

Original Research

Physical Activity and Screen Time Sedentary Behaviors in College Students

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ABSTRACT

Int J Exerc Sci 4(2) : 102-112, 2011. It is well established that Americans are not meeting physical activity (PA) guidelines and college students are no exception. Given the lack of regular PA, many health promotion professionals seek to discover what barriers to PA may exist. A common explanation is screen time (ST), which is comprised primarily of television viewing, computer use, and the playing of video games. The purpose of this study was to present descriptive data on college students' PA and sedentary behavior and to assess if any evidence exists to suggest displacement between sedentary behaviors and PA in college students. Students completed an online health survey specific to time spent in PA and sedentary behavior. Students were categorized into one of three PA groups based on their activity level. Males were significantly more physically active than females in terms of days per week engaged in aerobic exercise ($p=.022$) and strength training ($p<.001$). When categorized by activity level, a greater percentage of male students met recommended PA levels than did females ($p<.001$). Males reported significantly higher levels of overall ST ($p=.004$) and television viewing ($p<.001$), whereas females reported significantly higher levels of time spent engaged in homework ($p<.001$). When categorized by activity level, physically active students reported significantly fewer minutes of total ST than inactive students ($p=.047$). Implications of this study suggest that within a college population, television and PA are not competing behaviors in either gender.

KEY WORDS: Sedentary behavior, physical inactivity, displacement hypothesis

INTRODUCTION

College is a time of great change for young adults. Newly found independence allows the college student to make decisions and choices that were often previously made for him or her. One of the most important decisions a college student may make is how to incorporate physical activity (PA) into a busy lifestyle. According to the 2008

National College Health Assessment, 18% of college students engage in PA five or more days per week, with 23.3% reporting zero physical activity in the last seven days (1). Recent recommendations from the 2008 *Physical Activity Guidelines for Americans* (43) suggest that low levels of PA are a major health concern. With so few college students participating in PA, researchers

seek to determine what activities may potentially be supplanting PA.

The U.S. Department of Labor publishes the American Time Use Survey (ATUS) which collects information on how people living in America spend their time. Data from the 2008 ATUS showed that weekday leisure time for full time university and college students totaled 3.67 hours (44). When leisure time is categorized, television viewing comprises the largest percentage, at 1.84 hours per day, or about half of all leisure time (44). Television is unquestionably a sedentary activity, and many studies have hypothesized that increases in television viewing may be partly to blame for reductions in PA (3, 11, 18).

Overall, sedentary behavior is perceived to have increased in the past decade, in large part due to increased computer and internet usage (30, 41). Screen time, defined operationally as time spent using computers, watching television or DVDs, and/or playing video games (29), may be heavily influenced in college students by the recent popularity of social networking sites such as Facebook and Twitter. Prior estimates of computer usage by college students are limited and range widely from 2.8 hours per week (44) to 11.6 hours per week (2). Nonetheless, much like the non-college adult population (44), it appears that a significant amount of college students' leisure time is spent on screen time sedentary behaviors.

One of the more popular explanations of how screen time may be negatively influencing PA is the displacement hypothesis (4). The displacement hypothesis posits a symmetrical, zero-sum

relationship in which the more time an individual devotes to screen time, the less time the individual will have to devote to PA (32). Another tenet of the displacement hypothesis is that the finite nature of time budgets requires the introduction of new activities and behaviors to force out old activities and behaviors (32). As screen time has increased over the past two decades, there has been a concomitant decrease in PA, contributing to an increased prevalence of obesity, especially in youth and adolescents (22, 27, 49). If screen time is somehow replacing PA, then this relationship may be explained by the displacement hypothesis. Specific to inactive college students, the displacement hypothesis postulates that an increase in sedentary behaviors, such as television viewing, computer usage, or video game playing, will be associated with a concomitant decrease in PA. Although the claims of the displacement hypothesis are often cited by many authors, empirical evidence supporting a negative relationship between PA and screen time is lacking (28). How sedentary behaviors may influence PA has yet to be fully explained (5).

Despite the fact that 18.2 million young adults are enrolled in colleges and universities (42), little is known about their PA and sedentary habits (20, 25). Previous research on the relationship between PA and sedentary behavior has been indeterminate in children (28, 39, 45), college students (37), and adults (16). Therefore, the purpose of this study was twofold. First was to present descriptive data on college students' PA and sedentary behavior and to examine for gender differences within these variables. Second was to assess if any evidence exists to

suggest displacement between sedentary behaviors and PA in college students.

METHODS

Participants

A sample of 736 students (461 male, 275 female, 62.1 % freshmen, mean age 19.11 ± 2.04 years) were recruited from two university required wellness courses at a Midwestern university. This study was approved by the university's Institutional Review Board (IRB). Students who participated in this study signed an informed-consent form prior to participation in accordance with IRB policies. All students 18 years of age or older, and enrolled in either of the two wellness courses, were invited to participate.

Protocol

Anthropometric measurements of height and weight were recorded for each participant. Height was measured to the nearest .5 cm with a Seca #214 portable stadiometer. Weight was measured with a calibrated Tanita Digital TBF-215GS scale to the nearest .1 Kg. Additionally, participants completed a comprehensive online health survey consisting of questions concerning dietary habits, PA, and sedentary pursuits. The participants were directed by their respective class instructor to complete the online health survey using the Blackboard™ web-based course management system. Participants were given one week to complete the survey outside of class.

Survey questions are presented in Figure 1. The first two questions, specific to PA, were based on a previously validated questionnaire, the Youth Risk Behavior

Surveillance System (YRBSS) (7). Response choices for each question ranged from zero to seven days. The third PA question was based upon a recently validated 5-response (PA5) single response survey to assess stages of change (21). The five stage of change categories were merged into three categories for data analysis: Inactive (pre-contemplation and contemplation), Insufficiently Active (preparation), and Active (action and maintenance). This merging allowed the data to be compared to a pre-established PA standard from the Centers for Disease Control and Prevention/American College of Sports Medicine (35). The stage of change methodology is consistent with the public health indicators used for tracking progress toward Healthy People 2010 standards (10).

Time spent in sedentary behaviors was assessed by three novel questions developed by the authors and validated in unpublished pilot testing. Responses for all three sedentary behavior questions were recorded in minutes. For sedentary behaviors, 24 hour recall was used instead of, "in the past 7 days" or "on average" as it has been shown to produce better recall and greater reliability with a large sample (23, 47).

Statistical Analysis

Data were analyzed via Statistical Package for the Social Sciences (SPSS) for Windows, version 18.0. Descriptive statistics were computed for various demographic variables (i.e. age, BMI, PA, sedentary behaviors). Independent samples *t*-tests were used to examine for differences in means between genders. Chi-square tests were used to examine for differences in proportions between the genders. Three separate 2 (gender) X 3 (stage of change

category) between-subjects ANOVAs were used to examine for differences in screen time, television time, and homework minutes. Scheffe post-hoc comparisons were used to determine the location of significant differences across the stage of change categories. Alpha was set at $p \leq 0.05$ for all analyses.

In the past seven days, on how many days did you engage in aerobic physical activity or exercise other than casual walking?

In the past seven days, on how many days did you engage in strength building or resistance exercise?

Which of the following statements best describes your current level of physical activity or exercise, including walking for exercise?

- a) I don't exercise or walk regularly now and I don't plan to start in the near future.
- b) I don't exercise or walk regularly now but I've been thinking about starting.
- c) I'm doing moderate physical activity fewer than five times per week or vigorous activity fewer than three times a week.
- d) I've been doing moderate physical activity five or more days a week or vigorous activity at least three days a week for the last one to six months.
- e) I've been doing moderate physical activity five or more days a week or vigorous activity at least three days a week for seven months or longer.

Yesterday, how much time, in minutes, did you spend in front of a screen? (This includes computer, television, video games, movies, etc.)

Of your total screen time yesterday, how much of it, in minutes, was spent watching television?

Yesterday, how many minutes did you spend on school work outside of class? (i.e. homework)

Figure 1. Physical Activity/Sedentary Behavior Survey Questions.

RESULTS

Independent samples *t*-tests were used to examine for differences in PA, sedentary

behaviors, and body mass index (BMI) (Table 1). Male students were older and had a higher BMI than female students. In addition, male students reported significantly more days of aerobic exercise, strength training, screen time, and television minutes compared to female students. Female students reported more time spent on homework compared to males.

Chi square tests were used to analyze the distribution of stage of change categories (Table 2). Of all students, 43.5% met recommended levels of PA, as represented by the Active stage (action and maintenance). A greater percentage of male students met recommended PA levels than did females. A greater percentage of females were classified as Inactive or Insufficiently Active than males.

Mean minutes ($\pm SD$) of homework, screen time, and television viewing are shown in Table 3 and stratified by stage of change category. Factorial ANOVA results indicated no significant main effects for stage of change when television viewing time and homework minutes were analyzed as separate dependent variables. Additionally, no significant gender by stage of change interactions were found when television viewing time, screen time, and homework minutes were used as individual dependent variables. However, when analyzing screen time, a significant main effect for stage of change was found, $F(2, 730) = 4.95, p = 0.007$. Scheffe post-hoc tests revealed that active students reported significantly fewer minutes of screen time than inactive and insufficiently active students ($p=0.047$ and $p=0.032$, respectively).

Table 1. Descriptive Characteristics of College Students.

Variable	Total (N=736)	Male (n=461)	Female (n=275)	t value	P
Age (years)	19.10±2.04	19.35±2.37	18.69±1.24	4.937	< .001
Body Mass Index	24.05±4.22	24.34±4.30	23.56±4.06	2.436	.015
Aerobic Exercise (d/wk)	3.25±1.91	3.38±1.88	3.04±1.93	2.298	.021
Strength Training (d/wk)	1.61±1.69	1.90±1.77	1.13±1.42	6.514	< .001
Screen Time (min)	144.60±104.25	153.18±108.71	130.21±94.54	2.918	< .001
TV Time (min)	61.26±67.08	69.39±70.73	47.62±58.08	4.529	< .001
Home-work (min)	96.55±84.94	85.00±77.47	115.92±93.15	-4.601	< .001

Note. The p values indicate between gender significance.

Table 2. Physical Activity Stage of Change Distribution.

Stage of Change	Total	Male	Female	χ ²	P
Inactive	12.4% (n=91)	9.8% (n=45)	16.7% (n=46)	7.714	.005
Insufficiently Active	44.2% (n=325)	40.6% (n=187)	50.2% (n=138)	6.462	.011
Active	43.5% (n=320)	49.7% (n=229)	33.1% (n=91)	19.277	< .001

Note. The p values indicate the difference between male and female responses.

DISCUSSION

The primary purpose of this study was to gather descriptive data on college students in regard to PA and sedentary behavior. Descriptive data concerning the above behaviors is quite limited within the literature; therefore, a major goal was to address the lack of research on the activity

habits and patterns of college students. As the current generation of college students is purported to have a sharp increase in internet usage (6), this study sought to determine how much time students spend in sedentary or inactive pursuits, as represented by screen time and daily homework.

Table 3. Sedentary Behaviors by Stage of Change.

	Inactive n = 91	Insufficiently Active n = 325	Active n = 320
Television (min)			
Male	69.91±69.65	75.21±71.35	64.54±70.36
Female	56.41±59.92	49.13±64.25	40.88±45.85
Total	63.09±64.91	64.14±69.53	57.81±65.16
Screen Time (min)			
Male	183.11±140.46	167.67±106.86	135.47±100.53
Female	140.87±82.67	132.59±104.01	121.21±84.72
Total	161.76±116.25 ^a	152.78±106.92 ^a	131.42±96.38
Homework (min)			
Male	83.02±85.65	84.29±75.35	85.97±77.83
Female	86.85±66.08	117.36±97.30	128.44±96.08
Total	84.96±75.99	98.33±86.78	98.05±85.45

The second objective of this study was to assess if the data collected provides any evidence of sedentary behaviors displacing PA in college students. This is relevant because many interventions that are designed to increase PA invariably target a reduction in sedentary behaviors in hopes of increasing PA (24). However, for this assumption to be true, PA and sedentary behaviors would have to be competing behaviors, as posited by the displacement hypothesis.

Within this study, male students reported significantly higher levels of PA than did female students, as represented by days per week of aerobic exercise (3.37 vs. 3.04), days of strength training (1.90 vs. 1.13), and by the stages of change categories that reflect recommended levels of PA (49.6% vs.

33.1%). The gender difference in PA demonstrated within this investigation is consistent with previous studies in multiple age cohorts which have reported that males are consistently more active than females (8, 9). Previous studies examining PA stage of change in college students have found that 50% of students do not meet recommended levels of PA (25). However the distribution of PA stage of change has been inconsistent in terms of gender (36, 48). In terms of total aerobic exercise, levels from this study (3.25 days per week) fall somewhere between the 3.41 days per week reported by Buckworth and Nigg (5) and the 2.8 days per week reported by Huang et al. (20). Students from this study did report fewer days dedicated to strength training (1.61 days per week) than shown in previous research (2.16 and 2.2 days per week, respectively) (5, 20). Collectively, the variations in reported PA may be representative of the limitations of the sample used, whether or not students were recruited from a physical education class, and perhaps most importantly, how PA was assessed. In this study, cross sectional surveys were used instead of more objective measures, such as accelerometers (13). However, a particular strength of this study was that participants were representative of the entire student body as the courses used for recruitment were a graduation requirement for all students, representing over 100 different academic majors on campus, resulting in a large sample size and results similar to previous ACHA assessments (1).

In regard to sedentary behavior, this study found, on average, that students spent 144 minutes per day dedicated to screen time, with 60 minutes spent watching television. Collectively, students from this study also

reported 96 minutes per day spent on homework, although a significant gender gap was noted between males and females (85 min vs. 115 min, $p < 0.001$). In this study, when compared to their female peers, male students reported significantly higher levels of overall screen time and time spent viewing television, whereas female students reported significantly higher levels of time spent engaged in homework.

The market research firm Student Monitor found that college students watched television 11.2 hours per week (26), a number that is comparable to the 10.56 hours per week reported by Buckworth and Nigg (5). Data from the Harvard School of Public Health's College Alcohol Study found students reported an average of two hours of television per day (33), which pales in comparison to a study by Nielsen Media Research (34), conducted during 2004-2005 which showed college students watched an average of 24.3 hours of television per week. Students in this study watched less television (approximately one hour per day, or seven hours weekly) than did those in the above studies. One possible explanation for this discrepancy is this study's use of 24 hour recall versus the global time estimates used in the comparison studies. Global time estimates, which are commonly used in cross sectional research, have a tendency to overestimate time spent within a given behavior, whereas 24 hour recall results in higher quality data in terms of validity (23). Specific to this study, almost 90% of responses are representative of a weekday, with more than 60% of all responses reflecting Tuesday and Wednesday.

Previous studies utilizing cross sectional estimates of college student computer use have ranged widely, from less than three hours to more than 11 hours per week (2, 5, 44). The present study did not directly measure computer use, but given the 16.8 hours per week of screen time reported (of which seven hours was dedicated to television viewing), an estimate of nearly 10.5 hours per week may be attributed to computers, which falls within the previously reported range. The measurement of computer use is still in its relative infancy, so this study contributes additional insight into how much time college students are actually spending on computers.

The second aim of this study was to assess if any evidence exists that may suggest screen time based sedentary behaviors may displace PA. Contrary to conventional wisdom, this study provides evidence that PA and television viewing may not be competing behaviors. Regardless of gender or PA participation, when students were categorized according to their PA stage of change, there was no significant difference in the amount of television watched. This finding suggests that if a college student chooses to watch television, it may not come at the expense of being physically active. In essence, a college student has the option to partake in both behaviors if he or she so chooses. Given this finding, this study calls into question the tenet of the displacement hypothesis that suggests choosing PA versus television is an either or choice.

Specific to this study, the displacement hypothesis would theorize that when sedentary behaviors such as television viewing increase, PA will subsequently

decrease; therefore television effectively displaces PA (32). This displacement hypothesis is an assumption that is very common within the literature, despite contrary findings by Marshall et al. (28). Biddle et al. take a harder stance against the displacement hypothesis suggesting that although watching television is prohibitive of PA at that time, one should not assume that television is thus negatively associated with PA over an entire day (4). If PA and inactivity are in fact separate constructs (12, 40), efforts to increase PA based on a competing behaviors model may prove to be unsuccessful. The present study tends to agree with the more recent literature, indicating that while multiple behaviors do exist, there appears to be little competition for PA time.

In terms of sedentary behaviors, when classified by PA stage of change, a distinction was made between television viewing and screen time as a whole. Specifically, no significant differences existed between the stages of change categories for television viewing time; however, inactive and insufficiently active students reported significantly more minutes of screen time than active students. If television does not displace PA, other modes of screen time may be contributing to the low levels of PA. Vandewater et al. (46) found that video game use among children was linked to reductions in PA. This may imply that various modes of screen time may in fact be independent of each other. Whereas television may not have any effect upon PA, evidence from this study suggests non-television related screen time, such as recreational computer use and video games, are associated with lower levels of PA.

Limitations of this study include not differentiating between screen time for academic purposes versus screen time for leisure pursuits and the use of recall, especially for screen time. Nonetheless, 24 hour recall has been shown to be quite reliable in large samples (44). As for leisure and academic screen time, some crossover is inevitable. Also, with no objective measurement of PA, the possibility of over-reporting exists. An additional limitation is that this study did not account for text messaging as a part of screen time. Whereas previous research examining text messaging has typically focused on the magnitude of texts sent each day (31), a recent study by the Kaiser Family Foundation indicated that junior and senior high students average 1:35 hours per day text messaging (38). However, due to the sporadic and multi-tasking nature of text messaging, a valid and reliable method of capturing this behavior has not been established. Pilot studies conducted by the authors and subsequent interviews of subjects concluded the ability to quantify text messaging was not feasible for this study.

In summary, male students were significantly more physically active than their female counterparts when assessed by days per week spent engaged in aerobic exercise and strength training. Male students also reported significantly higher levels of overall screen time and television viewing, whereas female students reported significantly higher levels of time spent engaged in homework.

Implications of this study suggest that within a college population, television and PA are not competing behaviors in either gender. These findings are important for

several reasons. First, future research in this area may be aided by utilizing a time diary or media log to record behaviors when they occur in real time rather than relying on recall. Several studies have utilized 24 hour time diaries to determine when PA and sedentary behaviors occur over the course of a day (17, 19, 46, 47). When time data can be analyzed via blocks of time, the sensitivity of the assessment tool may allow the researcher to identify the exact duration and time in which a specified behavior occurred (17, 19). Second and more practically, is that developing and implementing interventions to promote PA based on reduced television time alone may not be as successful as if all screen time behaviors were considered.

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