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Health and School Outcomes During Children's Transition into Adolescence

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Abstract

Purpose—Normative biopsychosocial stressors that occur during entry into adolescence can affect school performance. As a set of resources for adapting to life's challenges, health may buffer a child from these potentially harmful stressors. This study examined the associations between health (measured as well-being, functioning, symptoms, and chronic conditions) and school outcomes among children aged 9 to 13 years in 4th to 8th grades.

Methods—We conducted a prospective cohort study of 1,479 children from 34 schools followed from 2006 to 2008. Survey data were obtained from children and their parents, and school records were abstracted. Measures of child self-reported health were dichotomized to indicate presence of a health asset. Outcomes included attendance, grade point average, state achievement test scores, and child-reported school engagement and teacher connectedness.

Results—Both the transition into middle school and puberty had independent, negative influences on school outcomes. Chronic health conditions that affected children's functional status were associated with poorer academic achievement. The number of health assets that a child possessed was positively associated with school outcomes. Low levels of negative stress experiences and high physical comfort had positive effects on teacher connectedness, school engagement, and academic achievement, whereas bullying and bully victimization negatively affected these outcomes. Children with high life satisfaction were more connected with teachers, more engaged in schoolwork, and earned higher grades than those who were less satisfied.

Conclusions—Good health may buffer children from the potentially negative effects of school and pubertal transitions on academic success as children enter adolescence.

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Keywords

health; subjective well-being; children with special health care needs; student engagement; academic achievement; bullying; school performance; middle childhood; adolescence

Introduction

That children need good health for optimal learning and academic achievement is well accepted.[1] Health exerts direct beneficial effects on children's motivation to learn, their engagement in schoolwork, and their acquisition of learning skills. As a set of resources for adapting to life's challenges,[2] health may buffer a child from potentially harmful stressors. One approach for testing this hypothesis is to examine the effects of health on school outcomes during particularly stressful periods of life.

The biopsychosocial changes that occur as children transition into adolescence increase youths' physical and emotional distress and risk behaviors, strengthen ties to friends, but decrease subjective well-being, especially if puberty occurs early.[3–6] Compared with elementary school, middle school heightens performance demands and presents a child with a more impersonal environment for making and sustaining relationships. Co-occurrence of the middle school and pubertal transitions threatens both health and school outcomes.[6]

As conceptualized in the 2004 Institute of Medicine report, child health can be assessed as (1) health conditions, (2) functional status, and (3) well-being.[2] The influence of a chronic condition on academic performance and the need for educationally related services varies by impact of the disorder on a child's functioning.[7, 8] Children with a chronic condition that has no functional impact have comparable school outcomes as children without a long-term disorder.[8] Asthma is not associated with academic performance, even though children with asthma miss more days from school than counterparts.[9, 10] Evidence of associations between obesity and achievement suggests that neither body mass index nor body fat are strong predictors; rather, poor physical fitness seems to be the key determinant of lower achievement.[11, 12] When a chronic disorder limits functioning, affected individuals experience less interest in school, poorer attention, more bullying and bully victimization, and lower academic achievement.[8]

Poor health during middle childhood may result from chronic conditions, but is more likely to take the form of sub-clinical distress that manifests itself as problems with functioning or a high symptom burden.[13] Lack of emotional distress,[14] vigorous physical activity and good physical fitness,[12, 15, 16] low aggression,[17] and balanced nutrition[18, 19] are health assets positively associated with academic achievement. Children who rarely to never experience bullying are more likely to be engaged at school and connected with their teachers.[20]

We hypothesize that good health assessed as absence of functional limitations, low levels of emotional and physical distress, high subjective well-being, and positive health behaviors interacts with normative developmental demands to affect children's school outcomes. Conventional school outcomes include attendance, grades, and standardized achievement test scores. However, schools also address children's need for mastery, competence, control, and belongingness, which contribute to academic engagement and learning motivation.[21] Engaged and motivated students are interested in learning and experience a sense of security and connectedness with teachers. They are more likely to exhibit achievement-oriented behaviors (i.e., effort, persistence, attention, participation) and less likely to behave in ways that compromise their school success (i.e., aggression, rule breaking).[22, 23]

Although prior research has examined the effects of specific health conditions or health assets on school outcomes, very little research has evaluated the simultaneous contribution of a comprehensive set of health factors on school outcomes over time. To address this knowledge gap, we developed Project Healthy Pathways with three school districts to examine how health conditions, functioning and symptoms, and well-being affect school outcomes—measured as attendance, connectedness with teachers, engagement in school, grades, and state standardized achievement test scores--among children transitioning from middle childhood to adolescence. This manuscript reports our assessment of the the associations between health and school outcomes among children aged 9–13 years and in 4th to 8th grade. This age range was chosen to examine the individual and combined effects of two normative stressors, transitioning from elementary to middle school and puberty.

Methods

Participant Recruitment

The study took place in two school districts located in the Eastern Shore of Maryland (Dorchester and Caroline Counties) and one in the southern portion of West Virginia (Wayne County). The three districts comprised 34 schools--10 middle schools, 23 elementary schools, and 1 K-8 school. The school districts and the Institutional Review Boards of Children's Hospital of Philadelphia, the Johns Hopkins Bloomberg School of Public Health, and Marshall University approved study procedures.

In the fall of 2005, consent forms were distributed to the parents of students in regular 4th, 5th, and 6th grade classrooms. Children in self-contained special education classrooms were excluded. However, those with an individualized education program in a regular classroom were included in the sample. Special education categories were unknown because in accordance with the Family Education Rights and Privacy Act, parental consent permitted access to students' cumulative files but not to separately maintained special education records.

Data Collection

Students completed survey data annually for three years during the spring in 2006–2008. At baseline, enrolled students were in 4th, 5th, and 6th grades, with the result that data are available on children from 4th through 8th grade. In 25 participating schools (two of the school districts) children took a web-based audio computer-assisted self-administered interview. In the remaining 9 schools, the school system's computer network security could not support the large web-based data collection, so children in 4th and 5th grade completed a paper-and-pencil questionnaire as a survey administrator read the questions aloud, while 6th-8th grade students completed a self-administered questionnaire. Psychometric evaluation of the health scales used in this study revealed no differential item functioning by administration modality.[24]

Students who completed the survey took home parent questionnaire packets containing a cover letter, signed by the school district superintendent and the principal investigator, the questionnaire, and a return envelope. Parents who did not return questionnaires were sent postcard reminders. After six weeks of non-response, local school staff contacted parents and sent duplicate questionnaires. When parent questionnaires were returned, a $10 gift card was mailed to the parent.

We abstracted school records to obtain grades, state achievement test scores, and attendance. In two of the three school districts, these data were extracted from electronic records; in the third, abstraction was done with paper files. There were no differences in achievement and attendance data completeness across the three school districts.

For inclusion in the final study sample, we required that a child complete all 3 waves of survey data, all 3 waves of school records were obtained, and at least 1 wave of parent data was included.

Variables and Measures

Table 1 shows study variables, their definitions, and data sources.

Pubertal Status—Acquisition of secondary sexual characteristics was measured with the Puberty Development Scale (PDS)[25]--5 items administered to boys and 6 items to girls--as modified by Carskadon and colleagues.[26] The PDS has strong agreement with physical exam assessments (r=0.86) and good reliability.[26] The PDS includes no pictures or drawings about pubertal development, which made it acceptable for school administration. It has been used with youth as young as 4th grade.[26] We dichotomized children based on PDS data into having completed pubertal development or not.

Children with Special Health Care Needs—Parents completed the Children with Special Health Care Needs Screener (CSHCN), a non-categorical measure (i.e., does not require identification of a specific diagnosis).[27, 28] The CSHCN screener includes five qualifying indicators: the child has a condition lasting 12 months or more and (1) needs or uses more medical, mental health, or educational services than is usual for children of the same age, (2) currently needs or uses medicine prescribed by a doctor, other than vitamins, (3) is limited or prevented in any way in his or her ability to do the things most children of the same age can do, (4) needs or gets special therapy such as physical, occupational, or speech therapy, or (5) has any kind of emotional, developmental, or behavioral problem for which he or she needs treatment or counseling. Using these qualifying indicators, we created four mutually exclusive profile-types of children with chronic conditions, those with: (1) functional limitations, alone or with any other qualifying indicator, (2) prescription medications only, (3) emotional, behavioral, or developmental problems, and, (4) other.[8] A fifth category includes children without a condition.

We collected information from parents on whether a physician or other health professional had diagnosed their child with three common chronic health conditions--attention deficit hyperactivity disorder, learning disability, or asthma--and, if so, whether the child had problems with that condition in the past 12 months. Using height and weight data obtained from parental report, we calculated the body mass index of each child and dichotomized children into obese (≥95th BMI percentile) and non-obese.

Self-Assessed Health—We measured children's health experiences using the Healthy Pathways Child-Report scales.[24] The conceptual basis and content of these measures were based on modifications and expansions of the Child Health and Illness Profiles. Children reported the frequency with which health experiences had occurred in the past month, using a 5-level rating from Never to Always. The Healthy Pathway measures are reliable, comprehensive, and efficient; they are free of gender, age, mode of administration, and geographic location bias. The scales effectively differentiate children by socio-demographics and presence of a long-term medical condition. The number of items per scale is shown in Table 1. Each scale is scored as the item-level mean and has a range from 1 (low health) to 5 (high health). Complete details of item content, scale scoring, and item and scale psychometrics have been published previously.[24]

To create a binary indicator of health assets, each health scale was dichotomized into ≤4 (presence of asset) and <4 (absence of asset). A score of 4 or above indicates the child

almost always to always feels or acts healthfully. For example, a score of 4 or above on the physical comfort scale means that the individual almost always feels physically comfortable.

School Outcomes—Details are shown in Table 1. The psychometric properties of the Healthy Pathways Child Report teacher connectedness and school engagement scales are described elsewhere.[24]

Data Analysis

A sample of 4,437 child observations was used (three waves of data per child) for bivariate and multivariate analyses. Beta coefficients and p-values were computed using linear mixed effects models with random intercepts for children nested within schools, and a first-order autoregressive correlation structure to account for possible additional association amongst the repeated measurements for each child. Robust variance estimates were used. We found no substantive differences between estimates and p-values obtained using the subject-specific model and marginal models that used the generalized estimating equation approach with robust variance estimation. All p-values from the linear model were compared against models that used a logit link function and found to be comparable. Models were fit using the statistical computing software R, version 2.13.[29]

We tested the associations of socio-demographics, the elementary to middle school transition, and puberty status with the school outcomes and the child-reported health assets.

Multivariate modeling was done to evaluate the associations of chronic health conditions, self-assessed health, grade, and pubertal status with the school outcomes, while controlling for socio-demographics. We found no significant wave or cohort effects in any of the models. Days absent had a log-normal distribution, so the multivariate modeling using this response variable was done using the log transformation. Covariates were added to the model stepwise with forward selection. Model fit was assessed using the Akaike Information Criterion (AIC). Predictors with beta estimates not significant at a critical value of 0.05 were pruned from final models.

Results

Of the 2,920 children eligible to participate, parents of 74% (n=2,160) provided consent (Dorchester County, 74%; Caroline County, 76%; Wayne County, 71%). Of the children whose parents consented, 97% (n=2,091) completed the student questionnaire at baseline. Of these, 1,749 (84%) participated in all three waves of the student survey, school records were abstracted for 1,956 (91%) for all three years of the study, and parents participated in at least one survey 1,692 (78%). There were 1,479 children (71% of the baseline sample) that met all three of these inclusion criteria; this group served as the study sample. Almost all the parents completed the survey during the baseline year (n=1,457, 99%). There were no significant differences between the study sample and the 681 children who did not meet study inclusion criteria in age, gender, grade level, or school outcomes.

Baseline characteristics of the study sample are shown in Table 2. The only characteristic that varied by grade was pubertal status with 8.0% of 4th grade, 14.8% of 5th grade, and 29.2% of 6th grade children having completed puberty. The sample overall was 20.8% non-white and 23.9% of mothers had completed college.

Students missed on average 10 days of each school year. Girls had significantly better school outcomes than boys, whereas middle school students had poorer school outcomes than children in elementary school (Table 3). Lower socio-economic status and completed puberty were associated with more days missed from school. Black children missed fewer

school days, had better student engagement but poorer academic achievement (grades and achievement test scores) than white counterparts.

On average, children had 7.7 health assets (range 0 to 14). The most common health assets were life satisfaction, low bullying, low bully victimization, whereas the least common were balanced nutrition, low stress reactions, and active coping (Table 4). Female gender, low family income, and having achieved puberty were associated with fewer health assets. Blacks had more discomfort, less physical activity, and more aggression but higher subjective well-being (life satisfaction and body image) than whites.

In multivariate regression analyses that controlled for socio-demographics, grade, chronic conditions, and puberty, each increase in one health asset was associated with an increase in teacher connectedness score of 0.11 ($p<0.001$), student engagement of 0.10 ($p<0.001$), GPA of 0.02 ($p<0.001$), and state achievement test scores of 0.27 ($p<0.001$).

Results from the multivariate analyses (Table 5) showed that school absence was positively associated with chronic conditions but negatively related to physical comfort. Children who qualified as having a special healthcare need because they were on prescription medications did not differ from children without a special healthcare need on any school outcome. School absences was the only outcome associated with asthma, and lower GPA the only significant association for obesity. Chronic conditions were not associated with either teacher connectedness or student engagement.

Regarding the child-reported health assets, physical comfort was associated with each school outcome and low negative stress reactions was associated with 4 of the 5 (Table 5). Health assets not related to any of the outcomes were physical activity and body image. Balanced nutrition was related to student engagement only, vitality to teacher connectedness only, and peer connectedness to teacher connectedness only.

The strongest predictors of teacher connectedness and student engagement were active coping, low aggression, and family connectedness.

Higher GPA was associated with fewer health conditions and more child-reported assets. Notable predictors were presence of a learning disability and the health assets of low aggression and positive life satisfaction. Similarly, state achievement test scores were negatively associated with psychological disorders (learning disability and attention deficit hyperactivity disorder) and positively with physical comfort, low stress reactions, and low bully victimization.

Final GPA and state achievement regression models were rerun with days absent entered as a covariate to determine whether absenteeism mediated the effects of health on school outcomes. For each day absent, GPA decreased by −0.02 ($p<0.001$) and state achievement test scores by −0.10 ($p=0.002$), while in both cases the effect of physical comfort was no longer significant.

Discussion

The transition into middle school and completing puberty were both independently associated with lower teacher connectedness, decreased school engagement, and lower grade point average. This study shows that health may have buffered these negative effects. Children in good health as measured across a range of health assets had better school outcomes. Child-reported feelings of comfort and vitality, connectedness to others, balanced nutrition, low exposure to bullying, high subjective well-being, lack of negative stress, and active coping had positive effects on school outcomes. Strengthening children’s health

during middle childhood may be a strategy for promoting young adolescents' engagement and success in school.

The mechanism by which physical comfort affects academic achievement appears to mediated by school absence—i.e., children with little physical distress attend school more and achieve at a higher level than counterparts. On the other hand, physical comfort has a direct effect throughout this age period on connectedness and engagement. School-based health centers may be particularly well positioned to help students reduce the level or impact of physical distress by treating symptoms in the school setting. In fact, adolescent users of school-based health centers have higher grade point averages than non-users.[30]

Students with low levels of negative stress experiences had better grades and higher state achievement test scores than counterparts with more stress. Others have shown that children who become academically disengaged during the transition into middle school experience more stress,[31] and intellectual performance is impaired by high levels of stress.[32] Although stressful events and circumstances are normative and perhaps desirable[32] experiences, this study suggests that high levels of stress-related symptoms are particularly problematic for learning.

Bullying has been associated with decrements in school performance, which appear to result from negative effects on cognition, attendance, and connectedness to school.[17] Our finding that 24% of children reported being bullied is comparable to other studies.[33] Lack of exposure to bullying was associated with greater academic achievement, consistent with other research,[20] as well as stronger engagement in school, and stronger ties with teachers. The pernicious effects of bullying on children's school experiences provide strong justification for the extensive attention that states and school districts are giving to reducing bullying using evidence-based programs.[34]

The chronic conditions we studied—asthma, obesity, learning disability, attention deficit hyperactivity disorder, and more generally having a special healthcare need--pose challenges to academic achievement, but they have a weak or nil association with how connected children feel to their teachers or how engaged they are in school. Our findings indicate that the effects of these conditions on academic achievement are partly mediated by attendance as well as a direct effect on achievement, but not on children's motivation to learn or their engagement in the learning process.

Children who felt close to their friends also felt close to their teachers. A study of college freshman that provided an intervention that increased students' sense of belonging and connection with others enhanced their academic achievement.[35] Creating school environments that promote children's sense of belonging and connections with teachers may be an effective strategy for improving children's school experience and promoting academic achievement.

Children in this study who had high life satisfaction achieved higher grades, were more engaged in school, and felt more connected with teachers than those who were less happy with their lives. There is a dynamic association between achieving in school and feeling satisfied and happy with life. On one hand, school success has a well-established influence on children's health experiences, including happiness. At the same time, our findings suggest that life satisfaction has a strong effect on school outcomes even when powerful factors such as socio-demographic and health-related variables are controlled for.

Higher quality nutrition has been shown to be associated with better school performance.[18] This study suggests that one mechanism for this association may be the impact of good nutrition on engagement. Balanced nutrition may positively influence students' desire to

learn, their affective response to schoolwork, and the consistency of their responses to others at school. This study did not find an association between physical activity and school outcomes, which is inconsistent with some, but not all previous studies. A potential explanation for this lack of an effect is that the benefits of exercise on learning may result from vigorous but not moderate intensity activity,[36] and our measure included both types of activities.

This study advances prior work by using comprehensive assessments of health and school outcomes, its prospective study design, and providing new information on the patterns of health most strongly related to specific school outcomes. The associations that we found did not disentangle the directionality of the causal pathway. Students who achieve in school settings may as a result experience better health. Longer longitudinal studies are needed to address this possibility. Another limitation of our study is reliance on children's and parent's reports of health, which is a complex concept that includes biological, functional, and experiential dimensions. Even with the large set of variables that we studied, some important health assets such as sleep were excluded.

It is most likely, however, that health and education are dynamically interrelated throughout childhood and into adulthood. Our study suggests that child health is positively related to student's experiences in school and their achievement. Children's school success leads to higher educational attainment. Adult health and lifetime productivity are both influenced by educational attainment.[37, 38] This child health-educational attainment-adult health[39] connection may partly explain the lifespan association between child health and adult well being.[40] Understanding how children's health affects their school outcomes is therefore a necessary first-step toward leveraging this life course relationship for the benefit of the nation's health. Furthermore, eliminating the achievement gap will almost certainly require that children attend school healthy and prepared to learn.[1]

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Implications and Contribution

Health comprises a set of assets that enable children to adapt to and overcome life's challenges. This study shows that good health enhances children's school outcomes during the critical and stressful transition into adolescence. Strengthening children's health during middle childhood may be a strategy for promoting young adolescents' engagement and success in school.

Table 1

Variable Definitions and Their Data Sources.

Variables		Data Source		
Name	**Categories / Definition**	**Student Survey**	**Parent Survey***	**School Record Review**
Socio-demographics and Pubertal Status				
School district	Caroline County, MD; Dorchester County, MD; Wayne County, WV	X	X	X
Grade	4^{th}-5^{th} (elementary school; 6^{th}-8^{th} (middle school)	X	X	X
Gender	Male; female	X	X	X
Race	White; non-white		X	
Maternal education	Less than college; college or greater		X	
Family income	<$40,000; $40,000+		X	
Pubertal status complete		X		
Chronic health conditions				
Children with special healthcare needs profile-type	None; functional limitation only; medication only; emotional or behavioral problem; other		X	
Asthma	Doctor diagnosed asthma and child had problems with it during past 12 months: Yes; No		X	
Attention deficit hyperactivity disorder	Doctor diagnosed attention deficit hyperactivity disorder and child had problems with it during past 12 months: Yes; No		X	
Learning disability	Doctor diagnosed learning disability and child had problems with it during past 12 months: Yes; No		X	
Height and weight	Height in feet and inches; Weight in pounds; both used to calculate BMI		X	
Health assets [1]				
Physical comfort	Low physical distress such as pain, fatigue, and somatic complaints (8 item scale)	X		
Emotional comfort	Low anxiety, anger, and depression (7 item scale)	X		
Low stress reactions	Infrequent involuntary reactions to imagined social stressor (intrusive thoughts, mind goes blank, sleep disruption) (5 item scale)	X		
Physical activity	Involvement in activities that promote physical fitness (4 item scale)	X		
Balanced nutrition	Foods typically eaten in past month promote health and foods that threaten health rarely eaten (5 item index)	X		
Active coping	Typical problem-solving actions taken in responses to social stressor such as conflict with friend or getting a bad grade (7 item scale)	X		
Vitality	Feelings of energy, vim, vigor, pep, and healthfulness (5 item scale)	X		
Low bullying	Avoidance of inflicting verbal or physical harm on peers (4 item scale)	X		
Low bully victimization	Avoidance of being bullied by peers (3 item scale)	X		
Peer connectedness	A feeling of belonging with friends (8 item scale)	X		
Family connectedness	A feeling of belonging in one's family (8 item scale)	X		
Self worth	Satisfaction with one's self (3 item scale)	X		

Variables		Data Source		
Name	**Categories / Definition**	**Student Survey**	**Parent Survey***	**School Record Review**
Body image	Satisfaction with one's body (5 item scale)	X		
Life satisfaction	Evaluation of one's life as happy (5 item scale)	X		
School Outcomes				
Attendance	Total number of days absent during school year (excused and unexcused)			X
Teacher connectedness	Feeling that teachers care about you as a person and are invested in your learning (6 item scale)	X		
Student engagement	Feeling invested and interested in learning (4 item scale)	X		
Grade Point Average	Average of reading and math quarterly grades coded on a 4 – point scale (4=A, 3=B, 2=C, 1=D, 0=F).			X
State achievement test score	Average of the language arts and math test scores, which is standardized to a county-grade specific mean of 100 and standard deviation of 20.			X

[1]The development, reliability, validity, content, and scoring of the health asset, teacher connectedness, and student engagement scales have been described previously— see http://www.springerlink.com/content/522t24105l715012/.

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Table 2

Children's baseline characteristics by grade and school district.

	Grade				School District			
	4th	**5th**	**6th**	**Total**	**Caroline, MD**	**Dorchester, MD**	**Wayne, WV**	**Total**
Characteristic	**n (%)**				**n (%)**			
Overall (%)	505 (34.1)	491 (33.2)	483 (32.7)	1479 (100)	520 (35.2)	431 (29.1)	528 (35.7)	1479 (100)
Socio-Demographics and Pubertal Status								
Grade								
4th	n/a	n/a	n/a	n/a	154 (29.6)	150 (34.8)	201 (38.1)	505 (34.1)
5th	n/a	n/a	n/a	n/a	176 (33.8)	135 (31.3)	180 (34.1)	491 (33.2)
6th	n/a	n/a	n/a	n/a	190 (36.6)	146 (33.9)	147 (27.8)	483 (32.7)
					p=0.014			
Gender								
Female	252 (49.9)	264 (53.8)	247 (51.1)	763 (51.6)	263 (50.6)	228 (52.9)	272 (51.5)	763 (51.6)
Male	253 (50.1)	227 (46.2)	236 (48.9)	716 (48.4)	257 (49.4)	203 (47.1)	256 (48.5)	716 (48.4)
	p=0.461				p=0.775			
Race								
White	408 (81.1)	393 (80.5)	365 (75.7)	1166 (79.2)	410 (79.3)	238 (55.5)	518 (98.3)	1166 (79.2)
Non-White	95 (18.9)	95 (19.5)	117 (24.3)	307 (20.8)	107 (20.7)	191 (44.5)	9 (1.7)	307 (20.8)
	p=0.076				**p<0.001**			
Maternal Education								
Less than college	368 (73.6)	373 (76.9)	371 (77.9)	1112 (76.1)	412 (80.2)	344 (81.1)	356 (68.1)	1112 (76.1)
At least a college degree	132 (26.4)	112 (23.1)	105 (22.1)	349 23.9)	102 (19.8)	80 (18.9)	167 (31.9)	349 (23.9)
	p=0.249				**p<0.001**			

Characteristic	Grade				School District			
	4th	5th	6th	Total	Caroline, MD	Dorchester, MD	Wayne, WV	Total
	n (%)				n (%)			
Annual Family Income								
<$20,000–$39,999	213 (42.2)	227 (46.2)	206 (42.7)	646 (43.7)	191 (12.5)	212 (20.6)	243 (23.3)	646 (43.7)
$40,000 +	292 (57.8)	264 (53.8)	277 (57.3)	833 (56.3)	329 (24.2)	219 (28.6)	285 (22.7)	833 (56.3)
	p=0.373				**p<0.001**			
Pubertal Status								
Puberty Complete								
Yes	40 (8.0)	72 (14.8)	140 (29.2)	252 (17.2)	80 (15.5)	87 (20.3)	85 (16.2)	252 (17.2)
No	463 (92.0)	415 (85.2)	339 (70.8)	1217 (82.8)	436 (84.5)	341 (79.7)	440 (83.8)	1217 (82.8)
	p=<0.001				**p=0.113**			
Chronic Health Conditions								
Asthma								
Yes	47 (10.5)	56 (13.3)	47 (11.5)	150 (11.8)	51 (11.0)	31 (8.7)	68 (15.0)	150 (11.8)
No	399 (89.5)	364 (86.7)	362 (88.5)	1125 (88.2)	414 (89.0)	327 (91.3)	384 (85.0)	1125 (88.2)
	p=0.434				**p=0.016**			
Learning Disability								
Yes	22 (4.9)	28 (6.8)	22 (5.4)	72 (5.7)	31 (6.7)	19 (5.3)	22 (4.9)	72 (5.7)
No	423 (95.1)	387 (93.2)	383 (94.6)	1193 (94.3)	429 (93.3)	338 (94.7)	426 (95.1)	1193 (94.3)
	p=0.503				p=0.463			
Attention deficit disorder								
Yes	56 (12.6)	46 (11.0)	40 (9.8)	142 (11.1)	49 (10.5)	40 (11.2)	53 (11.7)	142 (11.1)
No	390 (87.4)	373 (89.0)	370 (90.2)	1133 (88.9)	416 (89.5)	318 (88.8)	399 (88.3)	1133 (88.90)

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Characteristic	Grade				School District			
	4th	5th	6th	Total	Caroline, MD	Dorchester, MD	Wayne, WV	Total
	n (%)				n (%)			
	p=0.426				p=0.849			
Obesity								
Yes	102 (24.4)	100 (25.4)	94 (24.2)	296 (24.7)	92 (22.0)	82 (24.0)	122 (27.7)	296 (24.7)
No	316 (75.6)	293 (74.6)	295 (75.8)	904 (75.3)	327 (78.0)	259 (76.0)	318 (72.3)	904 (75.3)
	p=0.906				p=0.139			
Special Healthcare Need Profile-Types								
None	291 (67.4)	275 (67.6)	274 (68.5)	840 (67.8)	307 (67.8)	239 (69.2)	294 (66.8)	840 (67.8)
Functional Limitation Only	31 (7.2)	25 (6.1)	30 (7.5)	86 (6.9)	29 (6.4)	23 (6.7)	34 (7.7)	86 (6.9)
Medication Only	57 (13.2)	51 (12.5)	53 (13.2)	161 (13.0)	56 (12.3)	44 (12.8)	61 (13.8)	161 (13.0)
Emotional/ Behavioral Problem	36 (8.3)	45 (11.1)	31 (7.8)	112 (9.0)	42 (9.3)	31 (9.0)	39 (8.8)	112 (9.0)
Other	17 (3.9)	11 (2.7)	12 (3.0)	40 (3.3)	19 (4.2)	8 (2.3)	13 (2.9)	40 (3.3)
	p=0.797				p=0.896			

(1) p-values were computed using the chi-squared statistic.

Table 3

School outcomes by socio-demographics and pubertal status.

School Outcome	Overall	Female vs. Male	6th–8th vs. 4th–5th grade	Lower Income (<$40,000) vs Higher Income ($40,000+)	Black vs. White	Low Maternal Education vs College Degree or Higher	Puberty Complete vs. Not Complete
	Mean (range)	Difference in means, (p-value)					
Days absent during school year	9.7 (0–73)			2.7 (<0.001)	−1.4 (0.002)	2.5 (<0.001)	1.4 (<0.001)
Teacher Connectedness	4.02 (1–5)	0.07 (0.012)	−0.12 (0.008)		−0.08 (0.031)		−0.09 (<0.001)
Student Engagement	2.84 (1–5)	0.31 (<0.001)	−0.27 (<0.001)		0.14 (0.003)		−0.13 (<0.001)
Grade Point Average	2.91 (0–4)	0.31 (<0.001)	−0.22 (0.005)	−0.44 (<0.001)	−0.41 (<0.001)	−0.40 (<0.001)	−0.12 (<0.001)
State Standardized Achievement Test	101.6 (5.6–178.1)	2.7 (<0.001)	Not applicable	−9.8 (<0.001)	−11.7 (<0.001)	−8.6 (<0.001)	

(1) Linear mixed effects models with random intercepts for children nested within schools and an AR(1) correlation structure were used to estimate differences in means and associated p-values. The p-value estimates were comparable between mixed effects and marginal models.

(2) Positive values indicate that the first group had a higher level of the learning asset or academic achievement outcome, and vice versa.

Table 4

Child-reported health assets by socio-demographics and pubertal status.

Child-Reported Health Asset	Overall	Female vs. Male	6th–8th vs. 4th–5thgrade	Lower Income (<$40,000) vs Higher Income ($40,000+)	Low Maternal Education vs. College Degree	Black vs. White	Puberty Complete vs. Not Complete
	%	Difference, % (p-value)					
Physical comfort	40.6	−9.5 (<0.001)		−4.9 (0.005)		−10.8 (<0.001)	−6.4 (<0.001)
Emotional comfort	58.7	−15.3 (<0.001)		−7.0 (<0.001)		−6.4 (0.007)	−5.8 (<0.001)
Low stress reactions	36.0	−4.0 (0.013)		−7.6 (<0.001)	−6.2 (0.001)		−6.7 (<0.001)
Physical activity	55.1	−19.8 (<0.001)		−4.8 (0.007)		−5.9 (0.009)	
Balanced nutrition	12.1	2.2 (0.046)			−4.9 (<0.001)		2.1 (0.047)
Vitality	58.4	−11.1 (<0.001)	−6.2 (0.010)	−4.9 (0.006)			
Active coping	39.0	10.2 (<0.001)	−4.6 (0.034)			−6.0 (0.006)	−3.8 (0.017)
Low aggression	78.9	11.4 (<0.001)	−5.9 (0.018)	−5.7 (<0.001)	−6.7 (<0.001)	−16.0 (<0.001)	−6.9 (<0.001)
Low Bully victim	75.9	−4.7 (0.002)		−6.9 (<0.001)	−4.4 (0.012)		
Peer connectedness	67.1	7.4 (<0.001)		−5.8 (<0.001)			6.1 (<0.001)
Family connectedness	47.8			−5.4 (0.003)			−5.4 (<0.001)
Life satisfaction	75.6			−7.3 (<0.001)			−2.8 (0.043)
Self worth	65.9	−5.6 (<0.001)		−3.8 (0.025)		8.0 (<0.001)	−4.5 (0.003)
Body image	57.5	−14.5 (<0.001)		−5.4 (<0.001)		4.3 (0.048)	−5.4 (<0.001)
	Mean (p-value)						
Total nos. health assets (range 0−14)	7.7	−0.5 (<0.001)		−0.8 (<0.001)	−0.5 (0.001)	−0.4 (0.007)	−0.3 (0.001)

(1) Child-reported health assets were scored in the direction of good health. They were dichotomized at 4 and above to indicate presence of the asset.

(2) Linear mixed effects models with random intercepts for children nested within schools and an AR(1) correlation structure were used to estimate beta coefficients and p-values. The p-value estimates were comparable between mixed effects that used Gaussian and binomial link functions. The linear model is presented to provide estimates of percentage change.

(3) Positive values indicate that the first group had a higher level of the health asset and vice versa.

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Table 5

Correlates of school outcomes among children in 4th to 8th grade.

	School Outcomes				
	Log-Days Absent	**Teacher Connectedness**	**Student Engagement**	**Grade Point Average**	**State Achievement Test**
Predictor	**Beta (p-value)** [1]				
Intercept	1.49 (<0.001)	3.20 (<0.001)	2.08 (<0.001)	3.29 (<0.001)	111.6 (<0.001)
	Socio-Demographics				
6th–8th Grade		−0.08 (0.030)	−0.22 (<0.001)	−0.23 (<0.001)	*Not Applicable*
Female		0.05 (0.045)	0.28 (<0.001)	0.28 (<0.001)	2.5 (<0.001)
School District Caroline, MD Dorchester, MD Wayne, WV	Referent 0.27 (0.001) 0.32 (<0.001)				Referent −3.6 (0.016) −4.9 (<0.001)
Maternal education < college degree	0.19 (<0.001)			−0.24 (<0.001)	−5.5 (<0.001)
Family income per year < $40,000	0.23 (<0.001)			−0.33 (<0.001)	−6.4 (<0.001)
Non-white	−0.39 (<0.001)		0.18 (<0.001)	−0.29 (<0.001)	−10.0 (<0.001)
Puberty complete	0.15 (<0.001)	−0.04 (0.050)	−0.10 (<0.001)	−0.16 (<0.001)	
Chronic Health Conditions					
Special health care need profile-type None Medication only Functional limitation Emotional/behavioral Other	Referent 0.16 (0.035) 0.18 (0.004)			Referent −0.25 (<0.001) −0.15 (0.027)	
Physician-diagnosed chronic conditions Asthma Learning disability Attention deficit disorder Obesity	0.24 (<0.001) 0.22 (0.012)			−0.19 (0.003) −0.33 (<0.001) −0.11 (<0.001)	−10.8 (<0.001) −4.3 (<0.001)
	Health Assets				
Physical comfort	−0.07 (<0.001)	0.10 (<0.001)	0.10 (<0.001)	0.06 (0.016)	0.8 (0.050)
Emotional comfort					
Low stress reactions		0.06 (<0.001)	0.07 (0.010)	0.06 (0.022)	1.2 (0.006)

Predictor	School Outcomes				
	Log-Days Absent	Teacher Connectedness	Student Engagement	Grade Point Average	State Achievement Test
	Beta (p-value) [1]				
Physical activity					
Balanced nutrition			0.14 (<0.001)		
Vitality		0.06 (0.017)			
Active coping		0.26 (<0.001)	0.30 (<0.001)		
Low aggression		0.23 (<0.001)	0.24 (<0.001)	0.08 (0.019)	
Low bully victim		0.06 (0.027)			1.7 (<0.001)
Peer connectedness		0.15 (<0.001)			
Family connectedness		0.26 (<0.001)	0.31 (<0.001)		
Life satisfaction		0.20 (<0.001)	0.12 (<0.001)	0.08 (0.006)	
Self worth		0.08 (0.004)	0.17 (<0.001)		
Body image					

[1] Linear mixed effects models with random intercepts for children nested within schools and an AR(1) correlation structure were used to estimate beta coefficients and p-values. The lme procedure from R version 2.13 was used for all analyses. Empty cells indicate that the covariate was not significantly associated with the outcome at a critical value of 0.05.