Adolescent Health Behavior, Contentment in School, and Academic Achievement

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***Objectives*: To examine the association between health behavior indicators, school contentment, and academic achievement. *Methods*: Structural equation modeling with 5810 adolescents. *Results*: Our model explained 36% of the variance in academic achievement and 24% in school contentment. BMI and sedentary lifestyle were negatively related to school contentment and academic achievement, but physical activity was positively related to school contentment and academic achievement (P< .01). School contentment was strongly related to academic achievement but only a weak mediator of the health behavior indicators. *Conclusion*: Findings may inform the efforts to improve academic achievement and the general health status of youth.**

***Key words*: academic achievement, adolescence, health behavior, school health**

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The health status of children and adolescents, and the potential impact of health behaviors on their academic achievement, are of growing interest to social scientists, public health authorities, and educational policy makers. Research on this topic has largely sought to identify correlational evidence in support of a positive relationship between good health status, good health habits, and good academic performance.[1,2] However, many of the reported research findings on the relationship between health behavior indicators and academic achievement have been neither robust nor entirely consistent.[1-5] These inconsistencies can be attributed, in part, to research and analytic designs that have limited generalizability and a wide range of methodological approaches to the measurement of health behaviors and their indicators and student academic performance. In addition, the diverse population samples, age ranges, and cultural con-

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texts in which such investigations have been conducted have complicated the picture.[1-3]

The precise mechanism by which health behavior and a host of potential exogenous factors influence school performance is far from understood. A statistical relationship between health behavior indicators and academic achievement can also be confounded by a complex nexus of variables, including the characteristics of school-age children, their families, and schools, and other unobserved individual psychological and social variables that retrospective data and correlational analyses cannot entirely address in order to specify a model of causality.[2-4] The purpose of this study was to examine the relationship between 2 health behaviors—sedentary lifestyle and physical activity—and one health behavior indicator—body mass index (BMI)—with school contentment and academic achievement, in a structural model.

Background and Review of Literature

In one of the earliest studies of the role of weight status, Tershakovec and associates[5] studied the obesity, school performance, and behavior of black, inner-city school children. They found that the proportion of obese children requiring special or remedial education was twice that for children who were not obese. Similarly, Falkner et al[6] conducted a cross-sectional study of a population-based sample of 4742 male and 5201 female public school students enrolled in the 7th, 9th, and 11th grades in order to examine the social, educational, and psychological correlates of weight status. They reported that both obese girls and boys were significantly more likely to report being held back a grade and more likely to consider themselves poor students than their average-weight counterparts. In a more recent study of over 11,000 US elementary school students, the authors examined the association between being overweight in kindergarten and academic achievement in kindergarten and first grade students.[7] They found that overweight children had significantly lower math and reading test scores compared to non-overweight children in kindergarten; however, they concluded that being overweight was a marker and not causal due to the influence of socioeconomic status. Prior to this, authors had found that teacher ratings of social-behavioral outcomes and approaches to learning among girls differed between weight-status groups.[8] Still other, more recent, studies have discovered similar relationships in terms of overweight and obesity.[1,9] All of these findings raise further questions about the possibly interacting influences of psychological variables in the relationship between obesity and academic achievement.

Studies have consistently shown that sedentary lifestyle is associated with greater levels of BMI[10-12] and physical inactivity,[13] although other studies have revealed TV viewing—a common proxy measure for sedentary lifestyle—to be unrelated with physical activity.[14] Other studies have suggested that sedentary lifestyle is positively associated with unhealthy dietary behaviors[15] and that adolescents' perceptions of higher academic rank or expectations predict greater levels of physical activity and lesser amount of sedentary lifestyle behaviors.[16] The study by Schmitz et al[16] showed that depressive symptoms predicted higher sedentary lifestyle scores but not physical activity. It is therefore of particular importance to look more specifically at the relative contribution of both BMI and sedentary lifestyles to academic achievement in order to determine whether these 2 constructs both relate independently to lower academic performance in school.

In light of the evidence on weight status and academic achievement, together with a burgeoning epidemic of overweight children and adolescents in countries with advanced economies, particularly the United States, increasingly more studies have focused attention on the relationship between academic achievement and physical activity.[1,3,5-7] Several papers have asserted that school-based physical activity increases concentration, boosts self-discipline, and improves academic skills, including reading and writing abilities;[17-19] physical activity has also been shown to be positively associated with higher levels of self-esteem.[20] In one of the largest and most compelling studies to demonstrate a clear relationship between academic achievement and physical activity, the California Department of Education[21] assessed several thousand students in the fifth, seventh, and ninth grades whose fitness levels were correlated with academic performance on math

and reading tests. Students in the study who achieved the minimum required fitness levels on 3 tests of physical fitness were found to have posted higher scores on math and reading tests than did those who were less physically fit. This finding was pronounced for females and students with higher socioeconomic status.

Studies of the relationship between various health behaviors and academic achievement in South American and Asian child and adolescent populations have yielded generally similar findings. These include studies in Brazil,[22] in the Peoples Republic of China,[23] and in Thailand.[24] Several European studies of school children and adolescents have produced findings consistent with the aforementioned studies; those include studies from Britain[25] and Finland.[26] In a recent study[1] of Icelandic adolescents, ages 14 and 15 years, the authors found that body mass index, dietary behavior, and physical activity explained up to 24% of the variance in academic achievement when controlling for gender, parental education, family structure, and school absenteeism.

Because the school is central to the lives of the vast majority of adolescents and is an institutional mediating structure that provides young people with sentiments of obligation and commitment and a set of common goals,[27] it is plausible that contentment with school may help to explain the relationship between health behavior indicators and academic performance. Studies have shown that adolescents who feel good in the school environment are less likely to suffer from emotional problems and more likely to partake in activities and commit to school-related issues.[1,18,28] The question of whether certain health behavior indicators are among the defining factors that influence school contentment is therefore of particular importance in understanding these relations. The main objective of this study was to examine how health behavior indicators, in the form of sedentary lifestyle, BMI, and physical activity, contribute to academic achievement, and whether these health behavior indicators do so through increased school contentment.

Although most studies of the relationship of health status and health behaviors to academic achievement and other indicators of school performance have generally found some evidence for the negative impact of being overweight, there is slightly more mixed evidence regarding the relationship between physical activity and school achievement.[1,7-9,17-19] Moreover, almost all studies have consistently shown that socioeconomic status (SES) and proxy measures of SES are powerful correlates of academic achievement that frequently overwhelm the contribution of all other variables.[1,30] For the most part, these findings appear to be consistent across cultures and different systems of schooling. Thus, the purpose of this study was to expand on the previous work by constructing and testing a structural model of the relationship of key health behavior indicators and potential mediating mechanisms, specifically contentment with school, to academic achievement. The analysis we report in this paper was designed to address 3 specific questions. Do health behaviors influence both school contentment and academic achievement simultaneously? Does contentment with school mediate the relationship between the 3 health behavior indicators to academic achievement? Do greater levels of school contentment have an independent relationship with better academic achievement when controlling for other variables?

METHOD

Sample and Procedures

The data for this investigation came from the 2000 Icelandic study, *Youth in Iceland*. The *Youth in Iceland* sample includes students aged 14 and 15 years who were enrolled in the 9th and 10th grades in all Icelandic secondary schools during March 2000. The study respondents in this sample represent approximately 82% of the national population of Iceland in these age-groups. All aspects of the data collection were supervised by the Icelandic Centre for Social Research and Analysis at Reykjavik University. The Centre distributed anonymous questionnaires and envelopes for returning completed questionnaires to all secondary schools in Iceland. Teachers at individual school sites supervised the participation of the students in the study and administered the survey questionnaire. All students who attended school on the day that the questionnaire was scheduled to be administered completed the questionnaire inside their classrooms. Students were instructed not to write their names or any

other identifying information anywhere on the questionnaire. They were instructed to complete the entire questionnaire, but to ask for help if they had any problems or had any questions for clarification. Once students had completed the questionnaires, they were asked to place their completed questionnaire in the envelope and seal it before returning the questionnaire to the supervising teacher.

A total of 6346 students (51.4% girls, 48.6% boys) completed the questionnaire, which constituted approximately 82% of all students in these age-groups who were enrolled in schools throughout Iceland during the time of the survey. However, body mass index (BMI), one of 3 key independent variables in the study, needed to be calculated from self-reports of height and weight. Those students who had not answered the questions on height and weight or either one, or those who answered them incorrectly or without foundation, were screened from the initial sample. This meant that those who reported being either 30 kg or less in weight, or 145 kg or more in weight, were omitted from the sample; similarly, those who reported to be 130 cm in height or less, or 230 cm in height or more were also omitted. Therefore, of the 536 answers omitted from the analysis, 307 were omitted due to the failure of students to answer either question about height and weight and the remaining 229 were omitted due to screening. This left a final remaining sample of 5810 respondents (51.7% girls, 48.3% boys), on whom complete data were collected and analyzed for this study. This represents a response rate of 76% for these 2 cohorts.

Measures

Five latent variables were specified and used in the analysis, along with 4 observed variables. All latent constructs were measured with multiple indicators. Four variables were used as control variables in the study: gender; parental education (a proxy measure of family socioeconomic status); family structure, ie, whether adolescents lived with both biological parents or in different arrangements, and a proxy measure for psychological well-being. Approximately 94% of the estimated 300,000 inhabitants of Iceland are of Norse-Celtic descent, and 87% of the population belongs to the Lutheran State Church.[29] Because of this homogeneity, other exogenous variables, such as race, ethnicity, and religion, which are often used in research in the United States and other countries, were not included in this analysis.

The psychometric properties of all the items used in our analysis had been previously established as valid and reliable for the *Youth in Iceland* study.[28] Both translation and criterion-related validity methods were used to establish construct validity for all measures. Internal consistency reliability of the items used in this analysis was generally high, with Cronbach alpha (a) ranging from .70 to .87.

Academic achievement. Academic achievement was the main dependent variable in this study. In order to estimate the level of academic achievement, respondents were asked to self-report their average grades in the core academic subjects of Icelandic, Mathematics, English, and Danish, or, alternatively, Swedish or Norwegian. These subjects are the so-called unitary subjects that every student in the 9th and 10th grades in Iceland must complete satisfactorily in order to complete secondary school. The grade range in Iceland in these subjects is 0-10, with a score of less than 5 resulting in a *fail* grade with 5 and over resulting in a *pass* grade. The response format was 0 = "under 4," 1 = "about 4," 2 = "about 5," 3 = "about 6," 4 = "about 7," 5 = "about 8," 6 = "about 9," and 7 = "about 10."

School contentment. To capture how content the adolescents generally were in their schools we asked them to evaluate how often the following 3 statements apply to them: "I want to quit school"; "I want to switch schools"; and "I feel bad at school." The response format was 1 = "applies almost always to me," 2 = "applies often to me," 3 = "applies sometimes to me," 4 = "applies seldom to me," and 5 = "applies almost never to me."

Body mass index (BMI). BMI was measured by asking respondents to self-report their weight and height. BMI was calculated using the formula: weight in kilograms/(height in meters * height in meters).

Sedentary lifestyle. In order to capture those who used TV excessively, as an indicator for sedentary lifestyles, we asked the respondents how many hours every day they used a VCR for TV watching with the following 3 questions: "How many

Table 1
Descriptive Statistics for Study Variables

Variable	N	Range	Mean	SD
Gender	5803	0-1	0.52	0.50
Mothers education	4791	0-4	2.77	1.42
Fathers education	4880	0-4	3.16	1.33
Family structure	5794	0-1	0.73	0.44
Sad and had litte interest in doing things	5759	1-4	3.03	0.98
The future seemed hopeless	5779	1-4	3.61	0.80
Not excited in doing things	5770	1-4	3.41	0.85
Grades in Icelandic	5752	1-8	5.20	1.52
Grades in English	5707	1-8	5.51	1.70
Grades in Danish	5669	1-8	5.00	1.84
Grades in mathematics	5720	1-8	4.85	1.94
I want to quit school	5749	1-5	4.27	1.13
I want to switch schools	5750	1-5	4.41	1.07
I feel bad at school	5759	1-5	4.22	1.04
Weight in kg	5810	33-126	61.37	11.88
Height in cm	5810	130-200	170.43	8.50
BMI	5810	9.42-57.07	21.05	3.33
VCR use on Saturdays	5474	1-8	3.65	1.71
VCR use on Sundays	5432	1-8	2.93	1.80
VCR use on working days	5486	1-8	2.88	1.75
Participation in sports with a club or a team	5662	1-6	2.85	1.96
Participation in sports in school outside compulsory lessons	5660	1-6	2.90	1.77
How often physically tests oneself so winded significantly or sweat	5661	1-6	4.16	1.48

hours do you usually spend on Saturdays watching videotapes?" "How many hours to you usually spend on Sundays watching videotapes?" "How many hours to you usually spend on working days watching videotapes?" Answers ranged from 1 = "almost none," 2 = "1/2 to 1 hour," 3 = "about 1 hour," 4 = "about 2 hours," 5 = "about 3 hours," 6 = "about 4 hours," 7 = "about 5 hours," and 8 = 6 hours or more."

Physical activity. Physical education is compulsory in the Icelandic national secondary school curriculum, and students usually participate in one lesson per week. To measure *additional* physical activity, respondents were asked 3 questions, which were intended to measure different levels of physical activity beyond the one compulsory school session: "How often do you participate in sports in school outside the compulsory lessons?" "How often do you participate in sports with a sports club or a team?", which captured those who attended formal training and/or practicing with such agents. "How often do you physically test yourself so you wind yourself significantly or sweat?", which is a more general question on physical activity. The response format was 1 = "almost never," 2 = "less than once a week," 3 = "once a week," 4 = "2-3 times a week," 5 = "4-5 times a week," and 6 = "almost every day."

Control variables. Several studies[30-32] have shown that gender, level of parental education as a proxy measure of socioeconomic status, and family structure, constitute variables that should be considered when studying the relationship of health behaviors and academic achievement. Hence, we treated the following variables as control variables in the analysis: gender was a dichotomized variable, with 0 = boys and 1 = girls. Parental education is a latent, 2-indicator variable in the analysis and was obtained by ask-

ing students separate questions about their fathers' and mothers' educational attainment. The response format was 1 = "finished elementary school or less," 2 = "started a school on the secondary level," 3 = "finished secondary level," 4 = "started university level," and 5 = "has a university degree." Family structure was measured by asking, "Who lives with you in your home?" The response format was 1 = "both parents," 2 = "mother and not father," 3 = "father and not mother," 4 = "mother and partner," 5 = "father and partner,"< 6 = "I live on my own," and 7 = "other arrangement." This variable was then collapsed and dichotomized with 0 = "lives with both parents" (73%) and 1 = "other arrangements" (27%). Furthermore, a recent study has shown that it is important to include mental health indicators as control variables in this regard in order to prevent the possibly confounding effects of differences in mental health on the relationship between health behavior and academic achievement among the study participants.[1] We used 3 items from the depressive symptoms check list developed by Derogatis and associates for possible variability in mental health in the study sample.[33] Our variables included the following statements: "I was sad or had little interest in doing things"; "The future seemed hopeless"; and "I was not excited in doing things." The response format was 1 = "often," 2 = "sometimes," 3 = "seldom," and 4 = "never" to indicate the severity of depressed mood symptoms. These items were then combined into a scale with a range from 0-30 (Cronbach a = .72). Descriptive statistics for all study variables are shown in Table 1.

Measurement Model and Data Analysis

Our analysis sought to answer 3 specific questions: (1) Are the health behavior variables directly related to academic achievement when controlling for the possibly confounding impact of school contentment, psychological well-being, and the background variables? (2) Does school contentment play a mediating role in the influences of health behavior on academic achievement? (3) Do greater levels of school contentment have independent relationship with better academic achievement when controlling for other variables in the model? Our analysis was based on structural equation modeling (SEM) and was conducted by using AMOS.[34, 35] SEM allowed us to explicitly model both direct and indirect effects using both measured and latent variables. A recent article in the *American Journal of Health Behavior* underlines the importance of health behavior researchers' using such analytic methods.[36]

Most social-psychological concepts are abstract and cannot be measured directly; thus, modeling entails specifying the underlying theoretical concepts and their operationalized measurement. The first step in testing the structural model is to specify and test the measurement model. A measurement model specifies the structural relationship between the underlying latent constructs and their observed measures.[37] We specified 5 latent constructs in the analysis: parental education, sedentary lifestyles, physical activity, school contentment, and academic achievement. The specification included the number of factors, the number of indicators for each factor, and whether the measurement errors were allowed to correlate or not. Confirmatory factor analysis was used to test the fit of the hypothesized factor structure to the covariance matrix of the observed variables. In the construction of all latent variables, we used confirmatory factor analysis from the beginning, as the latent variables already made clear what indicators we should be seeking.

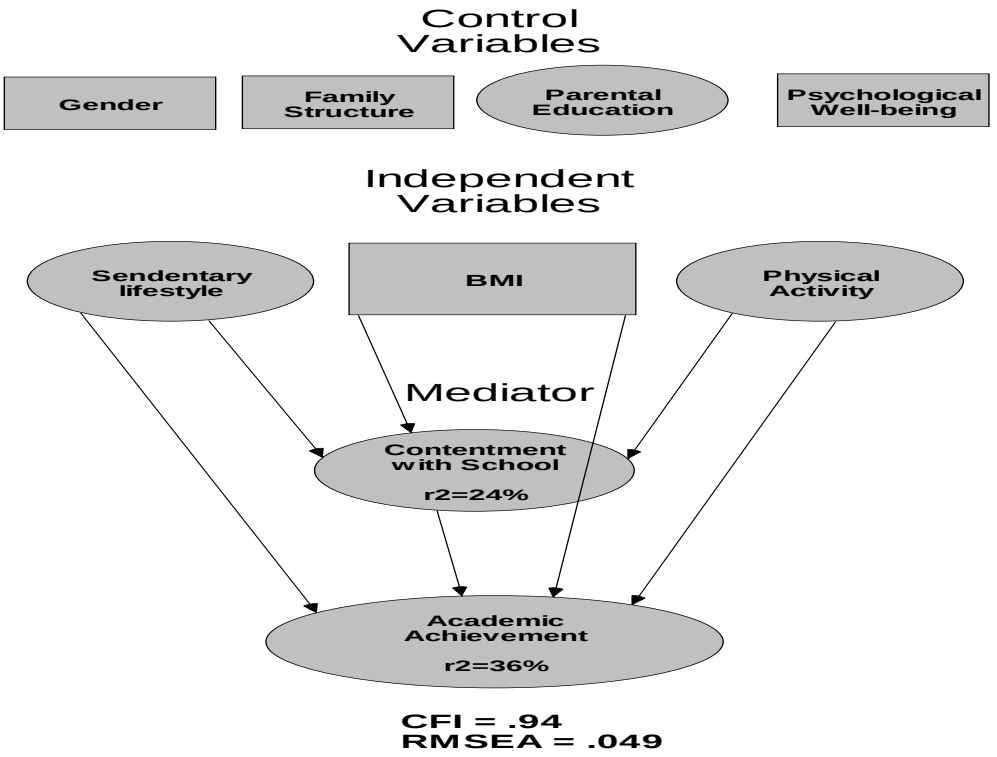
The structural equation model we tested can be expressed as the following equation:

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

where β is the matrix of regression weights interrelating the endogenous (η) variable, school achievement, as well as the mediating variables sedentary lifestyle, physical activity, BMI, and school contentment. Γ is the matrix of regression weights relating the exogenous (ξ) variables, gender, parental education, family structure and psychological well-being, to the endogenous (η) ones; and ζ is a vector of error terms.

The traditional method of constructing structural equation models calls for performing a chi-square test of the null hypothesis that the observed and the expected matrices are identical. The model is thus accepted if the test fails to reject the null hypothesis; however, in large

Figure 1
Relationship Between BMI, Sedentary Lifestyle and Physical Activity to School Contentment and Academic Achievement



Note.
For purposes of clarity, the lines from the control variables to all the other variables are implied but not presented. Readers should assume they are there.

samples, such tests can lead to the rejection of good models on the basis of trivial misspecifications.[38] When this occurs, a combination of goodness-of-fit indices to assess fit of the model to the data needs to be used. There are number of goodness-of-fit indices that are calculated by the AMOS program, each of which has various strengths and weaknesses and evaluates fit in different ways. Prior work has suggested that 2 of these indices—the comparative fit index (CFI) and the root mean square error of approximation (RMSEA), along with the chi-square statistic—when considered together, constitute appropriate measures for examining the fit of a proposed model.[39] Models are considered a good fit if the CFI is above .90, with coefficients closer to 1.0 signifying a better fit. Furthermore, the RMSEA, a measure of lack of fit of the model to the population covariance matrix per degree of freedom for the model, is less than .05.

RESULTS

Our chi-square test of the null hypothesis in the proposed model was χ^2 (129) = 1949.493 (P < .000). Hence, we used a combination of goodness-of-fit indices to assess fit of the model to the data.

Figure 1 depicts the proposed relationships between variables in this study. As

Table 2
Standardized and Unstandardized Regression Weights for the Structural Model with School Contentment as Mediating Factor

Hypothesized Relationships	Standardized Coefficients	Unstandardized Coefficients	SE	CR
BMI ⇨ Academic achievement	-.05**	-.02	.005	-4.23
BMI ⇨ School contentment	-.03**	-.01	.004	-2.34
Sedentary lifestyle ⇨ Academic achievement	-.11**	-.13	.017	-7.57
Sedentary lifestyle ⇨ School contentment	-.05**	-.03	.011	-2.92
Physical activity ⇨ Academic achievement	.08**	.08	.016	5.14
Physical activity ⇨ School contentment	.11**	.06	.010	5.86
School contentment ⇨ Academic achievement	.21**	.38	.032	11.77

Note.
*** P < .05 (2-tailed), **P < .01 (2-tailed)**

shown, each of the 3 independent health variables are hypothesized to be related to school contentment as well as academic achievement. The proposed mediation between the independent variables and academic achievement through school contentment is also shown. With a CFI = .94 and RMSEA = .049, our model fits the data very well.

The context of the hypothesized relationships of our model and the standardized (β) and unstandardized regression weights from the structural equation model are shown in Table 2, along with standard errors and critical ratios for statistical significance. For purposes of clarity and space, control relationships are not presented in the table. However, as expected, parental education (a proxy measure for family SES) is by far the strongest factor in relation to academic achievement (β = .40, t > 1.96), and psychological well-being is the strongest factor relating to school well-being (β = .40, t > 1.96). Other control relationships of importance are gender to physical activity (β = -.22, t > 1.96), gender to academic achievement (β = .22, t > 1.96), parental education to school contentment (β = .15, t > 1.96), and psychological well-being to physical activity (β = .15, t > 1.96). The background variables and the health behavior indicators explain just over 24% of the variance in school contentment, and all variables in the model explain about 36% of the variability in academic achievement.

There are several notable findings among the independent variables of interest. First, BMI has little negative and direct relationship with school contentment (β = -.03, t > 1.96), but a stronger direct negative relationship with academic achievement (β = -.05, t > 1.96). Neither of these relationships could be considered strong even though both are statistically significant (P = .01). Moreover, a very limited part of the latter relationship is caused by mediation through contentment with school.

Second, sedentary lifestyle is directly and negatively related with contentment with school (β = -.05, t > 1.96) and academic achievement (β = -.11, t > 1.96). Only about 10% of the latter relationship is due to mediation through school contentment.

Third, physical activity is positively and directly related with school contentment (β = .11, t > 1.96) and moderately related with academic achievement (β = .08, t > 1.96). About 20% of the latter relationship is due to mediation through school contentment.

Finally, school contentment is strongly related with academic achievement (β = .21, t > 1.96).

DISCUSSION

This investigation sought to extend previous work by estimating the relationship of BMI, sedentary lifestyle, physical activity, and school contentment to academic achievement among adolescents.

We undertook the analysis in an effort to better understand the role and impact of these variables in a multivariate model. We used a large data set of over 5000 adolescent respondents, virtually the entire national Icelandic population of students in the age range we studied; and both the response rate and quality and completeness of our data were high. Consistent with most of the previous research, our structural equation model showed that age-appropriate weight status (as measured by BMI), participation in physical activity, and sedentary lifestyles were all associated with better academic achievement. However, our findings also show that the health behavior indicators were positively and robustly associated with greater levels of school contentment. This raises the question of whether adolescents who feel good at school are more able to perform better in terms of academic achievement. It furthermore proposes additional questions regarding how to improve the well-being of adolescents in schools. The results demonstrate that positive school contentment is possibly caused, at least in part, by healthy lifestyle. Some of the measured relationships are quite weak, particularly those stemming from BMI and sedentary lifestyle. Moreover, we failed to discover a sizable mediational effect from the independent variables on academic achievement through school contentment. Nevertheless, these findings should be interpreted with relevance to the number of control variables in the structural model we tested. The results should also benefit from the fact that the model looks simultaneously at the relationship between the independent variables to school contentment and academic achievement. The results therefore suggest that BMI, sedentary lifestyle, and physical activity all independently and simultaneously relate to both school contentment and academic achievement. When evaluating these findings it is important to notice that sedentary lifestyle and BMI are health behavior indicators that are strongly correlated to one another ($r = .36$, data not shown). Recently, Datar et al[7] concluded that being overweight was a marker for poor academic achievement and not causal due to the influence of socioeconomic status. In this study we therefore separate BMI and sedentary lifestyle to look independently on their potential impact on both school contentment and academic achievement.

Although the high proportion of explained variance in our main dependent variables, school contentment (24%) and academic achievement (36%), should serve to further strengthen the argument made in the analysis, the interpretation of these results should be considered in light of several methodological limitations. First, like most previous studies that have examined the relationship of health behavior indicators to academic achievement, we used cross-sectional data. Second, although our measures were valid and reliable, the data we collected came from self-reports of behavior from adolescents; thus, the possibility of response error should be considered. Third, because our measure of academic achievement was based on student estimates of their grades, it is possible that students may have overestimated their academic performance. Finally, we measured sedentary lifestyle with questions about VCR use. However, because of rapid changes in computer and portable screen technology, this measure for sedentary lifestyle might be considered to be outdated.

Our findings have several important implications for both school policy and practice and future research in the context of the emerging debate in the United States and other advanced economies about improving academic achievement and adolescent health. First, with regard to school policy and practice, schools should consider strengthening the opportunities to facilitate, support, and reinforce a wide range of health-related behavior through comprehensive programming, especially physical activity.[40] Schools should also place more emphasis on adolescent participation in physical activity of an enjoyable, noncompetitive nature in order to increase the number of minutes (up to 60 per day) of moderate to vigorous physical activity.[41]

Second, future research should seek to examine the causal relationships regarding the association between health behavior indicators and academic achievement. Thus, longitudinal or panel-design studies, or both, are needed. Furthermore, because the social structure of gender is of such great importance in the daily lives of children and adolescents, the role of health behaviors in academic achievement might not be the same for

boys and girls. The implications of this are that gender-specific assessments may be necessary to fully illuminate the role. Additionally, it might be useful to expand the study of mediating indicators, such as school contentment, that probably influence academic achievement. Finally, limits should be placed on the time young people spend in front of the TV, and the range of healthy nutritional alternatives should be increased to improve health and possibly improve academic achievement. ■

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