physical activity declines markedly.[12,19] The current study provides new insights by showing that much of the decline in physical activity is likely associated with an age-related decline in team sports participation.

Participation in team sports has been demonstrated to confer a number of benefits during adolescence, beyond promoting physical fitness, including a lower risk of experiencing depression and higher levels of self esteem.[23-25] Not surprisingly, team sports are promoted in school and through community leagues during childhood and adolescence because of both their physical and social-psychological benefits. But, opportunities for participation in team sports, either through school-sponsored or community-sponsored leagues, wane with age. At the same time, an individual's range of time demands expands with age, making it more difficult to participate in team sports where practices and games may be at set times that require scheduling coordination. Changes in life course roles, particularly the loss of the student role, decrease the likelihood of engaging in team sports for 30 or more minutes per day.

If team sports are unlikely to continue after leaving school, education and public health officials should consider the potential benefits of placing greater emphasis on the promotion of cardiovascular and strength training activities such as running, walking, aerobics, cycling, and weightlifting during adolescence.[26] These activities require less organizational overhead, can be done either individually or as part of a group, and may have less of a competitive emphasis. Moreover, they need not be done at set times but rather they can be interjected into daily routines at the time that best fits with an individual's schedule. As such, individuals who learn to enjoy these cardiovascular and strength training activities in adolescence may be more likely to continue to pursue them in adulthood. Expansion of community sports and recreation programs beyond traditional team sports would also be in keeping with CDC recommendations.[12]

The emphasis on lifetime physical activities may be especially important in overcoming one of the main sources of differences in the ATUS data—the gender difference. Despite likely similarities in daily role obligations during adolescence, young females engage in less physical activity than young males. Other studies have found females are more likely to participate in activities such as aerobics and less likely to participate in team sports compared to males.[12] The ease of going to "drop in" aerobics classes or walking may increase the appeal of these physical activity options for women. More generally, focused educational and policy efforts are needed to increase the levels of physical activity among female teens, sustain the levels of physical activity by males transitioning out of school, and create physical activity opportunities for females who are making the transition to parenthood.

Finally, despite the age-related decline in team sports, time spent in active transportation (i.e., walking and biking as a form of transportation) and non-team sports appears to be invariant with age. Our finding with regard to the popularity of walking is consistent with other research that shows walking to be the most common physical activity among young adults.[27] However, since 1969, 35% fewer

students aged 5 to 15 walk or bike to school (decreasing from 48% to less than 15%), suggesting that current school children have few opportunities to develop healthy active transportation habits.[28] If active transportation and non-team sports participation habits established during youth persist into adulthood, then greater promotion of these options during childhood and adolescence could further inhibit the decline in physical activity at this critical juncture. Policy supports for active transportation could include access to transit systems and design improvements that create safe routes to school; these improvements have yielded more active transportation to school.[29]

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