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School environments and obesity: The mediating role of personal stress

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Abstract

Background—Youth spend a large amount of time in the school environment. Given the multiple influences of teachers, peers, and food and physical activity options, youth are likely to experience stressors that can influence their weight. This study examines the association between school climate and weight status.

Method—Students (n = 28,582; 58 schools) completed an online, anonymous school climate survey as part of the Maryland Safe and Supportive Schools Project. Multilevel structural equation modeling was used to explore the association between school climate, personal stress, and obesity. Analyses were stratified by gender.

Results—At the individual level, poor school climate (bullying, physical safety, and lack of whole-school connectedness) was associated with an increased likelihood of being overweight among females (β =.115, p = .019) but not males (β = .138; p =.244), after controlling for age, race, and physical activity. There was no association between school climate at the school level and being overweight among males or females. A second model included stress as a potential mediator; stress attenuated the relationship between poor school-related climate and being overweight (β = .039; p = .048) among females.

Conclusion—Findings suggest that stress related to school climate can play a role in the health and weight status of youth.

1 | INTRODUCTION

Obesity in youth is a significant public health problem, not only because of the great number of youth affected, but also because of the long-term consequences associated with developing debilitating and costly chronic diseases (Institute of Medicine, 2012). Research has shown that youth who are overweight or obese are likely to carry their weight gain into adulthood, which places them at increased risk of heart disease, stroke, and cancer (Field, Cook, & Gillman, 2005). With nearly one in five adolescents aged 12 to 19 years categorized as obese, understanding the bioecological factors that influence weight status at an early age has long-term public health implications (Ogden, Carroll, Kit, & Flegal, 2014).

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Research interest in the role of stress as it relates to obesity in youth is growing. Between the ages of 11 to 17, youth experience biological, psychological, and social changes that make late childhood and adolescence particularly vulnerable periods for fluctuations in weight status (Adair, 2008; Christie & Viner, 2005; Hutchinson, 2012). Environmental or psychological events (i.e., stressors) that threaten the perceived safety or well-being of youth can be translated into physiological, psychological, and/or behavioral factors that place youth at risk for obesity (Cohen, Janicki-Deverts, & Miller, 2007). Internal physical changes can interact with psychological and social changes to place youth at risk for behaviors that increase weight gain, promote sedentary activity, or lead to poor food choices, all of which increase the likelihood of becoming overweight or obese (Adair, 2008; Christie & Viner, 2005; Daniels, 2009).

Youth experience numerous types of personal stressors related to family, friends, and school. Stress results when environmental demands exceed the perceived ability to cope. Physiological responses to stress can result in hormonal responses that activate neuroendocrine and inflammatory pathways that increase fat accumulation and promote visceral adiposity (Adam & Epel, 2007). Additionally, constant exposure to chronically elevated levels of perceived personal stress can place youth at risk for higher rates of obesity because of high cortisol levels, which have been associated with increased risk for central obesity (Adam & Epel, 2007). Beyond the physiological response to stress, adolescents may experience disturbances in sleep patterns and difficulties with daily activities, which may put them at increased risk for weight gain, sedentary activity, and poor food choices (Jarrin, McGrath, & Drake, 2013). This can result in high rates of diabetes and hypertension in youth who are overweight or obese as well as mental health conditions such as depression and anxiety.

Youth and adolescents spend a large portion of the day in the school environment, which may contribute to increased exposure to stressors and obesity-related factors. In this environment, they make social connections, learn behaviors, and practice decision making that can influence their weight both positively and negatively. Research has shown that the schools with fewer health resources, more violence, and a distressed school climate are more likely to result in poor physical and mental health, behavioral problems, and association with deviant peers (Flores & Tomany-Korman, 2008; Hatzenbuehler, Birkett, Van Wagenen, & Meyer, 2014; Huang, Calzada, Cheng, & Brotman, 2012; Huang, Cheng, & Theise, 2013; Kidger, Araya, Donovan, & Gunnell, 2012; Wang & Dishion, 2012). Without proper support, the school environment can be stress inducing. Several theories have been used to explain the association between school climate and student outcomes including the bioecological theory. The bioecological theory suggests a bidirectional relationship between individuals and their environment (Bronfenbrenner, 1979) and recognizes not only interpersonal relationships but also the relationship between an individual and larger ecological systems (e.g., schools).

The purpose of this study was to examine the association of school climate (e.g., school connectedness, bullying, school supports, and physical safety) and weight status among high school students; specifically, we aimed to test the hypothesis that students with poorer

school climate would have higher body mass indices (BMI) and that this relationship would be mediated by personal stress.

2 | METHOD

2.1 | Overview

Data for this study came from the Maryland Safe and Supportive Schools (MDS3) Project, a joint initiative between the Maryland State Department of Education (MSDE), Johns Hopkins University, and Sheppard Pratt Health System. The MDS3 Project is a statewide project focused on measuring and improving school climate (i.e., safety, engagement, and environment); it includes 58 high schools (9^{th}–12^{th} grades) in 12 school districts across the state. Nonidentifiable data from the MDS3 School Climate Survey were collected via an online self-report survey completed anonymously by high school students. The nonidentifiable data analysis was approved by the Institutional Review Board at Johns Hopkins Bloomberg School of Public Health.

2.2 | Procedures

The MSDE approached local school districts for participation in the initiative. Upon expressing interest in MDS3, meetings were conducted to obtain school level and principal commitment to the project. Schools' participation in the MDS3 Project was voluntary. Once schools agreed to participate, letters were sent home to parents providing information about the survey and the larger initiative.

2.2.1 | Survey—An anonymous MDS3 School Climate Survey was administered using a passive parental consent process and youth assent process; all participation was voluntary. The survey was administered online in language arts classrooms to approximately seven ninth-grade classrooms and six 10th-, 11th-, and 12th-grade classrooms. School staff administered the survey following a written protocol developed by the university-based research team. The survey measured three domains of school climate (i.e., safety, engagement, and environment; for additional information about the creation and validation of the survey, see Bradshaw, Waasdorp, Debnam, & Lindstrom Johnson, 2014).

2.2.2 | Observations—In addition to the school survey, observational measures of the school environment were assessed using the School Assessment for Environmental Typology (SAfETy; Bradshaw, Milam, Furr-Holden, & Lindstrom Johnson, 2015). The SAfETy draws on several validated measures including the NIfETy Instrument (Furr-Holden et al., 2010) and the CPTED School Security Assessment (Wilcox, Augustine, & Clayton, 2006). Observations of the physical and social environment were collected from the school interior and exterior by data collectors in nine different locations. Data were collected over 3 days and at different times of the school day to ensure multiple observations for each item and location. All data were entered in real-time on a Samsung handheld tablet using the Pendragon mobile data collection software. Observers were trained and reliability and recalibration procedures were conducted to ensure consistency of collection. Average percent agreement for both reliability and recalibration assessments was 87% (for more

information about the training of raters and data collection procedures, see Bradshaw et al., 2015).

2.3 | Sample

Data on the MDS3 School Climate Survey (Bradshaw et al., 2014) were collected from 27,697 students in each of the 58 high schools participating in the MDS3 Project (see Table 1 for student and school demographics). An average of 24 classrooms per school was sampled (some schools did not have 25 classrooms to sample). Participating schools included a diverse population with a minority rate of 45.2% (standard deviation [*SD*] = 25.3%), with a mean student enrollment of 1,282 (*SD* = 467.9).

2.4 | Measures

The current paper focuses on the following core data elements captured via the MDS3 School Climate Survey and the SAfETy instrument.

2.4.1 | Weight status—Adolescents reported their weight in pounds and height in inches on the School Climate Survey. Participants' self-reported weight and height were used to calculate BMI. The Centers for Disease Control and Prevention (CDC) developed a programin SAS to calculate percentiles and z-scores for BMI based on gender and age using the 2000CDC growth charts (Centers for Disease Control and Prevention, 2016); this program was used to calculate percentiles and z-scores in the current investigation. The CDC program flags biologically implausible values (extremes of height and weight); there were 1,661 participants with biologically implausible values for BMI that were excluded. BMI percentiles were dichotomized into overweight/obese (> 85th percentile) versus all others (≤ 85th percentile).

2.4.2 | Exercise—The MDS3 School Climate Survey assessed participants' physical activity over the past week. The exercise question asked, "On how many of the past seven days did you exercise or do a physical activity for at least 20 minutes that made you sweat or breathe hard? (For example, basketball, soccer, running, swimming laps, fast bicycling, fast dancing or similar aerobics)." Reponse options ranged from 0 to 7 days.

2.4.3 | Stress—Four items on the MDS3 School Climate Survey focused on personal stress (Brown, Nobling, Teufel, & Birch, 2011). The items included "having trouble falling asleep, feeling stressed, feeling like difficulties were piling so high you could not overcome them, and feeling like you do not get enough sleep or rest" (α = .79). Responses were rated on a 4-point scale ranging from1 (*almost never*) to 4 (*always*).

2.4.4 | School climate

School connectedness: Four items on the School Climate Survey focused on general feeling about school including "I like coming to school, I like learning at the school, and I take pride in the school" (α = .83; Bradshaw et al., 2014). Responses were rated on a 4-point scale ranging from 1 *(strongly disagree)* to 4 *(strongly agree)*. These items were all reverse coded (e.g., students do not like coming to school).

Bullying: Four questions on the School Climate Survey captured the amount of bullying and harassment of students at the school (α = .64; Bradshaw, Sawyer, & O'Brennan, 2007). Specifically, two questions asked whether physical fighting between students and harassment/bullying of students was a problem at the school. Responses were rated on a 4-point scale ranging from 1 (*not a problem*) to 4 (*a large problem*). The other questions asked whether students at the school try to stop bullying, rated on a 4-point scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*), and if the student had seen someone being bullied in the past month (no or yes).

Physical safety: Four items on the School Climate Survey assessed students' perceptions of safety at the school (e.g., I feel safe at this school, students carry guns and knives; α =.65; Bradshawet al., 2014). Responses were rated on a 4-point scale ranging from 1 *(strongly disagree)* to 4 *(strongly agree)*. Similar to the items for school connectedness, these items were all reverse coded (e.g. students do not feel safe at this school).

Food environment, wellness, and school support: The SAfETy instrument was used to assess the presence of healthy food in the cafeteria. The School Climate Survey assessed students' ability to participate in sports, clubs, and other activities. Responses were rated on a 4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). This item was aggregated to the school level.

2.5 | Statistical analyses

The nested study design (i.e., students clustered within schools) was addressed through the use of multilevel structural equation modeling (SEM) in Mplus (Muthén & Muthén, 2012); this allowed us to assess the association between school climate and weight status. The two-level SEM was clustered at the school level (N = 58 schools/clusters). Given the use of categorical variables we used mean-and-variance corrected weight least squares estimator, which provides robust standard errors for data that is not normally distributed. We examined the following model fit indices including the root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI), such that RMSEA values ≤ .05, CFI values ≥ .95, and TLI values ≥ .90 generally represented good fit to the observed data.

Model 1 assessed the relationship between school climate (modeled as a latent variable at both the individual level and the school level; Cronbach's alpha 0.71) and being overweight. Model 2 added personal stress, also a latent variable (Cronbach's alpha 0.79), as a "mediator" between school climate and being overweight. The analyses were stratified by gender and controlled for age and race/ethnicity at the individual level. At the school level, we adjusted for the percentage of minority students, the percentage of students receiving free and reduced priced meals (FARMs; a proxy for socioeconomic status), and geographic setting (urban/urban fringe vs. suburban/rural). The geographic setting was obtained from the SAfETy. Unstandardized probit regression coefficients (B) are reported for each effect (i.e., change in the z-score/probit index for each unit change in the predictor/covariate). Significant findings were reported for alpha levels below .05.

2.5.1 | Missing data—Mplus uses full information maximum likelihood (FIML) to include all observed data unless the participant is missing on a predictor to build parameter estimates and standard errors. FIML assumes that the data are missing completely at random or missing at random. Data were more likely to be missing among males, African Americans, and those in higher grade levels; these variables were included in the analyses. The analytic sample included 22,109 participants; the 1,661 participants with extreme values for BMI were excluded, as were the 3,927 participants missing data on covariates. To rule out potential biases, we examined whether participants with missing data (while stratifying by gender) were more likely to be from schools with lower school climate. Missing data on covariates (i.e., not included in the analyses) was not associated to differences on the safety or bullying climate at the school level. Males not included in the analytical sample were at schools with slightly lower school connectedness (p = 0.019, mean [*M*] = 2.49 vs. *M* = 2.52).

3 | RESULTS

3.1 | Descriptive statistics

Table 1 includes the descriptive statistics for the sample stratified by gender. The sample was 51.3% female (n = 11,351), 54% of the students were Caucasian, and the mean age was 16.1 years (SD = 1.2). There were differences in self-reported health and physical fitness by gender. Males were also more likely to exercise ($p < .001$) and describe themselves as physically fit ($p < .001$). Approximately 31% of the sample was overweight or obese (BMI > 85th percentile); 34.0% of males were overweight compared to 28.7% of females ($p < .001$). The schools were on average 46.8% minority (SD = 25.1), 37.5% of the students received free and reduced priced meals, and healthy food was available in 87.9% of the schools. Additional descriptive statistics are included in Table 1.

3.2 | SEM

3.2.1 | Males—The results of the multilevel SEM for males are reported in Table 2. Model 1 assessed the relationship between school climate and being overweight. The fit indices for the model were acceptable (CFI = .98, TFI = .95, RMSEA = .035). Older males (B = −.033, p = .001) and those reporting exercising more than 4 days a week were less likely to be overweight (B = −.158, $p < .001$). The school climate latent variable (e.g., lack of school connectedness, bullying, physical safety) was not associated with being overweight (B = .138, p = .244). At the school level, there was a positive but nonsignificant relationship between school climate and being overweight (B = .089, p = .758). There was also a positive relationship between the percentage of students receiving FARMs and being overweight (B = .005, p = .010). There was an inverse relationship between the school-level percentage African American students and being overweight (B = −.002, p = .026). Neither the school-level availability of soda and healthy snacks nor students' opportunity to participate in sports or geographic setting of the school were associated with being overweight.

Model 2 treated personal stress as a potential mediator (cross-sectional) of the relationship between school climate and being overweight. The fit indices for the model were also acceptable (CFI = .98, TFI = .98, RMSEA = .028). Personal stress was regressed on the

school climate latent variable; a poorer school climate was associated with a higher probability of personal stress ($B = 1.349$, $p < .001$). The direct effect of personal stress on being overweight was positive and significant ($B = .020$, $p < .001$), such that higher personal stress was associated with a higher probability of being overweight. The direct effect of school climate on being overweight was not significant ($B = .108$, $p = .399$) as well as the indirect effect of school climate on being overweight via personal stress was significant ($B = .027$, $p = .108$).

3.2.2 | Females—The fit indices for the model were acceptable (CFI = .98, TFI = .97, RMSEA = .015). As reported in Table 3., similar to males, older age was associated with a lower probability of being overweight ($B = -.045$ $p < .001$). Exercising more than 4 days a week was also associated with a lower probability of being overweight ($B = -.238$, $p < .001$). There was a positive and signficiant relationship between school climate and being overweight ($B = .115$, $p = .019$). At the school level, a higher percentage of African American students ($B = .002$, $p = .026$) and students receiving FARMS ($B = .008$, $p < .001$) were associated with a higher odds of being overweight. School climate and geographic setting were not associated with being overweight at the school level.

The fit indices for Model 2 were acceptable (CFI = .99, TFI = .99, RMSEA = .028). Personal stress fully attenuated the relationship between school climate and being overweight ($B = .068$, $p = .230$). Personal stress was associated with a higher probability of being overweight ($B = .017$, $p = .045$). There was a positive association between school climate and personal stress ($B = 2.149$, $p < .001$). The indirect effect of school climate on being overweight was significant $B = .039$, $p = .0048$); however, the direct effect was not. This suggests the effect is largely mediated through personal stress.

4 | DISCUSSION

This study sought to better understand the relationship between school climate, personal stress, and weight status among a large statewide sample of high school students. The prevalence of being overweight or obese in this current investigation (28.7% among females and 33.9% among males) was consistent with estimates from the 2013 Youth Risk Behavior Surveillance System (27.5% among females, 33.1% among males). We hypothesized that students with poorer school climate would have a higher probability of being overweight and that this relationship would be mediated by personal stress. Our hypothesis was partially supported.

Specifically, we found that among females, there was a positive association between school climate and being overweight such that poorer school climate was associated with higher odds of being overweight. There was also a positive association between stress and being overweight. The association between school climate and being overweight was attenuated by stress, which provides evidence that stress is a mediator between school climate and being overweight. School climate was not associated with being overweight among males, but there was a positive relationship between personal stress and being overweight. We did not find an association between school climate at the school level and being overweight among males or females.

Our findings among females are consistent with findings from Gilstad-Hayden et al. (1999), who found a positive relationship between school climate (e.g., My school offers a wide variety of activities to keep students at my school engaged; I feel welcome at my school) and BMI percentile among K–8 students in an urban school district. Our study builds on the study by Gilstad-Hayden and colleagues by exploring personal stress as a mechanism by which school climate is related to weight status. Prior research has established a strong relationship between peronal stress and weight status, both directly and indirectly (Jaarsveld, Fidler, Steptoe, Boniface, & Wardle, 2009; Nguyen-Rodriguez, Chou, Unger, & Spruijt-Metz, 2008). Personal stress is associated with inflammatory pathways (Torres & Nowson, 2007), emotional eating (Nyguen-Rodriguez et al., 2008), and cortisol reactivity (Björntorp, 2001). Difference in coping styles between adolescent males and females may account for the variable findings associated with stress and obesity in females, with females often resorting to disordered eating to cope with stressful events (Hepworth, 2004; Mikolajczyk, Ansari, & Maxwell, 2009).

This current investigation also found that older age and increased physical activity were associated with lower odds of being overweight among males and females. Because older youth are more likely to consider and understand the consequences of poor food choices and sedentary activity, they may be more likely to engage in positive eating behaviors. Additionally, this maturity in cognition may also be associated with an increased ability to process the short-term and long-term consequences of their actions (Lohman, Stewart, Gundersen, Garasky, & Eisenmann, 2009). Moreover, numerous studies have demonstrated a clear association between increased physical activity and decreased weight in adolescents (Affenito, Franko, Striegel-Moore, & Thompson, 2012; Prentice-Dunn & Prentice-Dunn, 2012). When combined with stress, the relationship between physical activity and weight becomes complex. Research has shown a negative association between perceived stress and physical activity (Norris, Carroll, & Cochrane, 1992). However, physical activity is considered a protective factor against stress and the subsequent development of obesity (De Vriendt, Moreno, & De Henauw, 2009; Yin, Davis, Moore, & Treiber, 2005).

The results also showed that the percentage of students receiving free and reduced-priced meals at the school level was associated with being overweight among males and females. The percentage of students receiving FARMS served as a proxy for socioeconomic status. Previous research studies have shown a direct association between lower socioeconomic status and increase in BMI (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Cutler, Flood, Hannan, & Neumark-Sztainer, 2011). Availability of fresh fruits and vegetables, built environment, and screen time are influences by socioeconomic status and affect food intake and energy expenditure (Beech, Fitzgibbon, Resnicow, & Whitt-Glover, 2011).

4.1 | Limitations

It is important to note some limitations of this study. First, this investigation relied on self-reported height and weight from the participants. While actual height and weight would be ideal, studies have found a strong correlation between self-reported and actual height and

weight among adolescent populations. Strauss (1999) found that self-reported height and weight resulted in the correct weight status classification in 94% of adolescents.

Another limitation is the cross-sectional study design, which limits conclusions regarding causality and temporality. This is a concern with us exploring personal stress as a mediator; one of the requirements for mediation is a temporal relationship. The indirect effects observed provide some evidence of mediation; however, future studies should examine the relationship between school climate, personal stress, and being overweight over time. The cross-sectional study design also limits our ability to determine the direction of the relationship between being overweight and school-stressors; students who are overweight may be bullied (Lumeng et al., 2010; Mamun, O'Callaghan, Williams, & Najman, 2013) more often and feel less connected (Puhl, 2011) to the school (Gilstad-Hayden et al, 2014). While this current investigation used a large sample in multiple school districts, generalizability may be a concern since the schools were from a single state. There are certain policies that may vary by state (e.g., requirements for school meals, time for physical activity) that may be associated with weight status.

Despite these limitations, this study uses a large sample of high school students to explore the relationship between school climate and weight status. The study fills a gap in the literature by exploring stress as a potential mechanism to explain the relationship between school climate and weight status. The study also stratified by gender, given the differences in perception of school climate by gender as well as differences in weight status.

4.2 | Conclusion

Prevention of obesity in adolescents has the potential to be most effective when aimed at multiple levels of influence. By creating an ecological approach to obesity prevention, researchers are able to investigate factors beyond diet and physical activity that affect weight. As demonstrated by this study, there is evidence that school environment plays a significant role in influencing weight status for adolescents. More research is needed to understand the mechanisms by which social and environmental factors that diminsh school climate impact personal perceptions of stress and weight status. Additionally, schools should work to create a climate that engages and supports students while providing the resources to support positive healthy behaviors.

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TABLE 1

Sample and School Descriptive Statistics

Student-level characteristics	**Males (*n* = 10,829) n(%)**	**Females (*n* = 11,315) n(%)**	***p***
Caucasian	5,857(54.3)	6,051 (53.4)	.194
Mean age (*SD*)	16.0(1.3)	15.8(1.2)	.976
Grade			
9th	3,058(28.3)	3,286(29.0)	.032
10th	2,673 (24.8)	2,936 (25.9)	
11th	2,603 (24.1)	2,707(23.9)	
12th	2,457(22.8)	2,420(21.3)	
How many days during the past week have you exercised for at least 20 minutes?			
0 days	944(8.7)	1,562(13.8)	<.001
1day	623(5.8)	1,061(9.3)	
2–4 days	3,525 (32.7)	4,526 (39.9)	
> 4 days	5,700(52.8)	4,201(37.1)	
Overweight or obese (BMI >85th percentile)	3,659 (34.0)	3,252(28.7)	<.001
School-level characteristics			
% Minority *mean(SD)*	46.8%(25.1)		
% Free and reduced priced meals *mean (SD)*	37.5% (17.8)		
Healthy food available (SAfETy)	87.9%		
SAfETy: Soda available	44.2%		
Students have healthy food choices	59.9%		
Students have adequate health services	62.3%		
Opportunity to participate in sports	88.4%		
Geographic setting			
Urban/urban fringe	13.8%		
Rural/suburban	86.2%		

Note. SD = standard deviation; SAfETy = School Assessment for Environmental Typology; BMI = body mass index. Average cluster size across the 58 schools for males was 186 and 196 for females.

TABLE 2

Multilevel Structural Equation Model-School Climate, Personal Stress, and Weight Status Among Males

	Model 1[a]		Model 2[b]	
	B(SE)	***p***	***B(SE)***	***p***
Student-level characteristics				
Age	−.033 (.010)	.001	−.033 (.010)	.001
African American	.173(.185)	.351	.173 (.185)	.351
Exercise	−.158 (.034)	< .001	−.158 (.034)	< .001
School climate	.138(.119)	.244	.108 (.128)	.399
Bullying[c]	ref	-	ref	-
School connectednes[c]	.992 (.027)	< .001	1.006(.028)	< .001
Physical Safety[c]	1.291 (.041)	< .001	1.240 (.038)	< .001
Personal stress			.020(.013)	< .001
Feel stressed[c]			ref	-
Trouble falling asleep[c]			.551 (.017)	< .001
Feel like you didn't get enough sleep[c]			.522 (.015)	< .001
Couldn't handle difficulties[c]			.883 (.040)	< .001
Personal stressors *on*			1.349 (.069)	< .001
school stressors				
Indirect: Personal stressors-school stressors			.027 (.017)	.108
School-level characteristics				
School climate	.089 (.287)	.758	.088 (.285)	.756
Bullying[c]	ref	-	ref	-
School connectedness[c]	.587 (.163)	< .001	.587 (.163)	< .001
Physical safety[c]	.808 (.257)	.002	.808 (.257)	.002
Urban/urban fringe	.031 (.044)	.475	.031 (.044)	.475
% African American	−.002 (.001)	.026	−.002 (.001)	.026
% Free and reduced meals	.005 (.002)	.010	.005 (.002)	.010

	Model 1[a]		Model 2[b]	
	B(SE)	*p*	*B(SE)*	*p*
SAfETy: Healthy food availability	.059 (.048)	.214	.059 (.048)	.213
SAfETy: Soda available	.035 (.036)	.333	.035 (.036)	.333
Students have healthy food choices	.053 (.131)	.684	.053 (.131)	.684
Students have adequate health services	.054 (.190)	.776	.054 (.190)	.776
Opportunity to participate in sports	−.400(.261)	.126	−.400(.261)	.125

Note. SE = standard error; SAfETy = School Assessment for Environmental Typology; RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis index.

[a]CFI =.97, TFI = .96, RMSEA=.015.

[b]CFI =.98, TFI = .98, RMSEA = .028.

[c]Factor loadings.

TABLE 3

Multilevel Structural Equation Model-School Stressors, Personal Stress, and Weight Status Among Females

	Model 1[a]		Model 2[b]	
	B(SE)	*p*	*B(SE)*	*p*
Student-level characteristics				
Age	−.045 (.011)	< .001	−.045 (.011)	< .001
African American	. 160 (.280)	.567	.160(.280)	.567
Exercise	−.238 (.034)	< .001	−.238 (.034)	< .001
School climate	.115(.049)	.019	.068 (.057)	.230
Bullying[c]	ref	-	ref	-
School connectedness[c]	1.085 (.026)	< .001	1.035 (.018)	< .001
Physical Safety[c]	1.069 (.020)	< .001	.975 (.025)	< .001
Personal stress			.017(.009)	.045
Feel stressed[c]			ref	-
Trouble falling asleep[c]			.484 (.010)	< .001
Feel like you didn't get enough sleep[c]			.510 (.012)	< .001
Couldn't handle difficulties[c]			.879 (.022)	< .001
Personal stressors *on*			2.149 (.089)	< .001
school stressors				
Indirect: Personal stressors-school stressors			.039 (.019)	.048
School-level characteristics				
School climate	.462 (.388)	.233	−.462 (.390)	.236
Bullying[c]	ref	-	ref	-
School connectedness[c]	.700 (.212)	.001	.700 (.218)	.001
Physical safety[c]	.600 (.204)	.003	.600(.210)	.004
Urban/urban fringe	.051 (.045)	.258	.051 (.045)	.258
% African American	.002(.001)	.025	.002(.001)	.025
% Free and reduced meals	.008 (.002)	<.001	.008 (.002)	<.001

	Model 1[a]		Model 2[b]	
	B(SE)	*p*	*B(SE)*	*p*
SAfETy: Healthy food availability	.081 (.046)	.080	.081 (.046)	.080
SAfETy: Soda available	.020 (.035)	.567	.020 (.035)	.567
Students have healthy food choices	−.063 (.158)	.688	−.063 (.158)	.688
Students have adequate health services	−.025 (.241)	.917	−.063 (.241)	.917
Opportunity to participate in sports	−.164(.191)	.391	−.164(.191)	.391

Note. SE= standard error; SAfETy = School Assessment for Environmental Typology; RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis index.

[a]CFI =.98, TFI: = .97, RMSEA= .015.

[b]CFI= .99, TFI = .99, RMSEA= .028.

[c]Factor loadings.