

Associations between Physical Activity and Other Health Behaviors in a Representative Sample of US Adolescents

ABSTRACT

Objectives. This study examined the associations between physical activity and other health behaviors in a representative sample of US adolescents.

Methods. In the 1990 Youth Risk Behavior Survey, 11 631 high school students provided information on physical activity; diet; substance use; and other negative health behaviors. Logistic regression analyses examined associations between physical activity and other health behaviors in a subset of 2652 high-active and 1641 low-active students.

Results. Low activity was associated with cigarette smoking, marijuana use, lower fruit and vegetable consumption, greater television watching, failure to wear a seat belt, and low perception of academic performance. For consumption of fruit, television watching, and alcohol consumption, significant interactions were found with race/ethnicity or sex, suggesting that sociocultural factors may affect the relationships between physical activity and some health behaviors.

Conclusions. Low physical activity was associated with several other negative health behaviors in teenagers. Future studies should examine whether interventions for increasing physical activity in youth can be effective in reducing negative health behaviors. (*Am J Public Health*. 1996; 86:1577-1581)

Russell R. Pate, PhD, Gregory W. Heath, DHSc, MPH, Marsha Dowda, MSPH, and Stewart G. Trost, MS

Introduction

It is a widely held perception that adults who choose to be regular exercisers also tend to adopt other positive health habits. While the validity of this perception has not always been supported by the results of scientific investigations, there is some evidence that physically active adults tend to smoke less, consume healthier diets, and maintain a more favorable body composition.^{1,2} The same perception—that physical activity behavior is linked to other positive health behaviors—has been applied to teenagers. With this group, a commonly held view has been that time spent in exercise is time that is not available for negative health behaviors such as substance abuse, sexual activity, and television watching.^{3,4} This thinking has led some to recommend exercise programs for youth as interventions to prevent an array of negative health behaviors.

Unfortunately, the research literature includes few studies that have examined the associations between physical activity behavior and other health habits in teenagers, and we are aware of no studies in which these associations have been examined in a nationally representative sample of US youth. In 1990, however, the Centers for Disease Control conducted the first Youth Risk Behavior Survey, and this has provided us with the opportunity to describe the exercise habits of American youth and to study the relationship between exercise and other health habits among them. Thus, using the data collected in this survey, we examined the associations between physical activity behavior and various other health and demographic characteristics by comparing physically inactive with highly active high school students. Specifically,

we designed this study to determine if less physically active adolescents are at greater risk than their highly active counterparts for other risky health behaviors.

Methods

Data Source and Instrumentation

Data for this analysis were taken from the 1990 Youth Risk Behavior Survey, the sampling procedures and methodology of which have been reported previously.⁶ High school students from all 50 states and the District of Columbia completed a self-administered, 70-item questionnaire in the classroom under the supervision of trained professionals. Five of the items determined age, sex, grade, race/ethnicity, and self-perception of academic performance. The remaining 65 items were used to measure behaviors and characteristics thought to have the greatest impact on health. These include physical activity; dietary practices; cigarette, alcohol, and illicit drug use; body self-image; and various risk-taking behaviors (e.g., sexual activity, seat belt use, and physical fighting).

Sample and Definitions

A total of 11 631 students responded to the survey. Determinations of their

Russell R. Pate, Marsha Dowda, and Stewart G. Trost are with the Department of Exercise Science, School of Public Health, University of South Carolina, Columbia. Gregory W. Heath is with the Division of Surveillance and Epidemiology, Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Ga.

Requests for reprints should be sent to Russell R. Pate, PhD, School of Public Health, Department of Exercise Science, University of South Carolina, Columbia, SC 29208.

This paper was accepted March 14, 1996.

TABLE 1—Demographic Characteristics of Low-Active and High-Active High School Students in the 1990 Youth Risk Behavioral Survey

	Low-Active Students (n = 1641), ^a %	High-Active Students (n = 2652), %
Sex		
Male	31.8	67.2
Female	68.2	32.8
Race/ethnicity		
White	42.5	68.9
African American	33.3	13.9
Hispanic	24.2	17.2
Age, y		
12–15	31.7	39.0
16–18	68.3	61.0
Has exercised in community settings ^b (past 14 d)		
All	13.2	49.6
Male	19.6	50.8
Female	10.2	47.1
Enrolled in physical education		
All	29.4	59.1
Male	36.5	61.1
Female	26.1	55.0
School sports teams ^c		
All	21.8	60.2
Male	28.5	63.4
Female	18.8	53.7

^aUnweighted number and percentages.

^bExercised 1 or more days at the "Y," sports league, dance class, or recreation or community center.

^cParticipated on one or more varsity or junior-varsity sport teams during the preceding 12 months.

physical activity status were made from the following two survey questions: (1) On how many of the past 14 days have you done at least 20 minutes of hard exercise that made you breathe heavily and made your heart beat fast? (2) On how many of the past 14 days have you done at least 20 minutes of light exercise that made you breathe a little more than usual and made your heart beat a little faster than usual? Students who reported fewer than 2 days of light exercise and no days of hard exercise in the past 14 days were classified as low active (n = 1646). Those who reported 6 or more days of hard and 6 or more days of light exercise were classified as high active (n = 2661). After deletions for missing values for age, race/ethnicity, and sex, 2652 high-active and 1641 low-active students (n = 4293) were retained for the first analysis. The demographic characteristics for the low- and high-active groups are shown in Table 1.

Samples consisting of low- and high-active students were used in this study for two major reasons. First, because assessing physical activity in children and youth by self-report is known to be difficult and subject to classification errors,⁷ examining

only those students with the highest and lowest levels of physical activity minimized the possibility of misclassification bias. Second, to further the understanding of the public health impact of physical activity, it was considered appropriate to compare a group that was clearly meeting both the *Healthy People 2000* physical activity objectives⁸ and other physical activity recommendations⁹ with a group that clearly was not meeting those standards.

Statistical Analysis

All statistical analyses were performed with an SAS version of SUDAAN, a statistical software package designed to analyze complex survey data.¹⁰ Unadjusted odds ratios (ORs) were used to examine the crude association between physical activity behavior and the various health behaviors examined in the survey. Individual multiple logistic regression analyses were then used to examine the relationship of each health behavior to the student's physical activity level while controlling for age, sex, and race/ethnicity. For each logistic model, physical activity level was used as the dependent

variable, with low and high activity serving as the risk and referent levels, respectively. Independent variables consisted of the health behavior under examination; the covariables consisted of age group (12 to 15 or 16 to 18), sex (male or female), race/ethnicity (White, African American, or Hispanic), and all two-way interactions between the health variable and age, sex, and race. Backward stepwise elimination procedures were used to evaluate the significance of all interactions. To minimize the possibility of Type I errors, only interactions with associated probabilities of less than .01 were accepted into the final logistic model. For health behaviors that showed significant interactions with age, sex, or race/ethnicity, separate logistic analyses were performed to estimate the group-specific association with physical activity behavior.

Results

From the total sample of 11 631 high school students, 14.1% were classified as low active and 22.8% were classified as high active. As shown in Table 1, students from the low-active group were more likely to be female, between the ages of 16 and 18, and non-White. Compared with those in the high-active group, relatively few students in the low-active group reported exercising in community settings (49.6% vs. 13.2%), being enrolled in physical education classes (59.1% vs 29.4%), and participating in school sports (60.2% vs 21.8%). These trends were most noticeable among the female students.

Crude associations and 95% confidence intervals (CIs) for the association between each health characteristic and physical activity are shown in Table 2. Students who ate no fruit or vegetables on the previous day, watched television or played video games for 3 or more hours per day, used marijuana in the past 30 days, had one or more sexual partners in the previous 3 months, refrained from using seat belts, and perceived themselves as inferior students were more likely to be low active than those who did not report these behaviors. In contrast, students who had consumed one or more alcoholic beverages in the past 30 days were less likely to be low active than those who had consumed no alcohol in the past 30 days.

The results of the logistic regression analyses are shown in Table 3. After controlling for age, sex, and race/ethnicity, we found that students who smoked one or more cigarettes in the past 30 days, used marijuana one or more

times in the past 30 days, and did not wear a seat belt were approximately 1.5 times more likely to be low active than those who did not report these behaviors. Students who did not eat vegetables on the previous day and had low perceptions of their academic performance were almost twice as likely to be low active as those who demonstrated the opposite behaviors.

Several health characteristics were observed to have significant interactions with either race or sex ($P < .01$). Consumption of fruit on the previous day and television viewing were found to interact significantly with race/ethnicity, whereas use of alcohol was found to interact significantly with sex. To explore these interactions, we stratified students by race/ethnicity (for fruit consumption and television watching) or sex (for alcohol consumption) and calculated subgroup-specific odds ratios. The results of the race/ethnicity subgroup analyses are shown in Table 4.

Among the White and Hispanic subgroups, respectively, students who ate no fruit on the previous day were more than three and two times more likely to be low active than those who ate one or more servings of fruit on the previous day. This association was not significant among African-American students. Among Whites, students who watched television or played video games for 3 or more hours per day were almost twice as likely to be low active as those who reported engaging in these behaviors for less than 3 hours per day. In contrast, African-American students who watched television or played video games for 3 or more hours per day were approximately one half as likely to be low active than those who reported doing so for less than 3 hours per day. Television watching was not associated with physical activity among Hispanic students (Table 4). Among females, students who drank one or more alcoholic beverages in the past 30 days were significantly less likely to be low active than were students who drank no alcohol in the past 30 days (OR = 0.66; 95% CI = 0.51, 0.87). However, alcohol consumption was not significantly associated with physical activity level among male students (OR = 1.30; 95% CI = 0.95, 1.75).

Discussion

The results of this study provide important evidence that, in a nationally representative sample of American high

TABLE 2—Crude Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Health-Related Behaviors and Activity Levels of 1641 Low-Active and 2652 High-Active Students

Characteristic or Health Habit	Low-Active Students, %	High-Active Students, %	Crude OR ^a	95% CI
Cigarette smoking (past 30 d)				
1 or more days	28	27	1.21	0.97, 1.51
0 days	72	73	1.00	Reference
Alcohol drinking (past 30 d)				
1 or more times	52	60	0.77	0.64, 0.92
0 times	48	40	1.00	Reference
Cocaine use (past 30 d)				
1 or more times	3	3	1.20	0.61, 2.34
0 times	97	97	1.00	Reference
Marijuana use (past 30 d)				
1 or more times	15	13	1.35	1.06, 1.72
0 times	85	87	1.00	Reference
Injury in a physical fight (past 30 d)				
1 or more times	16	17	0.94	0.74, 1.20
0 times	84	83	1.00	Reference
Seat belt use				
Never/sometimes	57	50	1.39	1.01, 1.92
Usually/always	43	50	1.00	Reference
No. servings of vegetables (yesterday)				
0	50	32	2.03	1.73, 2.37
1 or more	50	68	1.00	Reference
No. servings of fruit (yesterday)				
0	41	21	2.64	2.21, 3.15
1 or more	59	79	1.00	Reference
No. sex partners (past 3 mo)				
1 or more	47	41	1.27	1.06, 1.52
0	53	59	1.00	Reference
TV/video game hours per day (14 d after school)				
3 or more hours	44	36	1.51	1.28, 1.77
<3 hours	56	64	1.00	Reference
Kind of student				
Bottom/little above middle	56	44	1.73	1.27, 2.36
Far above middle/best	44	56	1.00	Reference
Weight perception				
Too thin	14	14	0.98	0.76, 1.26
Too fat	22	18	1.32	1.01, 1.73
About right	64	68	1.00	Reference

^aWeighted ORs and 95% CI.

school students, physical activity behavior is associated with several other important health behaviors. The results of the logistic regression analyses show that little or no involvement in physical activity was associated with cigarette smoking, marijuana use, poor dietary habits, television viewing, failure to wear a seat belt, and perception of low academic performance. However, this pattern was not consistent for all health behaviors, given that low physical activity was found to be unrelated to behaviors such as cocaine use, sexual activity, physical fighting, and self-percep-

tion of weight and was positively associated with alcohol consumption among female students.

An important finding of this study was the association between low activity and tobacco and marijuana use. This finding is consistent with some previous investigations of adolescent health behaviors in which tobacco and other drug use was found to be negatively associated with participation in extracurricular activities such as school sports.¹¹⁻¹³ From a public health perspective, our observation of a significant association between low physi-

TABLE 3—Adjusted^a Odds Ratios (ORs) and 95% Confidence Intervals (CIs) from Individual Multiple Logistic Models for Health Behaviors According to Activity Level

Health Behavior	No.	Adjusted OR ^b	95% CI
Cigarette smoking (past 30 d)	4159		
1 or more days		1.42	1.16, 1.73
0 days		1.00	Reference
Alcohol drinking (past 30 d)	3959	NA ^c	
1 or more times			
0 times			
Cocaine use (past 30 d)	4220		
1 or more times		1.97	0.95, 4.10
0 times		1.00	Reference
Marijuana use (past 30 d)	4207		
1 or more times		1.75	1.34, 2.29
0 times		1.00	Reference
Injury in a physical fight (past 30 d)	4209		
1 or more times		0.90	0.71, 1.15
0 times		1.00	Reference
Seat belt use	4288		
Never/sometimes		1.67	1.17, 2.36
Usually/always		1.00	Reference
No. servings of vegetables (yesterday)	4292		
0		1.97	1.65, 2.36
1 or more		1.00	Reference
No. servings of fruit (yesterday)	4290	NA ^c	
0			
1 or more			
No. sex partners (past 3 mo)	3971		
1 or more		1.07	0.86, 1.34
0		1.00	Reference
TV/video game hours per day (14 d after school)	4288	NA ^c	
3 or more hours			
<3 hours			
Kind of student	4252		
Bottom/little above middle		1.88	1.32, 2.66
Far above middle/best		1.00	Reference
Weight perception	4282		
Too thin		1.17	0.91, 1.51
Too fat		0.93	0.68, 1.27
About right		1.00	Reference

^aControlling for age group, sex, and race.

^bWeighted ORs and 95% CI.

^cSignificant interaction; see results and Table 4.

preadolescent African-American school-children.

Although low physical activity was associated with a number of other negative health habits, it is important to note that, for several behaviors, the direction and strength of these associations varied considerably across different population subgroups. High physical activity was associated with increased alcohol consumption among female students but was unrelated to drinking practices among males. As noted above, low physical activity was associated with eating no fruit on the previous day among White and Hispanic students but not among African-American students. Television viewing and/or playing video games for more than 3 hours per day was associated with low physical activity among White students but with higher levels of physical activity among African-American students. Clearly, these interactions support the view that sociocultural factors are important determinants of health-related behaviors in children and youth.¹⁸ Accordingly, future studies should consider the potential contribution of differences in socioeconomic status and ethnicity to the interrelationships among health-related behaviors in teenagers.

Previous studies of television viewing and physical activity behavior in children and youth have produced equivocal results.^{19,20} While the amount of television watching appears to be a strong predictor of obesity in children,^{21–23} increased television viewing has not been shown to be associated specifically with decreased levels of physical activity. It is likely that some children watch substantial amounts of television and still obtain adequate physical activity at other times in the day. The results of this study suggest that cultural and ethnic differences may affect the association between physical activity behavior and television watching in children and youth.

It is important to note that the percentage of students reporting participation in school sports was considerably higher in the high-active group than in the low-active group (60.2% vs 21.8%). Consequently, future studies should test the hypothesis that participation in school sports may be causally related to the reduced risk of certain negative health behaviors. In theory, there are three ways in which school sports participation could influence health behaviors. First, it appears likely that sports participation provides substantial amounts of physical activity and, in so doing, may cultivate more favorable attitudes and beliefs con-

cal activity and cigarette smoking is particularly important. Recent studies have shown smoking at an early age to be associated with an increased likelihood of smoking during adulthood¹⁴ and a decreased likelihood of stopping smoking.¹⁵ While little is known about the effects of physical activity interventions on negative health behaviors such as cigarette smoking, the results of this study suggest that controlled experimental studies examining the effect of increased participation in physical activity and risk on tobacco use would be appropriate.

Another important finding was the association between low physical activity

and inappropriate dietary behavior. With the exception of African Americans, student who did not eat fruit and vegetables on the previous day were more likely to be low active. Few studies have examined the association between exercise and dietary behavior in children and adolescents. Using factor analysis, Terre et al.¹⁶ found physical inactivity to cluster with poor eating habits in sixth-grade children but were unable to detect any relationship between exercise and eating behavior in high school students. D'Elia et al.¹⁷ observed a significant but weak positive correlation between exercise and consumption of fruit and low-fat milk among

TABLE 4—Adjusted^a Race-Specific Odds Ratios (ORs) and 95% Confidence Intervals (CIs) from Individual Multiple Logistic Analyses for Health Behaviors According to Activity Level

Health Behavior	Race					
	White		African American		Hispanic	
	No.	OR ^b (95% CI)	No.	OR (95% CI)	No.	OR (95% CI)
Fruit (yesterday)	2524		914		852	
0 servings		3.10 (2.44, 3.94)		1.26 (0.85, 1.86)		2.27 (1.51, 3.42)
1 or more servings		Reference		Reference		Reference
Watched TV/played video games	2525		914		849	
≥ 3 hours daily		1.99 (1.57, 2.53)		0.47 (0.36, 0.61)		0.88 (0.58, 1.32)
< 3 hours daily		Reference		Reference		Reference

^aControlling for age group and sex.

^bWeighted OR and 95% CI.

cerning positive health behaviors. Second, by making participation contingent on following rules and regulations, extracurricular activities such as school sports discourage participation in negative health behaviors. Third, by providing adolescents with a professionally supervised, prosocial after-school environment, school sports may reduce those adolescents' exposure to settings that would encourage risky health behaviors.

The associations observed in the present study should, of course, be interpreted with caution. Given the cross-sectional design of this study, it is impossible to determine whether a cause-and-effect relationship exists between physical activity and other health behaviors. Furthermore, although efforts were made to ensure subject confidentiality, we cannot exclude the possibility that some respondents may have overreported physical activity and underreported engagement in socially undesirable health behaviors. Nevertheless, within the limitations of our study design, we believe that the results of this study reveal an interesting and potentially important relationship between exercise behavior and other health habits. It is conceivable that this relationship may be explained by the effect of physical activity participation on a central underlying construct such as self-esteem²⁴ or peer influence.^{25,26} Also, it may be that time spent exercising reduces time available for engaging in negative health behaviors. As discussed above, school sports participation may influence certain health behaviors.

In conclusion, the results of the present study indicate that low levels of physical activity are associated with several other important negative health be-

haviors in American high school students. Future studies should examine whether intervention programs aimed at increasing habitual physical activity in youth can effectively reduce the prevalence of certain other health behaviors. □

Acknowledgments

This research was supported by grant U48/CCU 409664-01 from the Center for Health Promotion and Disease Prevention.

The authors appreciate the assistance of S. Winnail and D. Kasparek with preparation of this manuscript.

References

- Blair SN, Jacobs DR Jr, Powell KE. Relationships between exercise or physical activity and other health behaviors. *Public Health Rep.* 1985;100:172-180.
- Simoes EJ, Byers T, Coates RJ, Serdula MK, Mokdad AH, Heath GW. The association between leisure-time physical activity and dietary fat in American adults. *Am J Public Health.* 1995;85:240-244.
- A Matter of Time: Risk and Opportunity in Non-School Hours.* New York, NY: Carnegie Corporation of New York; 1992.
- Collingwood TR, Reynolds R, Kohl HW, Smith W, Sloan S. Physical fitness effects on substance abuse risk factors and use patterns. *J Drug Educ.* 1991;21:178-207.
- Stone EJ, Perry CL, Luepker RV. Synthesis of cardiovascular behavioral research for youth health promotion. *Health Educ. Q.* 1989;16:155-169.
- Kolbe L. An epidemiological surveillance system to monitor the prevalence of youth behaviors that most affect health. *Health Educ.* 1990;21:44-48.
- Pate RR. Physical activity in children and adolescents. *Crit Rev Food Sci Nutr.* 1993;33:321-326.
- Healthy People 2000: National Health Promotion and Disease Prevention Objectives: Full Report, with Commentary.* Washington, DC: US Dept of Health and Human Services,

Public Health Service; 1991. DHHS publication PHS 91-50212.

- Sallis JF, Patrick K. Physical activity guidelines for adolescents: consensus statement. *Pediatr Exerc Sci.* 1994;6:302-314.
- Shah BV, Folsom RE, Harrell FE, Dillard CN. *Survey Data Analysis Software for Logistic Regression: Work Assignment 74, Final Report.* Research Triangle Park, NC: Research Triangle Institute; 1984.
- Shilts L. The relationship of early adolescent substance use to extracurricular activities, peer influence, and personal attitudes. *Adolescence.* 1991;26:613-617.
- Escobedo LG, Marcus SE, Holtzman E, Giovino GA. Sports participation, age at smoking initiation, and the risk of smoking among US high school students. *JAMA.* 1993;269:1391-1395.
- Thorlindsson T, Vilhjalmsson R, Valgeirsson G. Sports participation and perceived health status. A study of adolescents. *Soc Sci Med.* 1990;31:551-556.
- Chassin L, Presson CC. The natural history of cigarette smoking: predicting young-adult smoking outcomes from adolescent smoking patterns. *Health Psychol.* 1990;9:701-716.
- Ershler J, Leventhal H, Fleming R, Glynn K. The quitting experience for smokers in sixth through twelfth grades. *Addict Behav.* 1989;14:365-378.
- Terre L, Drabman RS, Meydrecht EF. Relationships among children's health-related behaviors: a multivariate developmental perspective. *Prev Med.* 1990;19:134-146.
- D'Elio MA, Mundt DJ, Bush PJ, Iannotti RJ. Healthful behaviors: do they protect African-American, urban preadolescents from abusable substance use? *Am J Health Prom.* 1993;7:354-363.
- Gottlieb NH, Chen M. Sociocultural correlates of childhood sporting activities: their implications for heart health. *Soc Sci Med.* 1985;21:533-539.
- Taras HL, Sallis JF, Patterson TL, Nader PR, Nelson JA. Television's influence on children's diet and physical activity. *J Dev Behav Pediatr.* 1989;10:176-180.
- Robinson TN, Hammer LD, Killen JD, et al. Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analysis among adolescent girls. *Pediatrics.* 1993;91:273-280.
- Tucker LA. The relationship of television viewing to physical fitness and obesity. *Adolescence.* 1986;21:797-806.
- Dietz WH, Gortmaker SL. Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics.* 1985;75:807-812.
- Klesges RC, Shelton ML, Klesges LM. Effects of television on metabolic rate: potential implications for childhood obesity. *Pediatrics.* 1993;91:281-286.
- Sonstroem RJ. Exercise and self-esteem. *Exerc Sports Sci Rev.* 1984;12:123-155.
- Buhrmester D, Furman W. The development of companionship and intimacy. *Child Dev.* 1987;58:1101-1113.
- Terre L, Drabman RS, Meydrecht EF, Hsu HSH. Relationships between peer status and health behaviors. *Adolescence.* 1992;27:593-602.