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RESEARCH ARTICLE

Measuring School Climate in High Schools: A Focus on Safety, Engagement, and the Environment

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ABSTRACT

BACKGROUND: School climate has been linked to multiple student behavioral, academic, health, and social-emotional outcomes. The US Department of Education (USDOE) developed a 3-factor model of school climate comprised of safety, engagement, and environment. This article examines the factor structure and measurement invariance of the USDOE model.

METHODS: Drawing upon 2 consecutive waves of data from over 25,000 high school students (46% minority), a series of exploratory and confirmatory factor analyses examined the fit of the Maryland Safe and Supportive Schools Climate Survey with the USDOE model.

RESULTS: The results indicated adequate model fit with the theorized 3-factor model of school climate, which included 13 subdomains: safety (perceived safety, bullying and aggression, and drug use); engagement (connection to teachers, student connectedness, academic engagement, school connectedness, equity, and parent engagement); environment (rules and consequences, physical comfort, and support, disorder). We also found consistent measurement invariance with regard to student sex, grade level, and ethnicity. School-level interclass correlation coefficients ranged from 0.04 to .10 for the scales.

CONCLUSIONS: Findings supported the USDOE 3-factor model of school climate and suggest measurement invariance and high internal consistency of the 3 scales and 13 subdomains. These results suggest the 56-item measure may be a potentially efficient, yet comprehensive measure of school climate.

Keywords: school climate; safety; engagement; environment; school improvement; measurement.

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School climate is profoundly important to the social, emotional, and academic successes of its students and staff. Whereas this has been recognized for over a century,[1] the last 2 decades have ushered in a new appreciation for the importance of school climate.[2] There is a growing body of research documenting an association among a positive school climate and pro-social motivation, academic motivation, self-esteem, conflict resolution, and altruistic behavior.[3-7] School climate is also a significant predictor of rates of dropout, absenteeism and truancy,[8-11] suspension,[12] drug use, and violent and aggressive behavior.[13,14] As a result of the research linking school climate with positive outcomes for students, it has become a target for many federal and local school improvement initiatives, such as the Safe Schools/Healthy Students Program and the Safe and Supportive Schools Program through the US Department of Education (USDOE).[15]

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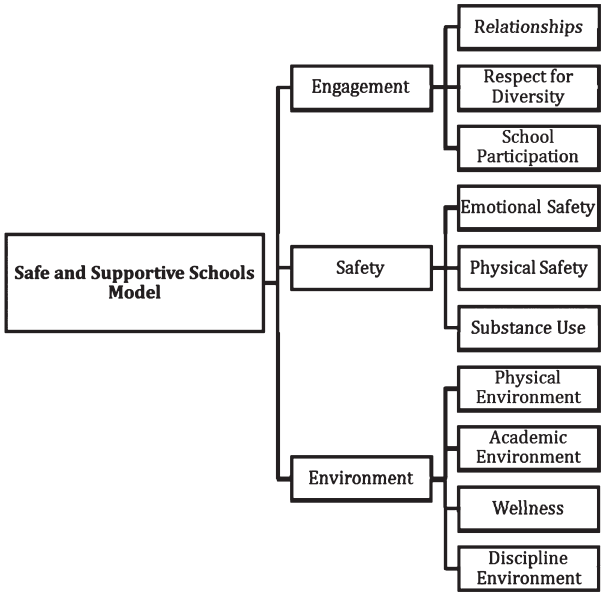
Figure 1. **USDOE Safe and Supportive Schools Model of School Climate**



However, there is little consensus among educators, policymakers, and researchers regarding the definition and measurement of school climate. Moreover, there is a need for efficient methods for assessing school climate to inform decision-making by school and district leadership. This study aimed to address these gaps in the extant research regarding school climate and its measurement. Specifically, we assessed the psychometric properties of an instrument based on the USDOE's model[15] for school climate (Figure 1), which focuses on the interrelated concepts of safety, engagement, and the environment.

Defining and Measuring School Climate

School climate refers to the shared beliefs, values, and attitudes that shape interactions between students, teachers, and administrators and set the parameters of acceptable behavior and norms for the school.[16,17] School climate is a product of teacher and student social interactions, and is influenced by educational and social values. Haynes et al[18(p322)] defined school climate as ''the quality and consistency of interpersonal interactions within the school community that influence children's cognitive, social, and psychological development.'' More recently, the definition has been expanded to include safety[19] and the physical environment.[20,21]

Although there is no universally agreed upon set of core domains, several reviews[2,19,22] have identified some commonalities. For example, the National School Climate Center identifies 5 domains of school climate in their review of over 200 references: safety (rules and norms, physical safety, and social-emotional safety); relationships (respect for diversity, school connectedness/engagement, social support, leadership, students' race/ethnicity and their perceptions of school climate); teaching and learning (social, emotional, ethical, and civic learning, service learning, support for academic learning, support for professional relationships, teachers' and students' perceptions of school climate); institutional environment (physical surroundings, resources, and supplies); and the school improvement process (implementation of evidence-based programs). Similarly, the USDOE Safe and Supportive Schools model of school climate includes 3 interrelated domains of *safety* (social-emotional safety, physical safety, and substance use), *student engagement* (relationships, respect for diversity, and school participation), and the *school environment* (physical environment, academic environment, wellness, and disciplinary environment) (see Figure 1).[15]

Several tools and assessments have been created to measure school climate. Despite the evidence indicating that school climate is a multifaceted construct, few measures adequately reflect its multidimensional nature. In contrast, most measures have focused on specific domains of school climate, such as student engagement, through the use of self-report surveys completed by students and/or staff. Examples of such surveys include the National Association of Secondary School Principals Comprehensive Assessment of School Environments, the School Development Program, and the San Diego Effective Schools Student Survey.[22] Student engagement often includes measures of social relationships/connectedness as well as academic emphasis. Specifically, many measures have assessed perceptions of helpfulness of school staff, teacher-student relationships, and student-peer relationships.[21,23] School connectedness is closely related to social relationships and has been measured by assessing the existence of meaningful roles for students at school, the level of public recognition of students' achievements and constructive behavior, feelings of closeness between staff and students, level of engagement of learners, and students' sense that their input is valued.[22,24-27] Student perceptions of academic accomplishment, recognition for success, and sense of value and commitment to academics have also been measured as indicators of student engagement.[28]

Other approaches have focused on order, safety, and discipline using items assessing health risk behaviors from the Youth Risk Behavior Surveillance Survey, Monitoring the Future survey, the National School Crime Victimization Survey, and the National School Crime and Safety Survey.[29] Generally, these measures identify incidents of violence, perceived safety, respect for peers and authority, knowledge and fairness of disciplinary policies, and gang activity.[22] However, some may question the extent to which

these are behavioral indicators of the school climate or behavioral correlates/outcomes. Nevertheless, it is common for measures of school climate to include a combination of perceptual and behavioral indicators.

The domain of the physical environment has been measured through both observational assessments as well as self-report surveys of students and staff.[20,22] The quality and maintenance of school facilities, classrooms, buildings, and grounds have been shown to be important indicators of this domain.[20] Ambient noise, school temperatures, and classroom arrangement also have served as indicators of the physical environment domain of school climate.[22]

Overview of the Study

Given the growing body of research documenting an association between school climate and student outcomes, there has been increased effort to improve school climate through preventive interventions and school reform models.[30] Yet, the field has struggled to define, and thus, measure school climate and its interrelated facets.[31-35] This study aimed to validate the USDOE's[15] multicomponent model of school climate, which includes *safety*, *engagement*, and the *environment*, through a youth self-report measure. The data for this project come from Maryland's Safe and Supportive Schools Initiative (MDS3), which is a joint project of the Maryland State Department of Education (MSDE), Sheppard Pratt Health System, and Johns Hopkins University. We adopted the USDOE's model of school climate as a framework for guiding our development of a school climate measure to assess the climate of high schools and provide data to facilitate data-based decision making for school and district staff. A primary goal of MDS3 was to implement a sustainable system for assessing school climate state-wide.

METHODS

Participants

Data were collected from 58 Maryland high schools participating in MDS3 during spring 2011 (wave 1) and spring 2012 (wave 2) from 9th to 12th grade students via a Web-based survey. Wave 1 data were collected on 21,824 adolescents in an average of 23.04 classrooms per school. Wave 1 student mean age in the sample was 15.98 (SD = 1.37) and participating schools included a diverse population with a minority rate of 47.16% (SD = 25.61) and a mean student enrollment of 1269.79 (SD = 478.22). Wave 2 data were collected on 28,104 adolescents in an average of 25.40 classrooms per school participated in the data collection. Wave 2 student mean age in this sample was 15.93 (SD = 1.33) and participating schools again included a diverse population with a minority rate of 45.93% (SD = 25.11) and a mean student enrollment of 1268.48 (SD = 466.82). Additional youth demographic characteristics for wave 1 and wave 2 are presented in Table 1.

Table 1. **Sample Demographics**

Student Characteristics Wave 1 (N = 21,824 students)	**N (%)***
Sex	
Girls	9965 (49.3)
Boys	11,859 (50.7)
Race/ethnicity	
Native American/American Indian	318 (.5)
Native Hawaiian	133 (.3)
Asian/Pacific Islander	869 (3.5)
Black/African American	6156 (36.4)
White/Caucasian	10,146 (52.1)
Hispanic	940 (5.2)
Other	1271 (2.0)
Grade	
Grade 9	6115 (26.8)
Grade 10	4851 (25.7)
Grade 11	4946 (25.1)
Grade 12	3923 (22.4)
Student Characteristics Wave 2 (N = 28,104 students)	**N (%)***
Sex	
Girls	13,724 (49.4)
Boys	13,573 (50.6)
Race/ethnicity	
Native American/American Indian	437 (.6)
Native Hawaiian	158 (.2)
Asian/Pacific Islander	1206 (3.9)
Black/African American	8798 (33.5)
White/Caucasian	13,421 (53.6)
Hispanic	1331 (5.6)
Other	1939 (2.6)
Grade	
Grade 9	7623 (26.9)
Grade 10	6834 (25.6)
Grade 11	6594 (24.1)
Grade 12	6011 (23.4)

*N indicates original unweighted sample size, whereas % indicates the weighted percentage. The sample size may not total to the full N due to missingness.

Instrument

The MDS3 Student Survey was developed by the Johns Hopkins Center for Youth Violence Prevention in collaboration with project partners. Researchers from the Center undertook a comprehensive review of the literature focusing on the 3 domains of school climate included in the USDOE model.[15] Additionally, focus groups were held with students, district personnel, and school administrators to understand the operationalization of school contextual factors for each of the different stakeholders. The MDS3 School Climate Survey is comprised of 56 core items (see Table 2 for the specific questions) based on previously

Table 2. **Item Loading by Domain for Wave 1 and Wave 2 CFA**

	Wave 1			Wave 2		
Safety Factor	**Loading**	**SE**	**Z**	**Loading**	**SE**	**Z**
Perceived safety						
I feel safe at this school	0.81	0.01	99.33	0.85	0.01	133.3
I feel safe going to and from school	0.73	0.01	70.94	0.77	0.01	96.57
Programs for violence and conflict	0.31	0.01	24.97	0.3	0.01	23.96
Students carrying guns or knives	0.52	0.01	38.34	0.5	0.01	41.15
Bullying and aggression						
Physical fighting between students	0.68	0.01	84.62	0.67	0.01	63.15
Harassment or bullying of students	0.77	0.01	107.63	0.77	0.01	105.02
Seen someone else being bullied	0.43	0.01	57.16	0.47	0.01	67.68
Students at this school try to stop bullying	0.43	0.01	32.6	0.43	0.01	30.91
General drug use						
Students' drug use (such as marijuana, LSD, cocaine, and ecstasy)	0.88	0.01	150.8	0.87	0.01	142.58
Students' tobacco use (cigarettes, chew, and cigars)	0.82	0.01	87.29	0.81	0.01	102.11
Students alcohol use (such as beer, wine, and liquor)	0.81	0.01	95.99	0.82	0.01	93.19
Engagement factor						
Connection to teachers						
My teachers listen to me when I have something to say	0.78	0.01	139.97	0.77	0.01	161.56
My teachers care about me	0.81	0.01	172.8	0.8	0	196.07
Teachers respect the students	0.78	0.01	135.17	0.78	0.01	159.63
My teachers tell me when I do a good job	0.62	0.01	78.43	0.63	0.01	83.99
My teachers notice when I am not there	0.63	0.01	79.45	0.62	0.01	79.29
Students trust the teachers	0.7	0.01	85.87	0.69	0.01	87.47
Student connectedness						
I feel like I belong	0.62	0.01	70.09	0.62	0.01	76.08
Students help one another	0.81	0.01	151.95	0.81	0	180.41
Students respect one another	0.78	0.01	136.71	0.79	0.01	153.7
Students like one another	0.77	0.01	109.73	0.77	0.01	129.83
Students trust one another	0.79	0.01	117.94	0.79	0.01	161.5
Academic engagement						
My teachers believe that I can do well in school	0.83	0	194.2	0.82	0	196.27
I believe I can do well in school	0.69	0.01	75.69	0.6	0.01	48.42
My teachers always want me to do my best	0.81	0.01	155.39	0.82	0	196.94
It is important to finish high school	0.53	0.01	40.67	0.5	0.01	42.62
Whole-school connectedness						
Students and staff feel pride in this school	0.62	0.01	64.64	0.63	0.01	76.67
I enjoy learning at this school	0.79	0.01	149.57	0.81	0.01	171.73
I like this school	0.79	0.01	138.58	0.79	0.01	147.28
I like coming to school	0.74	0.01	126.03	0.76	0.01	160.39
Culture of equity						
Students of all races are treated the same	0.79	0.01	139.06	0.78	0.01	131.49
All students are treated the same, regardless of whether their parents are rich or poor	0.83	0.01	161.92	0.82	0.01	140.87
Boys and girls are treated equally well	0.78	0.01	132.64	0.77	0.01	163.37
The school provides instructional materials that reflect my culture, ethnicity, and identity	0.61	0.01	76.34	0.61	0.01	100.45
Parent engagement						
My parent(s) or guardian(s) feels welcome at this school	0.7	0.01	102.9	0.71	0.01	115.3
If I do something bad at school, my parent(s) or guardian(s) hears about it	0.49	0.01	43.01	0.48	0.01	53.98
When I do something good at school, my parent(s) or guardian(s) usually hears about it	0.62	0.01	89.63	0.62	0.01	81.3
The school tries to involve parents or guardians	0.71	0.01	93.26	0.69	0.01	107.86
Parents or guardians often come to my school to help out	0.6	0.01	89.42	0.56	0.01	70.55
Environment factor						
Rules and consequences						
Students listen to the teachers	0.63	0.01	77.41	0.6	0.01	71.05
Teachers can handle students who disrupt class	0.69	0.01	100.18	0.67	0.01	89.87
There are clear rules about student behavior	0.6	0.01	54.95	0.6	0.01	70.07
Students are rewarded for positive behavior	0.58	0.01	60.89	0.58	0.01	70.52
Everyone knows what the school rules are	0.57	0.01	54.87	0.57	0.01	72.73
Physical comfort						
The bathrooms in this school are clean	0.74	0.01	56.88	0.73	0.01	56.46
The school is usually clean and well maintained	0.82	0.01	83.78	0.82	0.01	98.47
The temperature in this school is comfortable all year	0.55	0.02	30.8	0.55	0.02	35.05
This school has a bright and pleasant appearance	0.72	0.01	78.01	0.71	0.01	60.72
Support						
Teachers at my school help students with their problems	0.79	0.01	145.88	0.81	0.01	141.38
Students who need help for their problems are able to get it through school	0.78	0.01	114.45	0.78	0.01	149.68
There is someone at school who I can talk to about personal problems	0.64	0.01	62.47	0.59	0.01	77.65
Disorder						
Students disobey the rules	0.35	0.02	15.79	0.4	0.02	20.97

Table 2. **Continued**

	Wave 1			Wave 2		
	Loading	SE	Z	Loading	SE	Z
Disruptions by other students can get in the way of my learning	0.38	0.03	14.94	0.31	0.03	11
Misbehaving students get away with it	0.48	0.03	18.47	0.47	0.02	21.84
There are often broken windows, doors, or desks in this school	0.58	0.03	19.46	0.57	0.03	19.81
Vandalism of school property is a problem at this school	0.56	0.02	25.6	0.54	0.02	28.62

CFA, confirmatory factor analyses; Loading, standardized factor loading; SE, standard error; z, z score.

validated indicators of *safety*, *engagement*, and the *school environment*. All answer choices were on a 4-point Likert scale from *strongly agree* to *strongly disagree* (unless otherwise noted), whereby all items were coded with high score representing a more favorable school climate. Additional psychometric information from this study is provided in Table 2. Below we provide details regarding the individual subscales that encompassed each of the 3 domains.

Safety. The following 3 subscales comprise the safety scale. Four items assessed students' *perceptions of the safety* of the school environment. These items included students' feelings of safety at school and going to and from school.[36] One question assessed how much of a problem they perceived was students' carrying weapons to schools, with answer choices on a 4-point scale from large problem to not a problem.[6] Students were also asked whether their school had enough programs to address conflict.[37] Consistent with the definition by Olweus[38] and the CDC,[39] the survey provided a definition of bullying, which read: ''A person is bullied when he or she is exposed, repeatedly and over time, to negative actions on the part of one or more other persons. Bullying often occurs in situations where there is a power or status difference. Bullying includes actions like threatening, teasing, name-calling, ignoring, rumor spreading, sending hurtful emails and text messages, and leaving someone out on purpose.'' Four items assessed the climate of *bullying and aggression* including whether students had witnessed another student being bullied (answer choice yes/no)[36] and youths' perceptions that students in their school would intervene to stop bullying.[40] Participants also rated the extent of a problem their school has with harassment or bullying of students and with students fighting.[6] Answer choices to these last 2 questions were on a 4-point scale from large problem to not a problem. Students' *concerns about student substance* use were assessed using 3 items, upon which youth self-reported the extent to which each was a problem at their school: alcohol, tobacco, and drug use including marijuana, LSD, cocaine, ecstasy.[6] Answer choices were on a 4-point scale from large problem to not a problem. These items are similar to other items used to assess student perception of drug use as a problem in their community.[41]

School engagement. The following 6 subscales comprised school engagement. Six items assessed students' *connection with teachers* in their school. Items included both perception of teacher behavior (my teachers listen when I have something to say and my teachers tell me when I do a good job),[35] as well as student-teacher relationships (students trust the teachers and teachers respect the students).[37] *Student connectedness* was assessed using 5 items which examined the perception that students helped, respected, liked, and trusted one another,[37] as well as students' general perception of belonging.[7] *Academic engagement* was assessed with 4 items.[37] Three items assessed perception of academic success (believe I can do well in school) with 1 item assessing academic values (it is important to finish high school). Four items focused on general feeling about school including liking coming to school[7] and taking pride in the school,[37] which we refer to as *whole-school connectedness*. Four items were used to assess schools' *culture of equity*. Three items assessed students' perception of fair treatment by race, sex, and socioeconomic status (all students are treated the same regardless of whether their parents are rich or poor).[37] One item assessed cultural representativeness of educational materials (school provides instructional materials that reflect my culture, ethnicity, and identity).[35] Students' perception of the amount of *parent engagement* in their school was assessed with 5 questions. Two questions assessed general perception of parent involvement (parents or guardians often come to my school to help out).[37] The other 3 assessed personal experiences with their own parents' engagement.[35,37]

School environment. The school environment scale was comprised of 4 subscales. Five questions asked about the existence and awareness of rules[6] and 2 questions asked about teachers' classroom management ability (teachers can handle students who disrupt class);[6,37] we refer to this as *rules and consequences*. The survey also included 4 questions regarding the physical environment including the overall cleanliness of the school and bathrooms and the temperature of the school;[6] we refer to this as *physical comfort and cleanliness*. Students' perception of *support*, or that someone was available to help students with their problems, was assessed by 3 questions (teachers at my school help students with their problems).[37] Five questions captured the amount of *physical and behavior disorder* present in the school. Specifically, 3 questions asked about the level of behavioral disruption (misbehaving students get away with it);[6,37] 2 questions

inquired about physical indicators of disorder (there are a lot of broken windows, doors, or desks).[6]

Demographics

Youth demographic characteristics. Participants responded to a series of questions regarding their basic demographic characteristics, including age, sex, and grade level. Participants were also asked to report on their ''race/ethnicity,'' and indicate whether it was Asian/Pacific Islander, Black/African American, Hispanic/Latino, Native American/American Indian, Native Hawaiian, White/Caucasian, or other.

Procedure

Schools' participation in the MDS3 Initiative was voluntary. Districts were approached for participation by MSDE. Upon expressing interest in the MDS3 Initiative, district-specific principal meetings were conducted to obtain school-level and principal commitment to the project. The anonymous survey was administered using a passive consent process and youth assent process, and all participation was voluntary. Letters were sent home to parents providing information about the survey and the larger initiative. The survey was administered online in language arts classrooms at participating high schools. School staff provided instructions for students to complete the survey following a written protocol developed by the Center research team. The nonidentifiable data were obtained from MSDE for analysis for this article.

Data Analysis

We first conducted exploratory factor analyses (EFA) in Mplus 7.1[42] using data from wave 1 to examine the 3 proposed scales (engagement, safety, and environment) of school climate. We next conducted confirmatory factor analyses (CFA) on the wave 1 data to test the resulting factor structure separately for each of the 3 scales; a CFA was then conducted on the separate wave 2 sample. Model fit was assessed utilizing the comparative fit index (CFI), Tucker-Lewis index (TLI), root mean-square error of approximation (RMSEA), and standardized room mean square residual (SRMR). For the CFI and TLI a value of 0.90 or higher is considered acceptable fit,[43] with those closer to 0.95 considered to be a well-fitting model.[44] For RMSEA, a fit of 0.06 or less and for SRMR a fit of 0.08 or less indicates a good fit.[44] All analyses accounted for the clustering of students within schools using the Huber-White adjustment of the standard errors.[42]

We also examined 3 different forms of measurement invariance using the wave 2 data (configural invariance, weak factorial invariance, and strong factorial invariance)[45-48] to explore the extent to which the item loadings varied as a function of student ethnicity, sex, and grade level. The first step was to test for configural invariance which ascertains whether the model fits adequately for all subgroups. We allowed all model parameters to vary freely across groups,[45] and examined fit indices.[48] If configural invariance was present, the next step was to examine weak factorial invariance, which holds factor loading equal across groups. Given these measurement models are nested the difference between the fit indices for the models were used to evaluate invariance.[48] A decrease in CFI of at least 0.010 and an increase in RMSEA of at least 0.015 or an increase in SRMR of at least 0.03 indicates noninvariance.[48] The next step was to examine strong factorial invariance, where both factor loadings and intercepts are held equal across groups. The following criteria were used to judge noninvariance: a decrease in CFI of at least 0.010 and an increase in RMSEA of at least 0.015 or an increase in SRMR of at least 0.01.[42,45,48] The final step was to compute basic descriptives (means and SD) and correlations among the final subscale scores using the sample weights (see below). Finally, intra-class correlation coefficients (ICCs[49]) were computed for the unconditional models as an indicator of shared variance at the classroom and school levels.

Sample weighting. When computing the descriptive and correlational analyses, we weighted the sample of students to reflect the entire student population within the 58 schools. Specifically, sampling weights were created using the raking method,[50,51] an iterative procedure that produces weights based on marginal results from multiple variables in Stata 11.0.[52] The 3 school-specific variables of interest were the total number students at each grade level, of each sex, and of each race/ethnicity. Using 1 variable at a time, weights that adjusted the subsample of participants from each school to the first school-specific characteristic were calculated. The weights were further adjusted to match the school population using the next variable of interest. Once all of the variables were used, the sequence was repeated until the weights converged. This iterative procedure was repeated for each school.[50] The weighted sample allows for generalizability of the sample to the full population of students within the 58 schools.

RESULTS

Examining Factor Structure

Safety. The EFA revealed that a 3-factor model provided the best fit to the data (CFI = 0.984, TLI = 0.964, RMSEA = 0.038, and SRMR = 0.023). The resulting factors were labeled: (1) bullying and aggression, (2) perceived physical safety, and (3) general drug use (Table 2). The CFA confirmed the 3 factors, with all fit indices indicating an adequate

Table 3. **Correlations Between Subscales and Cronbach's Alphas**

Safety	1	2	3	M (SD)	ICC Classroom	ICC School
1. Bullying and aggression	(0.64)			2.32 (0.77)	0.03	0.05
2. Physical safety	0.58	(0.63)		3.02 (0.61)	0.04	0.04
3. General drug use	0.66	0.33	(0.87)	2.27 (1.01)	0.04	0.07
Full safety scale	($\alpha = 0.81$)			2.53 (0.60)	0.03	0.07

Environment	1	2	3	4	M (SD)	ICC Classroom	ICC School
1. Rules and consequences	(0.73)				2.56 (0.57)	0.04	0.02
2. Physical comfort/cleanliness	0.65	(0.79)			2.15 (0.71)	0.16	0.03
3. Support	0.77	0.52	(0.76)		2.71 (0.70)	0.01	0.03
4. Disorder	0.33	0.46	0.22	(0.58)	2.34 (0.53)	0.06	0.02
Full environment scale	($\alpha = 0.85$)				2.43 (0.44)	0.03	0.10

Engagement	1	2	3	4	5	6	M (SD)	ICC Class-room	ICC School
1. Teacher connect	(0.86)						2.73 (0.63)	0.04	0.02
2. Student connect	0.68	(0.87)					2.48 (0.69)	0.02	0.05
3. Academic engagement	0.75	0.42	(0.79)				3.22 (0.58)	0.05	0.01
4. School connect	0.71	0.63	0.62	(0.82)			2.57 (0.76)	0.05	0.05
5. Culture of equity	0.62	0.57	0.49	0.53	(0.83)		2.64 (0.73)	0.03	0.03
6. Parent engagement	0.75	0.62	0.66	0.71	0.57	(0.74)	2.59 (0.61)	0.02	0.03
Full engagement scale		($\alpha = 0.94$)					2.71 (0.52)	0.04	0.04

ICC, intraclass correlation.
Values in parentheses are coefficients of internal consistency (Cronbach's alpha [α]) for each subscale from the wave 2 sample and include the sample weights. All correlations are significant at $p < .001$. ICCs were calculated for both the school and classroom levels.

fit (CFI = 0.941, TLI = 0.920, RMSEA = 0.057, and SRMR = 0.060). Cronbach alpha estimates for the wave 1 sample were: bullying and aggression (0.65), perceived physical safety (0.68), general drug use (0.87), and for the full scale (0.81). The CFA on the wave 2 sample provided further confirmation of the adequate fit for the 3 subscales on the safety scale (CFI = 0.975, TLI = 0.966, RMSEA = 0.056, and SRMR = 0.064; Table 3 shows correlations among scales and Cronbach alpha estimates for each subscale) ($\alpha = 0.812$ for the full scale at wave 2).

Engagement. The EFA revealed a 6-factor model provided the best fit to the data (CFI = 0.983, TLI = 0.971, RMSEA = 0.029, and SRMR = 0.013). The resulting factors were labeled (1) teacher connectedness, (2) student connectedness, (3) academic engagement, (4) whole-school connectedness, (5) culture of equity and fairness, and (6) parent engagement (see Table 2 for specific items). The CFA confirmed the 6 factors with all fit indices indicating an adequate fit (CFI = 0.945, TLI = 0.934, RMSEA = 0.048, and SRMR = 0.050). Cronbach alpha estimates for the wave 1 sample were: teacher connectedness (0.86), student connectedness (0.87), academic engagement (0.79), whole-school connectedness (0.82), culture of equity (0.84), parent engagement (0.76), and for the full scale (0.94). We ran the CFA on the wave 2 sample, which provided further confirmation of the adequate fit for the 6 subscales on the engagement scale (CFI = 0.942, TLI = 0.935, RMSEA = 0.05, and SRMR = 0.05; Table 3 shows correlations among scales and Cronbach alpha estimates for each subscale) ($\alpha = 0.94$ for the full scale at wave 2).

Environment. The EFA revealed a 4-factor model provided the best fit to the data (CFI = 0.969, TLI = 0.943, RMSEA = 0.045, and SRMR = 0.022). The resulting factors were labeled (1) rules and consequences, (2) physical comfort/cleanliness, (3) emotional support, and (4) disorder (Table 2 shows item descriptions). The CFA confirmed the 4 factors with all fit indices indicating an adequate fit (CFI = 0.953, TLI = 0.943, RMSEA = 0.043, and SRMR = 0.046). Cronbach alpha estimates for the wave 1 sample were: rules and consequences (0.75), physical comfort/cleanliness (0.80), emotional support (0.78), disorder (0.60), and for the full scale (0.83). The CFA on the wave 2 sample provided further confirmation of the adequate fit for the 4 subscales on the environment scale (CFI = 0.990, TLI = 0.988, RMSEA = 0.042, and SRMR = 0.046; Table 3 shows correlations among scales and Cronbach alpha estimates for each subscale) ($\alpha = 0.85$ for the full scale at wave 2).

Measurement Invariance

Sex. Tests of the configural invariance of the environment, engagement, and safety scales for boys

Table 4. **Fit Statistics for CFA Models Testing Measurement Invariance Across Sex, Race, and Grade Level**

Model	χ^2	df	CFI	SRMR	RMSEA
Safety					
Sex					
Model 1	4768.48	82	0.958	0.066	0.065
Model 2	4824.882	90	0.958	0.066	0.063
Model 3	4994.138	98	0.956	0.068	0.062
Race					
Model 1	4603.876	82	0.965	0.064	0.064
Model 2	4558.404	90	0.965	0.065	0.061
Model 3	4120.495	98	0.969	0.066	0.055
Grade level					
Model 1	4556.797	82	0.958	0.064	0.064
Model 2	4626.932	90	0.957	0.065	0.061
Model 3	4732.376	98	0.956	0.065	0.059
Engagement					
Sex					
Model 1	26,989.65	670	0.924	0.05	0.055
Model 2	27,447.35	692	0.922	0.053	0.054
Model 3	28,375.28	714	0.92	0.055	0.054
Race					
Model 1	27,192.29	670	0.925	0.051	0.055
Model 2	27,308.62	692	0.924	0.051	0.054
Model 3	29,143.82	714	0.919	0.052	0.055
Grade level					
Model 1	27,213.11	670	0.923	0.051	0.055
Model 2	27,267.46	692	0.923	0.051	0.054
Model 3	27,729.32	714	0.922	0.051	0.054
Environment					
Sex					
Model 1	6093.479	226	0.963	0.047	0.045
Model 2	6242.417	239	0.962	0.048	0.045
Model 3	6751.745	252	0.959	0.049	0.045
Race					
Model 1	6443.966	226	0.973	0.047	0.046
Model 2	6280.853	239	0.974	0.048	0.045
Model 3	6245.779	252	0.974	0.048	0.043
Grade level					
Model 1	5970.778	226	0.961	0.046	0.045
Model 2	6029.534	239	0.961	0.047	0.044
Model 3	6059.914	252	0.961	0.047	0.043

CFI, comparative fit index; RMSEA, root mean-square error of approximation; SRMR, standardized room mean square residual.

and girls suggest adequate fit (Table 4). The difference between the configural (model 1) and the weak factorial (model 2) invariance models indicated that there was weak factorial invariance across sex for the environment χ^2 difference = 122.5 (Δdf = 13), $p < .001$, ΔCFI = −0.001, ΔRMSEA = 0.000, ΔSRMR = 0.001; engagement χ^2 difference = 457.7 (Δdf = 22), $p < .001$, ΔCFI = −0.002, ΔRMSEA = −0.001, ΔSRMR = 0.003; and safety χ^2 difference = 25.09 (Δdf = 8), $p = 0.002$, ΔCFI = 0.000, ΔRMSEA = −0.002, ΔSRMR = 0.000. With regard to differences between the strong factorial (model 3) and weak factorial (model 2) invariance the results provided evidence of strong factorial invariance: environment χ^2 difference = 492.20 (Δdf = 13), $p < .001$, ΔCFI = −0.003, ΔRMSEA = 0.000, ΔSRMR = 0.001; engagement χ^2 difference = 927.94 (Δdf = 22), $p < .001$, ΔCFI = −0.002, ΔRMSEA = 0.000, ΔSRMR = 0.002; and safety χ^2 difference = 193.81(Δdegrees of freedom [df] = 8), $p < .001$, ΔCFI = −0.002, ΔRMSEA = −0.001, ΔSRMR = 0.002.

Race. Tests of the configural invariance of the environment, engagement, and safety scales for white youth and the youth self-characterized as minority or other suggested adequate fit (Table 4). The difference between the configural (model 1) and the weak factorial (model 2) invariance models indicated that there was weak factorial invariance across race for environment χ^2 difference = 31.04 (Δdf = 13), $p = .003$, ΔCFI = 0.001, ΔRMSEA = −0.001, ΔSRMR = 0.001; engagement χ^2 difference = 116.3 (Δdf = 22), $p < .001$, ΔCFI = −0.001, ΔRMSEA = −0.001, ΔSRMR = 0.000; and safety χ^2 difference = 38.6 (Δdf = 8), $p < .001$, ΔCFI = 0.000, ΔRMSEA = −0.003, ΔSRMR = 0.001. With regard to differences between the strong factorial (model 3) and weak factorial (model 2) invariance models indicate that there was strong factorial invariance for environment χ^2 difference = 149.53 (Δdf = 13), $p < .001$, ΔCFI = 0.000, ΔRMSEA = −0.002, ΔSRMR = 0.000; engagement χ^2 difference = 1835.20 (Δdf = 22), $p < .001$, ΔCFI = −0.005, ΔRMSEA = 0.001, ΔSRMR = 0.001; and safety χ^2 difference = 119.75 (Δdf = 8), $p < .001$, ΔCFI = 0.004, ΔRMSEA = −0.006, ΔSRMR = 0.001.

Grade level. Tests of the configural invariance of the environment, engagement, and safety scales for older (11th and 12th graders) and younger grades (9th and 10th graders) suggest adequate fit (Table 4). The difference between the configural (model 1) and the weak factorial (model 2) invariance models indicated that there was weak factorial invariance across sex for environment χ^2 difference = 27.95 (Δdf = 13), $p = .009$, ΔCFI = 0.000, ΔRMSEA = −0.001, ΔSRMR = 0.001; engagement χ^2 difference = 54.3 (Δdf = 22), $p < 0.001$, ΔCFI = 0.000, ΔRMSEA = −0.001, ΔSRMR = 0.000; and safety χ^2 difference = 23.2 (Δdf = 8), $p = .003$, ΔCFI = −0.001, ΔRMSEA = −0.003, ΔSRMR = 0.001. With regard to differences between the strong factorial (model 3) and weak factorial (model 2) invariance models indicate that there was strong factorial invariance for environment χ^2 difference = 65.61 (Δdf = 13), $p < .001$, ΔCFI = 0.000, ΔRMSEA = −0.001, ΔSRMR = 0.000; engagement χ^2 difference = 461.86 (Δdf = 22), $p < .001$, ΔCFI = −0.001, ΔRMSEA = 0.000, ΔSRMR = 0.000; and safety χ^2 difference = 138.25(Δdf = 8), $p < .001$, ΔCFI = −0.001, ΔRMSEA = −0.002, ΔSRMR = 0.000.

Descriptive Analyses

We conducted basic descriptive and correlational analyses on the final subscales, based on the wave 2 sample weighted to be reflected of the full student population within the participating 58 schools (Table 3). The results of the correlational analyses supported the hypothesized associations between the subscales. We also computed the ICCs at both the classroom- and school-level as derived from a series of unconditional models in order to examine the amount of shared variance at these 2 levels[49] (Table 3).

DISCUSSION

This study aimed to examine the fit of the USDOE's multicomponent model[5] of school climate, which is comprised of Safety, Engagement, and the Environment using a 56-item self-report instrument. We drew upon 2 waves of data collected from over 25,000 youth at 58 high schools. Our exploratory and confirmatory analyses demonstrated overall support for the 3 broad domains of school climate. Although there were some minor deviations between the observed subscales and those outlined in the USDOE model, our analyses generally suggested broad support for the USDOE model. Below we consider the findings from this study in greater detail, along with potential implications of the results for measurement of school climate.

Fit of the USDOE Model of School Climate

The final *safety* domain included indicators of bullying and aggression, perceived physical safety, and general drug use; the fit statistics and internal reliability measures all confirmed the 3-factor solution for safety. As expected, a central aspect of the school climate model was safety, which reflects students' fundamental need to feel safe in school.[21] Although previous research has used individual items assessing physical safety as the only indicator of perception of school safety, our findings suggested that bullying and substance also played a role in student perceptions of safety. These findings are consistent with prior research showing a link between bullying and aggression with poor school climate.[53] In addition, previous research has noted an inverse association between substance use and perceptions of school climate among high school students.[54]

The *engagement* domain comprised the majority of the items on the survey, including subscales pertaining to teacher connectedness, student connectedness, academic engagement, whole-school connectedness, culture of equity, and parent engagement. Many of the indicators of this domain have been extensively studied in the literature. For example, connectedness focuses on caring and respectful relationships, which in turn have been linked with academic outcomes and reduced risk for engagement in health comprising behaviors such as substance use, harm to self, and aggression.[55-58] In contrast to the well-researched construct of connectedness, there has been relatively limited research on the culture of equity and fairness. Yet, in this study, we found this to be an important indicator of student engagement. In fact, emerging research has shown that in schools where students perceive a better structured school, fair discipline practices, and more positive student-teacher relationships, the student behavioral problems are lower.[59] Last, parent engagement was also an important indicator of student engagement. It is widely recognized that students experience greater academic achievement, school engagement, and school adjustment when parents are engaged in their learning. For example, Simons-Morton and Chen[60] found that increased parent involvement had a positive effect on school engagement during middle school. Collectively, these indicators demonstrate the various dimensions of engagement as measured on the climate survey.

School *environment* also proved to be an important component of school climate. This domain was comprised of rules and consequences, physical comfort/cleanliness, emotional support, and disorder. Research demonstrates that providing school-wide expectations and behavioral violation consequences for students will create a supportive environment for them to succeed.[61] Schools that systematically implemented these practices show a significant decline in office discipline referrals, suspensions, and increases in student achievement.[62] The environment is further strengthened by teacher support and the availability of resources for students. For example, Wentzel et al[63] found that student academic motivation was positively associated with teacher emotional support. There is also evidence to suggest that evidence of physical disorder like broken windows, trash, and graffiti can create an environment of social disorder in schools.[6] When students perceive their environment to be in social disorder (ie, threatening, violent, or disruptive interactions among people within a school), they are less able to learn and be successful in school.

Measurement Invariance

With regard to the measurement invariance findings for sex, ethnicity, and grade level (Table 4), we found that the assumptions of measurement invariance generally held across all 3 scales of safety, engagement, and environment. These findings were robust across all 3 types of measurement invariance.[45-48] This suggests that the 3 overall scales were appropriate for use with both boys and girls, as well as across high school grade levels and student ethnicity.

Intraclass Correlation Coefficients

As reported in Table 3, in general the ICCs were slightly smaller at the classroom-level (eg, ICC = 0.03

for the Safety Scale) than at the school-level (ICC = 0.07). This is in contrast to prior work at the elementary level which suggested a higher proportion of shared variance at the more proximal classroom level.[64] A likely reason for this difference in the influence of the classroom is the fact that high school students change classes throughout the day, whereas elementary school students typically stay within the same classroom or travel as an intact cohort to different rooms throughout the day. Although there may be some shared variance associated with the class during which the MDS3 survey as administered (due to test conditions), that level of nesting appears to have been relatively modest. Taken together, our findings do suggest a fair amount of variance in high school students' ratings of school climate associated with the clustering of students within schools, rather than within classrooms.

Limitations

To keep the survey relatively short and efficient to administer, we restricted the number of items on each subscale. We attempted to use items from widely validated scales that succinctly encompassed that factor; this may have lowered the alphas for some scales, as scales with fewer items typically have lower alphas.[65] Because the climate survey is cross-sectional, more research is needed to understand the temporal association between these factors. Some may also question the association between the behavioral indicators and the attitudinal components of school climate. For example, substance use and bullying could be conceptualized as possible behavioral outcomes or behavioral predictors of school climate, rather than specific domains of school climate. This study included only high school students; thus, additional work is needed to determine if this measure demonstrates a similar factor structure and measurement invariance when completed by middle school and elementary school aged youth. Although we drew upon a relatively large set of geographically and ethnically diverse schools, the data were collected in a single state; further research is needed to understand if these scales operate similarly in other states. Given the primary purpose was to fit the USDOE's school climate model, we drew upon existing measures, rather than develop new items or instruments. Nevertheless, additional research examining the convergent, divergent, and predictive validity of the measure is needed. Because our study design necessitated the use of anonymous data collection procedures, we are unable to track student-specific changes across the years, or measure test-retest reliability; therefore, additional research is also needed to examine various aspects of reliability.

Conclusions

Taken together these 3 scales and their 13 subdomains provide a comprehensive and efficient tool for measuring school climate among high school students, largely consistent with the USDOE model. Whereas many surveys of climate currently exist, few have attempted to measure several different domains which have been linked to school climate in previous research. The current findings add to the growing body of research regarding the measurement of school climate and highlight the potential utility of the USDOE's model for understanding this important predictor of student achievement.

IMPLICATIONS FOR SCHOOL HEALTH

Due to federal and state reporting requirements, schools collect data on incident rates of suspensions, expulsions, criminal acts, drug use, violent activities, and weapons possession. However, these data are not collected in a systematic manner across districts and they rarely include student, staff, and parent views of school safety and climate.[66] The reauthorization of Elementary and Secondary Education Act will likely include an increased focus on the assessment of school climate and the use of school contextual data to make critical decisions regarding funding and school reform.[66] As such the MDS3 survey was designed to be used within a sustainable system to measure and improve school climate across Maryland. Decades of research show that schools with a positive school climate provide conditions for learning, which in turn translate into a range of academic and behavioral outcomes for students.

Although there is considerable variation in the definitions of school climate, the current findings provide evidence that safety, environment, and engagement are important dimensions to consider when measuring it. Whereas several surveys have been created to measure school climate, few are as comprehensive and concise at this survey. With just 56 items, the survey was adequately able to gauge youths' perceptions of the school environment. A comprehensive, but concise measure of school climate is needed for schools to begin to effect change in this area. With full and accurate measurement of student perceptions of school climate, districts and administrators can make data-based decisions about selecting evidence-based programs to create effective conditions for learning.

Human Subjects Approval Statement

This study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

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