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The Association of Self-reported Sleep, Weight Status and Academic Performance in Fifth Grade Students

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Abstract

BACKGROUND—To improve support and justification for health promotion efforts in schools, it is helpful to understand how students' health behaviors affect academic performance.

METHODS—Fifth grade students completed an online school administered health survey with questions regarding their eating behavior, physical activity, academic performance, and sleep patterns. Differences in health behaviors were examined by sex, self-reported weight status, and sufficient (≥ 9 hours) versus insufficient sleep. Logistic regression was used to determine the relationship between academic performance and the health behaviors.

RESULTS—One-third of the sample did not get the recommended amount of physical activity and more than half of the students watched TV ≥ 2 hours/day. Self-reported overweight status was related to lower self-reported academic performance, fewer lunch and breakfast occasions, less physical activity, not meeting the recommendations for vegetable and soda consumption as well as hours of TV watching. Sufficient sleep (≥ 9 hours/night) was associated with better grades, meeting the recommended hours of daily TV watching and video game playing, being more physically active and increased breakfast and lunch frequency. Percentage of serving free/reduced lunch, soda consumption, breakfast frequency, amount of physical activity, and TV watching were associated with academic performance.

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CONCLUSION—More positive health behaviors generally were associated with better academic performance. Promoting healthy behaviors in schools might improve not only students' health academic performance as well.

Keywords

health behaviors; academic performance; sleep; nutrition; physical activity

The rise in children's obesity rates suggests there is an urgent need to promote healthy behaviors among youth.[1] Because obesity is associated with increased risk of many chronic diseases, addressing obesity in children can have a long-term positive impact on health. Rates of obesity and overweight status in US children are concerning, part due to their association with related health problems.[2–5]

Health Behaviors and Weight Status

Obese children differ from normal weight children in regards to their eating behavior, physical activity patterns and sleep patterns.[6,7] In England, schoolchildren aged 10–16 years who only sometimes ate breakfast were more likely to be obese than those who always did.[8] Other nutritional factors such as the consumption of sugar-sweetened beverages also have been identified as possible contributing factors to the increase in weight status among children.[9] Some studies have shown a link between sleep patterns and risk of obesity in adolescents,[10–12] and particularly in elementary school children.[13] Other health related behaviors such as watching television also seem to affect children's health. Results from the 2003–04 and 2005–06 National Health and Nutrition Examination Surveys suggest high TV viewing as a predictor for cardio-metabolic risk factors such as obesity or hypertension.[14]

Health Behaviors and Academic Performance

There is a great deal of interest in how health behaviors relate to academic performance. Sleep patterns, physical activity, eating behaviors, and body weight have all been suggested to influence academic performance.[15–18] Edwards et al. [17] found that higher academic scores were associated with less soda consumption, more physical activity and fewer hours of watching television. A review investigating the relationship between obesity and academic performance revealed that overweight and obesity were associated with poorer academic performance.[16] Whereas these data are promising, additional research is required to solidify the link between health behaviors and academic performance.

Interventions with Children

Much research in health behavior in schools has targeted 5th graders (age of 9–10 years).[19–21] One reason is that persistent obesity is thought to develop before the age of 11 years.[22] In addition, 5th grade students are already making decisions about food purchases and participation in physical activities; however, they also still depend on their families and the school when it comes to food and physical activity choices as well as other health behaviors such as sedentary behavior and sleep patterns. Lastly, because 5th graders are the oldest children in elementary schools they may be more willing to engage in interventions than children in middle schools where social pressures focus less on healthy behaviors, and physical activity declines.[23]

Colorado is the state with the lowest rates of adult obesity [24] but it is not the state with the lowest rates of childhood obesity.[25] Data from the 2008 Colorado Child Health Survey showed that approximately 28.7 % of Colorado children ages 1–14 years were overweight or obese.[26] Obesity rates vary as a function of ethnicity and socioeconomic status such that

obesity is a particular problem in parts of Colorado with more minority and low income populations. The current study presented herein explored associations among various health behaviors, overweight, socioeconomic status and academic performance in 5th graders using secondary data from a school district in Denver, Colorado.

METHODS

Participants and Procedures

Data from 1095 students of 11 elementary schools enrolled in 5th grade in the school year 2009–10 and enrolled in the Cherry Creek School District in Denver, Colorado were used. The district has 41 elementary schools with a total of about 4000 enrolled 5th graders. The 11 elementary schools are part of an ongoing pilot study regarding health and wellness in this school district. The percentage of children across the elementary schools receiving free/reduced lunch ranged from 3.5% to 76.5%. About 65% of the school district had free/reduced lunch rates of 30% or below. About one fourth of the elementary schools in the district had free/reduced lunch rates of 50% and above. The selected schools do not differ from the remaining schools in terms of ethnicity, sex, or size.

All students in the district complete a biennial Climate, Safety, and Wellness Survey. At the 5th grade level, all students complete the survey on a voluntary basis. Letters are sent home to the students' parents informing them of the survey and obtaining passive consent. Schools then have eligible students complete the survey, typically in a classroom in the school's computer lab, during a one-month survey administration window. For schools that are on a year-round calendar, this window is typically extended for an additional 2 weeks to ensure that students on all tracks have the opportunity to complete the survey. To address potential difficulties some students may have with reading, a school staff member reads the questions aloud along with the students as they complete the survey. Completing the survey requires about 45 minutes.

For this analysis, answers from the Climate, Safety and Wellness Survey regarding the 5th grader' health behaviors (hours of sleep, TV and video console usage, fruit and vegetable consumption, soda consumption, physical activity behavior, breakfast and lunch frequency, weight status) were selected. Questions about TV and computer usage, soda consumption, physical activity, and self-perceived weight status were taken from the Youth Risk Behavior Survey (YRBS). [27] Although the YRBS was originally designed for use in high school aged youth, researchers have used it with younger children; [28] students as young as 5th grade have been noted to understand questions from the YRBS. [29]

Data Analysis

Because the YRBS uses categorical scales for the assessment of TV and computer/video usage (eg, On a 7-point Ordinal scale with 1 indicating "no TV watching on an average school day" and 7 indicating "5 or more hours of TV watching") and the consumption of soda (On a 7-point Ordinal scale with 1 indicating "no soda in the last 7 days" and 7 indicating "4 or more times per day") these variables were re-coded based on the recommendations for healthy behaviors from international health agencies (eg, the Australian Government, the Centers for Disease Control) into two categories (eg, < 2 hours vs. > 2 hours TV or video usage; less than one soda per week vs. one soda or more per week). [30–32]

Independent samples *t*-tests (for continuous variables) and Pearson Chi-square tests (for categorical variables) were used to compare health behaviors between boys and girls, normal versus overweight students, and students reporting adequate (≥ 9 hours) versus inadequate (<9 hours) of sleep. Equal variance *t*-tests were used. The relationship between academic

performance (the dependent variable) and health behaviors (the independent variables) were determined by logistic regression analysis. The percentage of students qualifying for free/reduced lunch (a surrogate for socio-economic status) and sex were included as covariates. All significance levels were set at $\alpha = 0.05$. SPSS Version PASW 18 software was used for all analysis.

RESULTS

Data from 1095 5th grade students were analyzed with an even distribution among boys and girls (Table 1). The self-reported rate of overweight in the total sample was 11.6% which is lower than the Colorado average (27.2% for the age range of 10–17 years). Almost 25% of the sample described themselves as underweight.

There were no sex differences in ethnicity but Pearson chi-square tests revealed a significant higher percentage of boys reporting to be African-American, c^2 (1, N=1083) = 4.980, p = .026, and to underweight or slightly underweight than girls, c^3 (2, N=1042) = 6.050, p = .049. A higher percentage of girls reported to be Asian, c^2 (1, N=1083) = 3.884, p = .049, and having better grades than boys, c^3 (2, N=1069) = 7841, p = .020.

Sex Differences in Various Health Behaviors

No sex differences in days where they reported ≥ 60 minutes of physical activity were found, but a Pearson chi-square test revealed a significantly higher percentage of boys being physically active for the recommended 5 days or more per week than girls, c^2 (1, N=1057) = 9.604, p = .002 (Table 1).

Chi-square tests showed no significant gender differences in fruit and vegetable category but significant differences for soda consumption. Significantly more boys drank more than one soda per day compared to girls, c^2 (1, N=1052) = 8.440, p = .004. Also, significantly more boys compared to girls played video games for 2 hours or more per day in the last 7 days, c^2 (1, N=1063) = 54.901, p <.001. Furthermore, significantly more boys failed to receive the sufficient amount of 9 hours or more of sleep per night, c^2 (1, N=1060) = 4.751, p = .029.

Weight Status and Various Health Behaviors

A significantly larger proportion of overweight children reported lower grades than normal weight children, c3 (2, N=776) = 6.897, p = .032. The TV category (c2 (1, N=774) = 7.706, p = .006), soda (c2 (1, N=773) = 3.894, p = .048) and vegetable consumption categories (c2 (1, N=749) = 4.211, p = .040) all significantly differed by weight status. The group of overweight children was more likely not to eat vegetables daily and overweight children were more likely to watch 2 hours or more of television daily and to drink soda once per week or more. Overweight and normal weight children also differed significantly in their days of eating lunch, p = .005, and breakfast, p < .001. The difference in days of physical activity for a least 60 minutes between overweight and normal weight children approached significance with, p = .071 (Table 2).

Relationship of Sleep with Other Health Behaviors

Experts recommend 9 hours/night of sleep for children of this age.[33] Therefore, independent sample *t*-tests were conducted comparing children with and without the recommended hours of sleep for health behaviors and academic performance (Table 3).

The Chi-square test revealed that school grades significantly differed by sleep category, c^3 (2, N=1057) = 15.913, p < .001 (Table 3). Significant differences were also observed for the recommended days of physical activity, c^2 (1, N = 1054) = 5.328, p = .021, and for the

recommended hours of television viewing, c^2 (1, N= 1054) = 11.844, p = .001, and computer/video usage, c^2 (1, N= 1060) = 12.587, p < .001. Independent samples t-tests revealed significant differences for number of days eating lunch, p < .000, and breakfast, p < .001 as well as number of days being physically active, p = .003. The group of 5th grade students with the recommended hours or more of sleep was more likely to have better grades, watch fewer hours of television, play less video games, eat breakfast and lunch more often and to be more physically active than the group of 5th grade students with less than the recommended hour of sleep.

Academic Performance and Health Behaviors

For the analysis of the relationship between academic performance and health behavior variables, self-reported academic performance, an 8-item categorical ordinal scale, was dichotomized into “Students with A’s through B’s” and “Students with some B’s or lower grades” (B’s and C’s, Mostly C’s through F’s) performance because the data was highly skewed. Stepwise logistic regression analysis was used to predict self-reported academic performance from health behaviors, sex, and socio-economic status as covariates (Table 4). The variables significantly associated with academic performance in the regression model include soda consumption (>1 soda/day), breakfast frequency (<5 days/week), physical activity (< 5 days/week), and socio-economic status measured in percentage of free/reduce lunch participation (<50% free/reduced lunch). The overall model was significant with Chi-square = 92.784, p < .001 with df 4.

DISCUSSION

Overall, 11.6% of the students considered themselves as slightly overweight or very overweight. Although this is lower than the Colorado average, it is based on self-report and therefore lacks objective verification. Research on accuracy of weight status perception in children has shown that especially children in the overweight category tend to underestimate their weight status.[34,35] Nevertheless, some behaviors considered as less favorable for health are apparent not only in overweight students. Less than 30% of the overall sample reported to be physically active for a total of ≥ 60 minutes on < 5 days per week as recommended by the Centers for Disease Control and Prevention.[36] Only about 42% of the sample reported to watch fewer than two hours of television per day as recommended by various experts such as the Australian Government or the American Academy of Pediatrics.[30,31] On the other hand, fruit and vegetable consumption was high with only 37 students indicating that they do not eat fruits daily and with only 9.5% of the students indicating that they do not eat vegetables on a daily basis. This is a substantially lower percentage than reported in US children, [37,38] as well as children in other countries. [39, 40] In addition, soda consumption was fairly low across all students with only 15.2% indicating they drink soda once or more per day which is also lower than among US children in general. [41, 42] Similar to the results of Edwards et al.[17] examining health behaviors among 6th graders in Minnesota, we found an association between higher academic performance and more days of having breakfast and physical activity and less soda consumption. A positive relationship between physical fitness and academic performance in 4th through 9th grade students was also found by London and Castrechini.[43] Also, higher socio-economic status (measured by percentage of free/reduced lunch students in a school) and viewing television less than 2 hours per day were variables associated with higher academic performance.

Furthermore, sleep has been identified as a contributing factor to the development of obesity and health in general as well as academic performance. [44] Although the results did not show a significant relationship between weight status and adequate hours of sleep (≥ 9 hours per night for 5th graders), they showed that adequate hours of sleep were associated with better school grades, fewer hours of watching TV and playing video games, and more days of

eating breakfast and lunch. Previous research results have suggested similar associations regarding academic achievement and TV watching [45,46] but the idea of an association between adequate hours of sleep and eating breakfast and lunch regularly in children appears to not have been investigated yet.

Looking at specific health behaviors and their relationship with overweight status, it was revealed that when comparing overweight with normal weight 5th grade students, the group of overweight students were more likely to watch 2 or more hours of television daily, to consume soda on a daily basis, to eat breakfast and lunch as well as vegetables less frequently and were less physically active than the group of normal weight students. Similar associated patterns between health behaviors and weight status can be found elsewhere. [47–50] Also, the group of overweight students were more likely to have lower school grades although overweight was not an independent predictor of academic performance in the regression model. The regression model showed that children with good academic performance were less likely to be participating in the free/reduced school lunch program, but more likely to be physically active for ≥ 5 days/week. In addition, the odds for children with good academic performance to have daily breakfast and to drink fewer sodas per week were higher than for children with poor academic performance.

Limitations

A major limitation of this study was the reliance on self-reports of all the variables. In general, self-reported questionnaires have limitations and can lead to biased results (eg, by being influenced by social desirability). One indicator for possible biased results is the lower rates of soda consumption and the relatively high rates of fruit and vegetable consumption in our sample. Even so, given the practical difficulties created by gathering objective data on the broad array of variables assessed in the current study, it is thought the self-report data provide an important preliminary step in the process of understanding the relationship among these variables.

In addition, it was decided to dichotomize some variables either because the data were highly skewed or because standard cut points such as recommendations regarding physical activity and food intake were a better fit for the hypothesis. Also, the possible response choices for the academic performance variable were not ideal to measure good compared to poor academic performance. Given the large sample size, the clustering of the data (eg, the free/reduced lunch percentage was only available on school level not individual level) was overlooked which could have caused residual confounding by free/reduced lunch percentage in the regression model.

Finally, the data are cross-sectional and do not allow for determining whether health behaviors and weight status are casually related to academic performance. Nevertheless, for the purpose of policy and intervention recommendations, this study is an important step in the process of convincing policy makers and schools of the importance of promoting healthy behaviors in regards to academic performance and children’s overall health.

Conclusion

We found that health behaviors and body weight status were related to academic performance. Those students who reported being at a healthy weight and engaging in healthier behaviors were more likely to be in the “better grade” category. By providing further scientific support for the association of health behaviors with academic performance, school districts could more effectively justify their emphasis on health promoting activities throughout the school day and obtain (financial) support for related policy changes. In addition, the results could provide information not only for teachers and policy makers

regarding changes to the school environment through nutrition education on soda consumption or the importance of sleep, but also for educating parents regarding the relationships between sleep, weight status, academic performance and other health behaviors of their children.

IMPLICATIONS FOR SCHOOL HEALTH

Some school districts may view the time and resources needed to promote health behaviors such as adequate sleep, enough fruits and vegetables, less soda consumption, more physical activity, less media time and frequent breakfast and lunch as being in direct conflict to meeting specific academic goals mandated by the No Child Left Behind Act of 2001 (Public Law 107-110), time constraints and budget cuts. The current assessment suggests that health promotion should not be a competing priority but should be part of academic achievement support. Informing school authorities of the associations between health behaviors and academic performance, as well as incorporating such results into the school curriculum to inform teachers, students, and parents, could be strategies that encourage pro-health behaviors. Offering time and opportunities to be physically active and providing favorable fruit and vegetable choices as well as attractive alternatives for sugar-sweetened carbonated beverages could be another path to effective health promotion in schools.

Human Subjects Approval Statement

This study was approved by the University of Colorado at Denver Institutional Review Board as well as the Cherry Creek School District Review Board.

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Table 1

Sex Differences in Sample Characteristics and Health Behaviors

	Total	Boy	Girl	p-value
N (%)	1095 (100)	567 (51.8)	516 (47.1)	
Ethnicity				
Non-Hispanic	910 (83.1)	477 (84.1)	423 (82.0)	
Hispanic	185 (16.9)	90 (15.9)	93 (18.0)	
Race				
White	640 (58.4)	326 (57.5)	310 (60.1)	
African American	183 (16.7)	109 (19.2)	73 (14.1)	p = .026
American Indian/Alaskan Native	53 (4.8)	29 (5.1)	24 (4.7)	
Asian	134 (12.2)	59 (10.4)	74 (14.3)	p = .049
Native Hawaiian/Pacific Islander	24 (2.2)	10 (1.8)	14 (2.7)	
Other	61 (5.7)	34 (6.0)	21 (4.1)	
Grade level				
A's & B's	857 (70.3)	375 (66.7)	377 (74.4)	p = .020
B's & C's	255 (23.7)	147 (26.1)	106 (20.9)	
C's, D's & F's	64 (6.0)	30 (7.2)	24 (4.7)	
Weight status				
Underweight	266 (24.3)	153 (27.0)	110 (21.3)	p =.049
Normal Weight	658 (60.1)	323 (57.0)	330 (64.0)	
Overweight	127 (11.6)	69 (12.2)	57 (11.0)	
% free/reduced lunch *				
Low (<50%)	761 (74.1)	386 (74.2)	373 (75.1)	
High (>50%)	266 (25.9)	134 (25.8)	124 (24.9)	
Physical Activity				
< 5 days/week	326(30.6)	146 (26.4)	178 (35.2)	p = .002
≥ 5 days/week	740 (69.4)	406 (73.6)	327 (64.8)	
TV hours/day				
< 2 hours/day	611 (57.3)	304 (54.7)	303(60.5)	
≥ 2 hours/day	455 (42.7)	252 (45.3)	198 (39.5)	
Video games				
< 2 hours/day	754 (70.3)	338 (60.7)	412 (81.4)	p < .001
≥2 hours/day	318 (29.7)	219 (39.3)	94 (18.6)	
Sleep hours				
< 9 hours/night	345 (32.3)	198 (35.4)	146 (29.1)	p = .029
≥ 9 hours/night	724 (67.7)	361 (64.6)	355 (70.9)	
Daily Fruit Consumption				
0 times/day	37 (3.5)	23 (4.1)	14 (2.8)	
1 time or more/day	1031 (96.5)	535 (95.9)	487 (97.2)	
Daily Vegetable Consumption				
0 times/day	104 (10.2)	62 (11.9)	41 (8.3)	

	Total	Boy	Girl	p-value
1 time or more/day	919 (89.8)	461 (88.1)	451 (91.7)	
Soda consumption				
< once per week	895 (84.4)	450 (81.2)	437 (87.8)	p = .004
≥ once per week	166 (15.6)	104 (18.8)	61 (12.2)	
	Mean± SD	Mean± SD	Mean±SD	
Days being physically active	4.61±2.1	4.9 ± 2.1	4.3 ± 2.0	
Days of lunch/week	6.49±1.3	6.44 ±1.3	6.55±1.2	p = .011
Days of breakfast/week	6.15±1.7	6.14±1.7	6.16±1.7	

*The free/reduced lunch variable is based on the school district's information for each of the 41 elementary schools and is not based on the individual child.

Table 2

Association of Weight Status, Academic Performance and Various Health Behaviors

	Normal weight	Overweight	p-value
N (%)	650	126	
Grade level			
A's & B's	462 (71.1)	80 (74.4)	p = .020
B's & C's	154 (23.7)	32 (20.9)	
C's, D's & F's	34 (5.2)	14 (4.7)	
Daily TV hours			
< 2 hours/day	375 (57.9)	56 (44.4)	p =.006
≥ 2 hours/day	273 (42.1)	70 (55.6)	
Daily video game hours			
< 2 hours/day	468 (71.1)	85 (68.0)	
≥ 2 hours/day	186 (28.3)	40 (32.0)	
Daily fruit consumption			
0 times/day	20 (3.1)	3 (2.4)	
1 time or more/day	631 (96.9)	122 (97.6)	
Daily vegetable consumption			
0 times/day	49 (7.8)	16 (13.6)	p =.040
1 time or more/day	582 (92.2)	102 (86.4)	
Physical activity recommendation			
≥ 5 days/week	446 (68.6)	80 (64.0)	p =.071
< 5 days/week	204 (31.4)	45 (36.0)	
Soda consumption			
< once per week	558 (85.7)	96 (78.7)	p =.048
≥ once per week	93 (14.3)	26 (21.3)	
	Mean±SD	Mean±SD	
Days being physically active	4.62± 2.1	4.25±2.1	p =.071
Days of lunch/week	6.60±1.1	6.27±1.5	p =.005
Days of breakfast/week	6.22±1.6	5.65±2.2	p <.001

Table 3

Association of Recommended Hours of Sleep for Children (≥ 9 hours), Academic Performance and Various Health Behaviors

	≥ 9 hours of sleep/night	< 9 hours of sleep/night	p-value
N (%)	724 (67.7)	345 (32.3)	
Grade level			
A's & B's	531 (74.0)	210 (61.9)	p <.001
B's & C's	150 (20.9)	102 (30.1)	
C's, D's & F's	37 (5.2)	27 (8.0)	
Weight status			
Underweight	178 (25.2)	85 (25.4)	
Normal Weight	449 (63.7)	203 (60.8)	
Overweight	78 (11.1)	46 (13.8)	
Daily TV hours			
< 2 hours/day	438 (61.1)	168 (49.9)	p =.001
≥ 2 hours/day	279 (38.9)	169 (50.1)	
Daily video game hours			
< 2 hours/day	528 (73.5)	215 (62.9)	p <.001
≥ 2 hours/day	190 (26.5)	127 (37.1)	
Daily fruit consumption			
0 times/day	23 (3.2)	12 (3.5)	
1 time or more/day	693 (96.8)	328 (96.5)	
Daily vegetable consumption			
0 times/day	64 (9.2)	40 (12.5)	
1 time or more/day	628 (90.8)	280 (87.5)	
Physical activity recommendation			
≥ 5 days/week	510 (71.5)	121 (35.5)	p =.021
< 5 days/week	203 (28.5)	220 (64.5)	
Soda consumption			
< once per week	605 (85.5)	280 (82.1)	
≥ once per week	103 (14.5)	61 (17.9)	
	Mean±SD	Mean±SD	
Days being physically active	4.68±2.0	4.44±2.2	p =.003
Days of lunch/week	6.61±1.1	6.25±1.5	p <.001
Days of breakfast/week	6.26±1.6	5.90±1.9	p <.001

Table 4

Binary Stepwise Logistic Regression Comparing Academic Performance with Socio-Economic Status, Nutrition and Physical Activity Behaviors.

Dependent Variable	Independent Variables	beta	S.E.	p-value	Exp(B)
Academic performance	< 50% free/reduced lunch	−1.296	.229	p <.001	.274
	<5 days of physical activity	.542	.228	p = .018	1.719
	> one soda/day	−1.318	.260	p <.001	.268
	Breakfast/week	−.154	.055	p =.005	.857