

# Physical Activity, Exercise, and Sedentary Behavior in College Students

Janet Buckworth, PhD; Claudio Nigg, PhD

**Abstract.** The authors examined the relationship between physical activity, exercise, and sedentary behaviors in 493 college students who were enrolled in 10 conditioning activity classes and had completed questionnaires at the beginning of the course. They analyzed sedentary activities and indicators of participation in exercise and physical activity by demographic variables. Surveyed men reported greater participation in physical activity and exercise than did women, and they also spent more time watching television/videos and using the computer. Older students were more likely to report more computer use, whereas younger students scored higher on several physical activity indicators. Of the sedentary behaviors, only computer use for men and television watching for women were negatively correlated with exercise and physical activity. In addition to accessibility and reinforcing properties of sedentary activities, the gender-related relationships between sedentary and active behaviors should be considered in designing interventions to promote exercise in this population.

**Key Words:** college students, exercise, physical activity, sedentary

The health benefits of physical activity described in the US Surgeon General's Report on Physical Activity and Health<sup>1</sup> provide compelling reasons to adopt and maintain an active lifestyle. Unfortunately, the level of physical activity declines during adolescence<sup>2,3</sup> so that about 70% of American adults are sedentary or inactive and are below the recommended level for health benefits.<sup>4</sup> According to the 2000 National College Health Assessment,<sup>5</sup> 57% of male and 61% of female college students reported that they performed no vigorous or moderate exercise on at least 3 of

the previous 7 days. Many adult health behaviors are established during late adolescence and early adulthood,<sup>6</sup> so the decline in physical activity in adolescence and young adulthood is a disturbing trend.<sup>3,7</sup> Physical inactivity, a serious and pervasive public health concern, has been designated as one of the priorities in the Healthy People 2010 Objectives (ie, Focus Area 22, Physical Activity and Fitness, and Objectives 22-1, 22-2, and 22-3)<sup>6</sup> and Healthy Campuses 2010 Campaign Objective 22-2/3.<sup>8</sup>

Exercise and physical activity have been described in national samples (National College Health Risk Behavior Survey: NCHRBS, 1995<sup>9</sup>; National College Health Assessment: NCHA, 2000<sup>5</sup>), and in various college populations (eg, African American<sup>10</sup> and older students<sup>11</sup>). However, few studies have examined the relationship between students' exercise and physical activity and their sedentary behaviors. Physical inactivity has been associated with the risk of several chronic diseases and health conditions (eg, obesity<sup>12</sup>), and the role of sedentary behaviors in public health is now gaining more attention.<sup>13</sup> Television watching has been associated with obesity in children<sup>14,15</sup> and adults,<sup>16</sup> and reductions in this sedentary behavior in children have been associated with decreases in body mass index.<sup>17</sup>

The contribution of sedentary behaviors to the risk of physical inactivity is not clear. In a sample of college students, television watching was not strongly correlated with 14 physical activity variables (eg, total minutes spent in leisure/moderate activity and number of days in the previous 7 days of participation in strength training) although it was correlated with physiological indicators of fitness such as resting heart rate and recovery pulse following a 3-minute step test.<sup>18</sup> Other sedentary activities, including reading, studying, or computer use, can compete with exercise when individuals are making choices about how to spend their discretionary time. For example, in a study of young Australian

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adults, those in the highest tertile of computer use were most likely to be physically inactive.<sup>19</sup>

Behavioral economics provides a model for studying the decision to choose sedentary or active behaviors.<sup>20</sup> Individuals base their decisions to engage in a particular activity on access (the work needed to obtain the activity) and motivation (the reinforcing value of the activity). Although college students have specific time constraints related to their academic schedules, they also have considerable discretionary time. The choices they make about how to spend this time influence their level of physical activity, and various factors influence these choices. For example, the reinforcing value and subsequent participation in studying and school-related computer use may increase for college students as they near graduation, whereas organized exercise may take more effort and their participation can decrease.

Therefore, our purpose in conducting this study was to analyze the relationship between exercise and physical activity and sedentary behaviors in a sample of college students. We conducted analyses of gender and age differences because researchers have found significant age and gender differences in physical activity and its determinants among college students.<sup>11,21</sup> We hypothesized that (1) men would be more active than women would be; (2) older students would engage in studying and computer use more and physical activities less than younger students; (3) significant positive relationships among different measures of exercise and physical activity but not among different sedentary activities were likely, and (4) television watching but not studying or computer use would be negatively correlated with exercise.

## METHOD

### Participants

Students enrolled in the classes at a large midwestern university in the autumn (6 classes,  $N = 215$ ) and spring (4 classes,  $N = 278$ ) academic quarters participated in our study. The classes were part of a study to test the effects of curriculum modifications on mediators of behavior change and exercise adherence.<sup>22</sup> Our analyses focused on baseline data. The sample included 288 women (58.3%); 73.8% were White, 16.2% were African American, 3.8% were Asian, 2.2% were Hispanic, and 4% listed other racial/ethnic groups. The students' average age was  $21 \pm 4.0$  years, and 90.8% of the sample were between the ages of 18 and 24 years. Class rank was consistently distributed (28.4% first year, 24.3% sophomore, 24.1% junior, and 21.0% senior/5th year; 2.3% not reporting), and most (96.5%) were enrolled in school fulltime.

### Procedure

The classes we included in the study were elective conditioning activity courses consisting of a 50-minute lecture and 45-minute exercise labs 3 times week. More students were enrolled in aerobic dance (44%) and weight training (39%), than in jogging exercise labs (16%). We adminis-

tered questionnaires, including items on age, gender, racial/ethnic group, and academic class, during the first lecture class of the 10-week academic quarter according to the protocol approved by the University Office of Research Risks Protection.

## Measures

### Exercise Behavior

Questions related to participation in exercise from the NCHRBS<sup>9</sup> provided data on the number of the past 7 days that students participated in vigorous exercise, stretching exercises, activities to strengthen or tone muscles, and moderate intensity exercise. We also asked 3 additional questions about typical exercise duration (min), frequency in days per week, and length of time in months exercising at this level. One-week test-retest reliabilities for these 3 items were 0.93, 0.90, and 0.97, respectively ( $N = 56$ ).<sup>21</sup>

### Physical Activity History

We used the CARDIA Physical Activity History Questionnaire<sup>23</sup> to measure participation in moderate intensity (eg, walks or hikes, home maintenance) and vigorous intensity activities (eg, jogging or running, strenuous sports) physical activities over the previous 12 months. We computed activity scores based on reports of frequency of participation per month and number of months of participation. Significant relationships have been reported between CARDIA activity scores and objective and physiological indicators of exercise.<sup>23</sup> Wallace and associates<sup>21</sup> reported 1-week test-retest reliabilities of 0.81 (moderate), 0.89 (vigorous), and 0.88 (total) in a college sample.<sup>23</sup>

### Sedentary Behaviors

We used 3 questions to measure participation in sedentary activities, which were similar to procedures used in other studies.<sup>24,25</sup> Participants reported the numbers of hours in a typical week they spent watching television and/or videos, studying, and using the computer. In an earlier study, Wallace and associates<sup>21</sup> reported 1-week test-retest reliabilities of 0.72 (watching television and/or videos), 0.62 (studying), and 0.87 (using the computer) a sample of college students.

### Statistical Analysis

To analyze data, we used Statistical Package for the Social Sciences (SPSS) for Windows,<sup>TM</sup> version 11.0 (SPSS Inc. 1989–2001) and we used descriptive statistics to compute demographic variables. We used analysis of variance (ANOVA) and multiple regression with Tukey's Honestly Significant Difference (HSD) post hoc comparisons to analyze differences in physical activity indicators and sedentary behaviors by sex and by age. Effect size was represented by  $\eta^2$  with .01, .09, and .25 representing small, medium, and large effects, respectively,<sup>26</sup> and we used Pearson correlation coefficients to determine the relationships between the study variables. We set the level of significance a priori at  $p < 0.05$ .

## RESULTS

Students reported that they had spent almost 30 hours in a typical week engaged in sedentary behaviors, mostly studying ( $13.25 \pm 9.16$  hr), but they also indicated they had participated in some exercise at the beginning of the class (Table 1). More of these students engaged in adequate levels of moderate activity ( $\geq 5$  of the previous 7 days, 30.6% vs 19.5%) and vigorous activity ( $\geq 3$  of the previous 7 days, 53.2% vs 37.6%) than students who were sampled in the 1995 NCHRBS.<sup>9</sup> More students in this sample also exercised, compared with those surveyed in the 2000 NCHA<sup>5</sup> survey on participation in vigorous or moderate exercise at least 3 times in the past 7 days (73.1% vs 40.5%).

We found significant differences between the men and the women on variables indicating sedentary behaviors and physical activity (Table 2). The male students reported more hours per week spent watching television and/or videos and using the computer compared with the female students ( $p < .05$ ). At the same time, the men self-reported higher levels of exercise compared with women on most activity indicators ( $p < .05$ ).

We found significant relationships between age and sedentary behaviors and activity variables (Table 3). Correlations of sedentary variables with age revealed that the older the student, the more time he or she spent using the

computer ( $p < .05$ ). Time spent studying and time viewing television/videos were not associated with age. The younger students reported more days per week devoted to stretching and greater participation in vigorous intensity activities during the past 12 months; they also indicated they had been exercising at their current level for significantly more months than the older students ( $p < .05$ ). These relationships changed when we analyzed the data separately for men and women. For men, the only exercise or physical activity variable associated with age was the number of months of regular exercise ( $r = 0.193, p = .008$ ). For women, there were significant negative correlations between age and days per week of moderate activity ( $r = -.178, p = .004$ ), exercise duration ( $r = -.127, p = .043$ ), and vigorous intensity activities during the past year ( $r = -.167, p = .008$ ).

We also analyzed the relationships between exercise, physical activity, and sedentary behaviors for the whole sample (Table 3) and for men and women separately. In general, exercise and physical activity variables were significantly related to each other, with stronger correlations between the measures representing higher intensity physical activity and exercise. Among sedentary behaviors, the amount of television watching was not related to the time spent using computers. For men only, a significant positive correlation existed between television watching and time spent studying ( $r = .226, p = .002$ ).

Correlations between sedentary behaviors and exercise and physical activity revealed different relationships for men and women. For male students, television watching was not related to any of the exercise or physical activity indicators, but computer use was negatively correlated with days per week they engaged in vigorous exercise and strength training, typical exercise frequency, and moderate and vigorous physical activity during the past year. Computer use was not related to any of the exercise or physical activity indicators for the female students. For them, television watching was negatively correlated with all items from the NCHRBS, typical frequency of exercise, and history of vigorous physical activity during the past year. Time spent studying was positively correlated with days per week of strength training for females, and with typical duration of exercise for both males and females.

## COMMENT

In this study, we analyzed the relationships among sedentary behaviors and exercise according to demographic variables of students who were enrolled in college conditioning activity classes. These students were typically physically active at the beginning of the course, reporting some consistent exercise for almost 2 years, on average, and therefore could provide insight into sedentary behaviors of physically active college students. We found no hypothesized positive relationship between age and studying, but increasing age was associated with more time using the computer. The positive association between computer use and age may reflect the different academic demands for upper-class students.

**TABLE 1. Sedentary Behaviors and Physical Activity Indicators**

Variable	<i>M</i>	<i>SD</i>	<i>N</i>
Sedentary behaviors†			
TV/Videos	10.56	8.59	475
Study	13.25	9.16	476
Computer	5.96	5.83	474
Total sedentary	29.72	15.19	474
Activity indicators			
NCHRBS‡			
Vigorous	2.79	1.97	482
Stretch	2.21	1.98	482
Strength	2.16	1.98	482
Moderate	2.97	2.40	481
Typical exercise			
Frequency‡	3.41	1.96	479
Duration§	47.35	36.46	477
Length	23.39	39.35	463
CARDIA¶			
Moderate	137.67	118.20	461
Vigorous	305.07	263.61	461
Total	442.74	350.87	461

Note. NCHRBS = National College Health Risk Behavior Survey<sup>9</sup>; CARDIA = Coronary Artery Risk Development in Young Adults.<sup>23</sup>

†hr/wk

‡d/wk

§min

||mo

¶activity score/yr

**TABLE 2. Study Variables, by Sex, in an Examination of Exercise and Sedentary Behavior**

Variable	Men			Women			F	df	p	$\eta^2$
	Mean	SD	N	Mean	SD	N				
Sedentary behaviors†										
TV/Videos	12.02	9.06	192	9.57	8.11	283	9.50	473	0.00	0.02
Study	12.92	10.01	193	13.47	8.55	283	0.41	474	0.52	0.00
Computer	6.74	6.65	192	5.42	5.15	282	5.86	471	0.02	0.01
Total sedentary	31.62	16.88	192	28.43	13.80	282	5.07	472	0.02	0.01
Activity indicators										
NCHRBS§										
Vigorous	3.28	2.05	198	2.45	1.84	284	21.66	480	0.00	0.04
Stretch	2.18	2.02	198	2.23	1.95	284	0.07	480	0.79	0.00
Strength	2.69	2.01	198	1.80	1.88	284	24.78	480	0.00	0.05
Moderate	2.94	2.43	198	2.99	2.38	283	0.03	479	0.85	0.00
Typical exercise										
Frequency‡	3.84	1.94	197	3.10	1.92	282	17.19	477	0.00	0.03
Duration§	61.89	43.19	196	37.21	26.63	281	59.38	475	0.00	0.11
Length	31.32	45.91	195	17.62	32.70	268	14.07	461	0.00	0.03
CARDIA¶										
Moderate	150.28	123.00	198	128.18	113.78	263	3.97	459	0.05	0.01
Vigorous	376.67	279.56	198	251.17	237.61	263	27.05	459	0.00	0.06
Total	526.94	371.70	198	379.35	320.72	263	20.85	459	0.00	0.04

Note. NCHRBS = National College Health Risk Behavior Survey<sup>9</sup>; CARDIA = Coronary Artery Risk Development in Young Adults.<sup>23</sup>

†hr/wk

‡d/wk

§min

||mo

¶activity score/yr

When we compared computer use between academic classes, the senior/5th year students reported significantly more computer use ( $7.6 \pm 6.9$  h/wk) than the freshmen ( $4.8 \pm 4.7$  h/wk),  $p = .003$  and juniors ( $5.1 \pm 5.2$  h/wk),  $p = .017$ , but not sophomores ( $6.3 \pm 5.8$  hrs/wk). We found no difference in time spent studying or watching television as a function of academic year.

As we had predicted, female students' age was negatively correlated with exercise (days/wk of moderate intensity exercise and typical exercise duration) and physical activity (vigorous intensity activities during the past year). These correlations reflect the continuation of a pattern of decreasing physical activity observed in high school,<sup>27</sup> even though enrollment in the conditioning activity classes may have introduced a bias toward exercise in this sample. In fact, for men, increasing age was associated with more time exercising at their current level. Social support from friends is an important exercise correlate for men,<sup>21</sup> and vigorous activity may be fostered in college through men's participation in group activities, such as intramural sports and enrollment in conditioning activity classes.

Associations between gender and level of physical activity reflect the literature; men were more physically active than women; they also reported more time in sedentary activities. Hours of television per week were greater for men than for women (Table 2), which is similar to findings

from the National Longitudinal Study of Adolescent Health.<sup>24</sup> However, compared with the 18-to-22-year age group in that study, participants in this sample watched fewer hours of television (10.56 vs 13.4 h/wk). Men in our study also reported that they spent more time using the computer than their female counterparts did.

We hypothesized that television watching would be the only sedentary activity correlated with measures of exercise and physical activity, but we found unexpected relationships between specific sedentary activities for female and male students. For women only, television watching was negatively correlated with many exercise and physical activity indicators, whereas studying was positively correlated with the duration of typical exercise and strength training. We found no significant relationship between computer use and physical activity indicators. These results suggest that television watching is the sedentary behavior that competes with active behaviors for these college women's discretionary time and is a greater risk factor for physical inactivity for women than for men. Typically, television is more accessible than exercise and requires less effort than computer use. In addition, the entertainment and distraction that television provides is immediate, but the reinforcing value of exercise (eg, weight loss, improved fitness) is usually delayed.

Although male students watched more television and used the computer more than female students, only computer use

**TABLE 3. Correlation Matrix of Age, Sedentary Behaviors, and Physical Activity Indicators**

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Age	0.04	0.06	0.20**	0.13**	-0.06	-0.09*	-0.06	-0.08	-0.04	-0.02	0.13**	0.04	-0.10	-0.06
1. Television†	1.00	0.10*	0.05	0.65**	-0.15**	0.12*	-0.06	-0.11*	0.10*	-0.01	0.06	-0.06	-0.13*	-0.12*
2. Study†	—	1.00	0.15**	0.72**	0.03	0.08	0.13**	-0.02	0.04	0.14**	-0.04	0.04	0.01	0.02
3. Computer†	—	—	1.00	0.51**	-0.05	-0.04	-0.04	-0.04	0.01	-0.01	-0.06	-0.07	-0.08	-0.09
4. Total sedentary†	—	—	—	1.00	-0.09	-0.04	0.03	-0.09	-0.03	0.07	-0.01	-0.04	-0.10*	-0.09
NCHRBS‡														
5. Vigorous				—	1.00	0.56**	0.57**	0.32**	0.67**	0.49**	0.34**	0.30**	0.44**	0.44**
6. Stretch					—	1.00	0.50**	0.34**	0.52**	0.33**	0.17**	0.17**	0.25**	0.25**
7. Strength						—	1.00	0.24**	0.57**	0.43**	0.18**	0.26**	0.33**	0.34**
8. Moderate							—	1.00	0.30**	0.20**	0.14**	0.28**	0.27**	0.30**
Typical exercise														
9. Frequency‡								—	1.00	0.60**	0.31**	0.28**	0.41**	0.40**
10. Duration§									—	1.00	0.26**	0.17**	0.36**	0.33**
11. Length										—	1.00	0.20**	0.28**	0.28**
CARDIA¶														
12. Moderate											—	1.00	0.64**	0.81**
13. Vigorous												—	1.00	0.97**
14. Total													—	1.00

*Note.* Each column represents a row variable with the corresponding number in the left-hand column. NCHRBS = National College Health Risk Behavior Survey.<sup>9</sup> CARDIA = Coronary Artery Risk Development in Young Adults.<sup>23</sup>

†hr/wk

‡d/wk

§min

||mo

¶activity score/yr

\* $p < .05$ . \*\* $p < .01$ .

was negatively associated with exercise and physical activity, specifically, days of vigorous exercise and strength training per week, and vigorous and moderate intensity activities during the past year. These findings are comparable to those in a study of 697 18-to-30-year old Australian adults that reported that individuals with high levels of computer use (ie, > 8 hr/wk) were more likely than other adults to be inactive.<sup>19</sup> It may be that for college men, using the computer provides reinforcement similar to that received by women from watching television. However, researchers need to develop more specific measures to determine the proportions of computer time spent in recreational viewing and in academic pursuits. The lack of association between physical activity and exercise and studying for both men and women may be explained by its utilitarian nature for college students, whereas exercise, television, and computer use are recreational activities that compete for students' discretionary time.

Our findings from this study support a concept of an independent and interactive relationship between sedentary behaviors and exercise and physical activities,<sup>28,29</sup> which introduces the notion of constructive, utilitarian sedentary behaviors versus escapist/mindless sedentary behaviors. Recreational sedentary behaviors (eg, watching television and videos) and those that are obligatory (eg, studying for exams) have different levels of perceived choice and different reinforcement value for college students.

Participation in exercise during college students' discretionary time may be positively modified by targeting sedentary activities, as has been demonstrated in studies with children in which increased physical activity was an outcome of strategies to reduce time in sedentary behaviors.<sup>20</sup> Based on our findings, college health promotion specialists should consider designing interventions that pose physical activities as more accessible and more rewarding than using the computer for male students and watching television for female students. Future research should include the development of instruments to detect a more extensive range of sedentary activities typical of college students, as Lee and King<sup>30</sup> have done for older adults, that can be evaluated in terms of perceived choice and reinforcement value. Decreasing accessibility and rewards from major competing sedentary activities while increasing the accessibility and reinforcement values of exercise and physical activity can have immediate and long-term health benefits for college students.

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#### NOTE

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