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School Climate as a Universal Intervention to Prevent Substance Use Initiation in Early Adolescence: A Longitudinal Study

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Abstract

Initiation of substance use often starts during adolescence, with tobacco and alcohol use frequently preceding the use of marijuana and other illicit drugs. Studies suggest that a positive school climate may prevent substance use while promoting healthy student behaviors. The purpose of this study was to determine the longitudinal associations between school climate and substance use initiation in a group of middle school students. Parallel latent growth curve modeling was used to examine changes among study variables longitudinally using a sample of 2,097 sixth-, seventh-, and eighth-grade students across 16 regional schools located in three counties in West Virginia. Results suggest that a positive school climate may prevent substance use initiation ($\beta = -0.07$ to -0.25, $p < .01$). However, perceptions of school climate decreased on their own over time ($\beta = -0.28$ to -0.66, $p < .01$). Furthermore, substance use initiation also increased as students grew older ($\beta = 0.96$ to 0.99, $p < .01$) and reduced the effects of school climate longitudinally ($\beta = -0.07$ to -0.24, $p < .01$). Early substance use initiation may be a warning sign of other underlying student issues and requires additional school support to foster student success. Findings suggest that a positive school climate may delay substance use initiation and promote school success. School climate may, therefore, be useful as an intervention to support school-based health promotion.

Keywords

middle school, high school, parallel latent growth model, substance use prevention

Initiation of substance use, defined as "the first use of a particular substance" (Substance Abuse and Mental Health Services Administration, 2018, p. 21), often starts during adolescence, with tobacco and alcohol use frequently preceding the use of marijuana and other illicit drugs (Miller & Hurd, 2017). Nationally, alcohol continues to be the most commonly initiated substance by adolescents (62%; Johnston et al., 2018). While combustible cigarette use is at an all-time low (9% among eighth graders and 27% among 12th graders), electronic cigarette (vaping) use appears to be increasing, with 13.5% of early adolescents and 37.7% of young adults reporting initiation of substances.

Preventing adolescent substance use is essential to reduce the likelihood of drug-related disorders and health problems in adulthood (Caetano et al., 2014). Research suggests that schools may play an important role in substance use prevention (Sigfusdottir et al., 2011). Studies also suggest that a safe and supportive school climate may ameliorate the likelihood of substance use initiation (Cornell & Huang, 2016). Furthermore, schools that foster a positive school climate have shown to encourage healthy student behaviors (Durlak et al., 2011). In a recent review, Michael et al. (2015) not only advocated the importance of school climate as a protective factor to prevent risky student behavior like substance use but also highlighted the shortage of comprehensive evidence of the importance of school climate, especially over time.

A school's climate provides an important example of how a social-emotional environment can shape behavior

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(Allensworth et al., 2011). Although descriptions vary, our definition aligns with Cohen et al. (2009) who state, “School climate refers to the quality and character of school life. School climate is based on patterns of people’s experiences of school life and reflects norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures” (p. 182). Furthermore, the tenets of school climate research emphasize concepts like *teacher relationships*, such as bonding with teachers and peers; *order and safety*, such as respect for school rules; *academic engagement*, such as a sense of accomplishment and emotional investment with school; and *school connectedness*, such as attachment and building social bonds to school (Wang & Degol, 2016).

A positive school climate is important because formal education often occurs during critical stages of growth and maturity when negative experiences during these stages may develop into cycles of deviant behavior that may affect not only school performance but also transition into adulthood (Mann et al., 2016). Studies have found that school climate may reduce substance use, while promoting healthy psychosocial development and well-being (Ruus et al., 2007). However, empirical attempts to explain the relationship between school settings and substance use have been drawn primarily from cross-sectional studies (Wang & Dishion, 2012). Currently, the literature remains unclear regarding school climate’s longitudinal association and potential impact on substance use initiation (Wang & Degol, 2016).

School-based substance use prevention strategies have demonstrated success at reducing initiation within a multi-tiered system of support (MTSS; OSEP Technical Assistance Center on Positive Behavioral Interventions and Supports, 2017). MTSS may be defined as ‘‘an evidence-based model of education that employs data-based problem-solving techniques to integrate academic and behavioral instruction and intervention’’ (Eagle et al., 2015, p. 161; Gamm et al., 2012, p. 4). Delivery of MTSS in schools often follows recommendations outlined by the Institute of Medicine’s prevention and treatment of mental disorders guidelines (National Research Council & Institute of Medicine, 2009). Tiered models, by design, use progressive levels of treatment to improve the likelihood of positive outcomes (Durlak et al., 2011). In addition, tiers are integrated to supplement and support one another as a collective whole (Macklem, 2011).

Universal (Tier 1) strategies in tiered models are designed so every child receives the benefit of an intervention simply by being in school (Wilson & Lipsey, 2007). Universal strategies are often implemented in school settings and focus on students’ social-emotional learning to prevent problems like substance use and other deviant behaviors (Stanis & Andersen, 2014). For students who are deemed as “higher risk,” *selective* (Tier 2) provides targeted group-based strategies such as supplemental instruction, while *indicated* (Tier 3) uses intensive individualized approaches such as one-on-one behavioral counseling (Domitrovich et al., 2010). Although, this study does not measure or address MTSS directly, the framework should be acknowledged as many school districts across the United States are implementing MTSS in various ways (March et al., 2016).

Universal models that integrate health and education are gaining ground among school districts (Lewallen et al., 2015). A shared goal of school climate research has been to empirically highlight the complementary impact of nonacademic factors to support desired student outcomes (Piscatelli & Lee, 2011). Although components of school-based frameworks are likely to improve student outcomes, integrating measures of school climate to stimulate actionable steps for school personnel presents some challenges (Mann et al., 2018). Models like MTSS often require substantial preparation to establish a coordinated system of leadership and monitoring of framework activities (Bradshaw et al., 2009). Furthermore, perceptions of school climate have been empirically shown to decrease longitudinally starting in early adolescence (Holfeld & Leadbeater, 2017). A study by Niehaus et al. (2012) demonstrated declines in school connectedness among Midwestern sixth-graders, noting males to be at higher risk than females. Improving aspects of school climate, therefore, seems practical as part of universal (Tier 1) strategies because of its inherent potential to improve positive characteristics of the learning environment that affects all students without much alteration to system-level change. Nevertheless, aside from a few notable exceptions (see Sugai & Horner, 2006), interventions meant to promote and sensibly explain school climate as a potential Tier 1 intervention are relatively nonexistent.

The purpose of this study was to determine the longitudinal associations between school climate and initiation of licit substances and marijuana across three waves in a sample of middle school students. We hypothesized that (1) perceptions of school climate (i.e., positive teacher relationships) would decrease over time, (2) self-reported substance use initiation would increase over time, and (3) positive perceptions of school climate would significantly change students’ self-reported substance use initiation over time.

Method

Participants, Procedures, and Handling of Missing Data

Annual data collections occurred from 2015 to 2017 using clustered sampling techniques from evenly distributed groups of students in sixth (37.8%), seventh (32.5%), and eighth (29.7%) grades across 16 regional schools from three counties in West Virginia. The three West Virginia counties represented a triangulation of diverse population characteristics ranging from families living in severe isolation/poverty to those living in modest privilege/affluence (Appalachian Regional Commission, 2011-2015). All aspects of each annual collection were approved by the host university’s institutional review board (Protocols 2015 #1406345394, 2016 #1406345394R002, and 2017 #1406345394R004). In line with best practices recommended by Chartier et al. (2008), a letter was sent to parents to provide an opportunity to exclude their children (parental opt out rate $<1\%$). Surveys were administered by classroom teachers with oversight from a coordinator at each school to ensure delivery protocols. Participation was voluntary and made available to all students. Students were free to answer all or part of the survey and opt out at any time. For expanded details on data collection procedures, see Kristjansson et al. (2013).

In 2015 (T1), students at baseline provided 6,364 eligible observations (response rate = 82.6%). In 2016 (T2), students provided 6,336 observations (response rate = 82.0%). In 2017 (T3), students provided 6,278 observations (response rate = 81.3%). Data management and cleaning removed 507 observations due to a temporal violation of substance initiation from T1 to T3. Student data were then matched over time using a unique self-reported state administered identification number yielding a final sample of 2,097 retained cases (three observations per participant). With participant dropout rates being common in longitudinal studies, this level of attrition was anticipated (Gustavson et al., 2012). To ensure data quality and accuracy, omnibus tests under the unrestricted latent class indicator models (Little, 1988; Little & Rubin, 2002) for data missing completely at random were tested and shown to be nonsignificant (all ps $>$ .05). Preliminary tests additionally demonstrated less than 5% missing on dependent variables using pairwise techniques on retained cases, which has been shown to produce stable estimates (Marshall et al., 2010). However, because of the inclusion of covariates, we chose a more conservative route and assumed missing to be a function of missing at random (Little & Rubin, 2002). Missing data were then handled using full information maximum likelihood estimation (Mazza et al., 2015), which yields unbiased estimates under missing at random hypotheses and is often equivalent to imputation techniques (Cham et al., 2017).

Measures

Substance Use Initiation. Substance use initiation items asked participants: Have you ever "tried cigarette smoking, even just one or two puffs?," "tried electronic cigarettes (e-cigarettes or vapors), even just one or two puffs?," "had a drink of alcohol, other than a few sips?," and "tried marijuana (also called weed or pot) or hashish (also called hash or hash oil)?" Response options for all substance use initiation variables were binary with "no" (coded 0) and "yes" (coded 1).

School Climate. Students' perceptions of school norms, practices, and relationships were measured using three subscales (positive student–teacher relationships, order and safety, and opportunities for student engagement, 20 items) from the School Climate Measure (SCM). The three subscales were selected based on previous studies that demonstrated robust psychometric support for the SCM (see Zullig et al., 2010; Zullig et al., 2014; Zullig et al., 2015) and measurement invariance among early adolescents (Daily et al., 2018). SCM items use a 5-point Likert-type scale with response options "strongly disagree" (coded 1) to "strongly agree" (coded 5). Higher scores indicate a positive perception of school climate.

Covariates

Study covariates were chosen based on a review of school climate literature and supported with citations.

Biological Sex. Biological sex was assessed by asking respondents "Are you a boy or girl?" Male (coded 0) and female (coded 1) were represented as a dichotomous time-invariant covariate (see Marcenaro-Gutierrez et al., 2017).

Family Structure. Respondents were asked to indicate their family structure using a multiresponse question, "Which of the following persons live in your home?" For analysis, student responses were dichotomized into "lives with both biological parents" (coded 1) and "other arrangements" (coded 0) and represented as a dichotomous time-invariant covariate (see O'Malley et al., 2015).

Maternal Education. Maternal education was captured by asking students to select one of nine response options from a singular question, "What is the highest level of schooling your mother has completed?" Responses were pooled into categories to simplify analyses, "college graduate" (coded 3), "high school graduate" (coded 2), "less than high school" (coded 1), and "I don't know" (coded 0), and represented as a nominal time-invariant covariate (see Holmes et al., 2018).

Data Analysis

Descriptive frequencies, central tendency measures, scale internal consistency, and confirmatory factor analysis estimates were analyzed using SAS 9.4 (SAS Institute, 2013). Parallel latent growth curve modeling (PLGM) was selected to examine changes in school climate subscales and substance use initiation while controlling for sex, family structure, and maternal education over time (Cheong et al., 2003). All PLGM analyses were performed in Mplus 8.0 (Muthén & Muthén, 2017) using a two-tailed distribution ($p \leq 05$). Model specifications used the complex option to accommodate nonnormality and nonindependence of participants clustered in schools with robust standard errors and probit transformation (Masyn et al., 2014). Numerical integration was also used to account for latent binary and continuous dependent variable interactions between initial start points (intercepts) and growth trajectory (slopes). Latent substance use initiation intercept and slope residuals were constrained

Table 1. Sample Frequencies, Scale Means, Standard Deviation, and Reliability Coefficients, n = 2097.

	2015		2016		2017	
Variable	*n*	%	*n*	%	*n*	%
Biological sex						
Female/male	1138/950	54.5/45.5				
Race						
White/all other races	1817/280	86.7/13.3				
Maternal education						
College graduation/high school graduation	696/615	34.2/30.2				
Less than high school/not sure	146/581	7.2/28.4				
Family structure (lives with)						
Biological parents/other arrangement	1195/902	57.0/43.0				
Ever tried e-cigarettes						
No/yes	1784/67	96.38/3.6	1626/145	91.8/8.2	1530/313	83.0/17.0
Ever tried cigarettes						
No/yes	1796/56	96.9/3.1	1670/107	93.9/6.1	1619/228	87.6/12.4
Ever drank alcohol						
No/yes	1740/194	88.8/11.2	1397/433	76.3/23.7	1397/433	76.3/23.7
Ever tried marijuana						
No/yes	1789/31	98.3/1.7	1668/67	96.1/3.9	1625/200	89.0/11.0
Scale variable	*M* (*SD*)	α	*M* (*SD*)	α	*M* (*SD*)	α
Student-teacher relationships	3.6 (0.8)	.91	3.5 (0.9)	.93	3.3 (0.9)	.94
Order, safety, and discipline	3.8 (0.8)	.85	3.6 (0.9)	.88	3.5 (0.9)	.90
Student engagement	3.8 (0.8)	.86	3.7 (0.9)	.88	3.6 (0.9)	.89

Note. HS = high school. Missingness of observations due to pairwise techniques not reported. (Cronbach & Meehl, 1955).

to 1 and 0 to support model convergence (Muthén & Muthén, 2017). Intercept and slope means represent between-person initial starting points and growth. Standardized latent regression path estimates (β) and standard errors (*SE*) signify predictive relationships and practical importance between school climate and substance use initiation over time. Model fits were determined using the deviance statistic (−2LL, free parameters), Akaike information criteria, and Bayesian information criteria. Last, we ran sensitivity analyses for group comparisons on a sample of middle school students who did not move into high school (n = 818) and a sample of high school students (n = 471) in ninth and 10th grade.

Results

School climate subscale mean scores ranged from 3.3 (SD = 0.9) to 3.7 (SD = 0.8) from T1 to T3, with all scales reporting acceptable internal consistency (α = .85–.94). Additionally, confirmatory factor analyses across T1 to T3 demonstrated excellent measurement fits and ranged as follows: χ^2 = 929.17 to 950.61 (all df = 157, p = < .01), comparitive fit index (CFI) = 0.97 to 0.98, Tucker–Lewis index (TLI) = 0.96 to 0.97, standardized root mean residual (SRMR) = 0.02 to 0.03, root mean square error of approximation (RMSEA) = all 0.044 [± 0.041, 0.047]. Alcohol was reported as the most initiated substance ranging from 7.6% at T1 to 27.8% at T3. Electronic cigarettes (4.5% at T1 to 20% at T3), combustible cigarettes (4.1 % at T1 to 14.6% at T3), and marijuana (3.2% at T1 to 13.7% at T3) followed with similar trends. Additional descriptive statistics are reported in Table 1.

All results for PLGMs are described in Tables 2 through 4, with a conceptual model depicted in Figure 1. For reporting parsimony and clarity, please refer to Tables 2 through 4 for between-person intercept and slope means. Table 2 reports associations between student-teacher relationships and substance use initiation. Student-teacher relationship growth estimates between intercepts and slopes across all substance use initiation models ranged β = −0.26 to −0.66 (SE = 0.09-0.10, all ps < .01). Substance initiation βs for students' growth trajectories ranged from 0.92 to 0.99 (all SEs = 0.02, p < .01). Cross-lagged βs between student-teacher relationships on substance models ranged from −0.07 to −0.25 (SE = 0.01–0.04, all ps < .01). Cross-lagged βs for substance models on teacher relationships ranged from −0.16 to −0.20 (SE = 0.01–006, p < .01). Standardized covariance between intercepts ranged from −0.20 to −0.32 (SE = 0.05–0.08, all ps < .01).

Table 3 describes the standardized association between order and safety and substance use initiation models. Growth estimates for order and safety across all substance use initiation models ranged from β = −0.29 to −0.32 (SE = 0.10–0.11, all ps < .01). Substance initiation βs reported relatively consistent growth estimates and ranged from 0.95 to 0.99 (SE = 0.02–0.03, all ps < .01). Cross-lagged βs for order

Table 2. Parallel Latent Growth Model Intercepts, Slopes, and Unstandardized/Standardized Regression Estimates for Teacher Relationships, n = 2,022.

	E-cigarettes	SC1	Cigarettes	SC1	Alcohol	SC1	Marijuana	SC1
Parameter	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
Intercept	−2.45 (.23)**	3.51 (.06)**	−2.51 (.18)**	3.51 (.06)**	−2.50 (.18)**	3.51 (.05)**	−3.08 (.17)**	3.50 (.06)**
Slope	3.80 (.42)**	0.12 (.10)	3.68 (.33)**	0.11 (.11)	3.56 (.30)**	0.10 (.14)	3.83 (.23)**	0.58 (.09)**
Int.→ slope	1.42 (.20)**	−0.12 (.04)**	1.55 (.06)**	−0.11 (.04)**	1.13 (.08)**	−0.11 (.04)*	0.96 (.16)**	−0.29 (.02)**
SC1 X drug	−0.05 (.01)**	−0.22 (.04)**	−0.05 (.02)**	−0.19 (.03)**	−0.04 (.02)*	−0.18 (.03)**	−0.09 (.02)**	−0.28 (.06)**
Int. ↔ int.	−0.15 (.03)**		−0.17 (.04)**		−0.19 (.03)**		−0.20 (.06)**	
Std. est.	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Int.→ slope	0.99 (.02)**	−0.28 (.09)**	0.99 (.02)**	−0.29 (.09)**	0.96 (.02)**	−0.26 (.10)**	0.93 (.02)**	−0.66 (.04)**
SC1 X drug	−0.18 (.04)**	−0.10 (.02)**	−0.20 (.07)**	−0.07 (.01)**	−0.16 (.06)*	−0.10 (.01)**	−0.20 (.04)**	−0.25 (.05)**
Int. ↔ int.	−0.25 (.05)**		−0.28 (0.7)**		−0.31 (.06)**		−0.20 (.07)**	
−2LL(FP)	15904.81 (26)		15399.22 (26)		16461.02 (26)		15388.62 (25)	
AIC/BIC	15956.81/16102.72		15451.22/15597.13		16513.02/16658.93		15438.62/15438.92	

Note. −2LL = deviance; FP = free parameters; Std. est. = standardized estimate; SC1 = teacher relationships; Int. = intercept; AIC = Akaike information criterion; BIC = Bayesian information criterion. Estimates include covariate adjustment. School clusters = 16.
**p* < .05. ***p* < .01.

and safety on all substance models ranged from −0.07 to −0.17 (SE = 0.01–0.06, $p < .01$) and βs for substances on order and safety ranged from −0.09 to −0.20 (SE = 0.03–0.08, $p < .01$). Alcohol was the only exception (β = −0.09, SE = 0.05). The correlation between intercepts ranged from −0.29 to −0.37 (SE = 0.04–0.06, all ps < .01).

Table 4 summarizes βs between student engagement and substance use initiation. Student engagement βs between intercepts and slopes were significant and ranged from −0.09 to −0.37 (SE = 0.02–0.06, $p < .01$) Substance initiation growth models ranged from 0.96 to 0.99 (all SEs = 0.2, $p < .01$). All cross-lagged βs were significant for student engagement on substance use initiation and ranged from −0.07 to −0.15 (SE = 0.01–0.03, $p < .01$). Cross-lagged βs for substances on student engagement were all significant and ranged from −0.07 to −0.24 (SE = 0.01–0.03). The correlations between student engagement intercepts were all significant and ranged from −0.20 to −0.30 (SE = 0.04–0.07, $p < .01$).

Discussion

This study sought to determine the associated growth trajectories between school climate and adolescent substance use

Table 3. Parallel Latent Growth Model Intercepts, Slopes, and Unstandardized/Standardized Regression Estimates for Order and Safety, n = 2,023.

	E-cigarettes	SC2	Cigarettes	SC2	Alcohol	SC2	Marijuana	SC2
Parameter	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
Intercept	−2.27 (.26)**	3.72 (.07)**	−2.48 (.18)**	3.72 (.07)**	−2.49 (.19)**	3.72 (.06)**	−3.08 (.18)**	3.72 (.07)**
Slope	3.62 (.38)**	0.28 (.18)	3.80 (.35)**	0.28 (.18)	3.38 (.29)**	0.23 (.18)	3.86 (.24)**	0.38 (.17)**
Int.→ slope	1.38 (.09)**	−0.15 (.05)**	1.56 (.07)**	−0.15 (.05)**	0.97 (.08)**	−0.13 (.06)**	1.06 (.06)**	−0.15 (.05)**
SC2 X drug	−0.05 (.02)**	−0.22 (.04)**	−0.05 (.02)**	−0.22 (.06)**	− 0.02 (.02)	−0.21 (.04)**	−0.04 (.02)*	−0.28 (.06)**
Int. ↔ int.	−0.16 (.04)**		− 0.17 (.04)**		−0.20 (0.3)**		−0.18 (.04)**	
Std. est.	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Int.→ slope	0.99 (.02)**	−0.32 (.10)**	0.99 (.02)**	−0.32 (.10)**	0.98 (.11)**	−0.29 (.09)**	0.95 (.03)**	−0.32 (.10)**
SC2 X drug	−0.17 (.06)**	−0.09 (.02)**	−0.20 (.08)**	−0.08 (.02)**	−0.09 (.05)	−0.07 (.01)**	−0.15 (.07)*	−0.15 (.03)**
Int. ↔ int.	−0.28 (.07)**		−0.28 (.07)**		−0.37 (.04)**		−0.30 (.06)**	
−2LL(FP)	16069.51 (26)		15573.36 (26)		16632.91 (26)		15286.61 (26)	
AIC/BIC	16121.51/16267.43		15625.36/15771.28		16684.91/16830.83		15338.61/15484.53	

Note. −2LL = deviance; FP = free parameters; Std. est. = standardized estimate; SC2 = order and safety; Int. = intercept; AIC = Akaike information criterion; BIC = Bayesian information criterion. Estimates include covariate adjustment. School clusters = 16.
**p* < .05. ***p* < .01.

Table 4. Parallel Latent Growth Model Intercepts, Slopes, and Unstandardized/Standardized Regression Estimates for Student Engagement, n = 2,023.

	E-cigarettes	SC3	Cigarettes	SC3	Alcohol	SC3	Marijuana	SC3
Parameter	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
Intercept	−2.45 (.23)**	3.79 (.05)**	−2.49 (.17)**	3.79 (.06)**	−2.48 (.16)**	3.79 (.05)**	−3.12 (.18)**	3.79 (.05)**
Slope	3.91 (.41)**	0.34 (.12)**	3.82 (.25)**	0.33 (.11)*	3.36 (.23)**	0.37 (.12)**	3.85 (.29)**	0.33 (.13)**
Int. → slope	1.40 (.07)**	−0.18 (.03)**	1.56 (.07)**	−0.18 (.03)**	1.05 (.07)**	−0.17 (.03)**	1.29 (.09)**	−0.16 (.03)**
SC3 X drug	−0.06 (.01)**	−0.23 (.02)**	−0.07 (.02)**	−0.19 (.03)**	−0.04 (.02)**	−0.17 (.03)**	−0.03 (.02)**	−0.18 (.03)**
Int. ↔ int.	−0.13 (.03)**		−0.13 (.04)**		−0.17 (.02)**		−0.19 (.03)**	
Std. est.	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Int.→ slope	0.99 (.02)**	−0.36 (.06)**	0.99 (.02)**	−0.37 (.05)**	0.96 (.02)**	−0.35 (.06)**	0.97 (.02)**	−0.36 (.06)**
SC3 X drug	−0.20 (.03)**	−0.10 (.01)**	−0.24 (.05)**	−0.07 (.01)**	−0.12 (.05)**	−0.10 (.01)**	−0.17 (.06)**	−0.15 (.03)**
Int. ↔ int.	−0.20 (.05)**		−0.21 (.07)**		−0.30 (.04)**		−0.21 (.06)**	
−2LL (FP)	16023.09 (26)		15519.03 (26)		16588.87 (26)		15243.63 (26)	
AIC/BIC	16075.09/16221.02		15571.03/15716.95		16640.87/16786.79		15358.63/15358.95	

Note. −2LL = deviance; FP = free parameters; Std. est. = standardized estimate, SC3 = student engagement; Int. = intercept; AIC = Akaike information criterion; BIC = Bayesian information criterion. Estimates include covariate adjustment. School clusters = 16.
*p < .05. **p < .01.

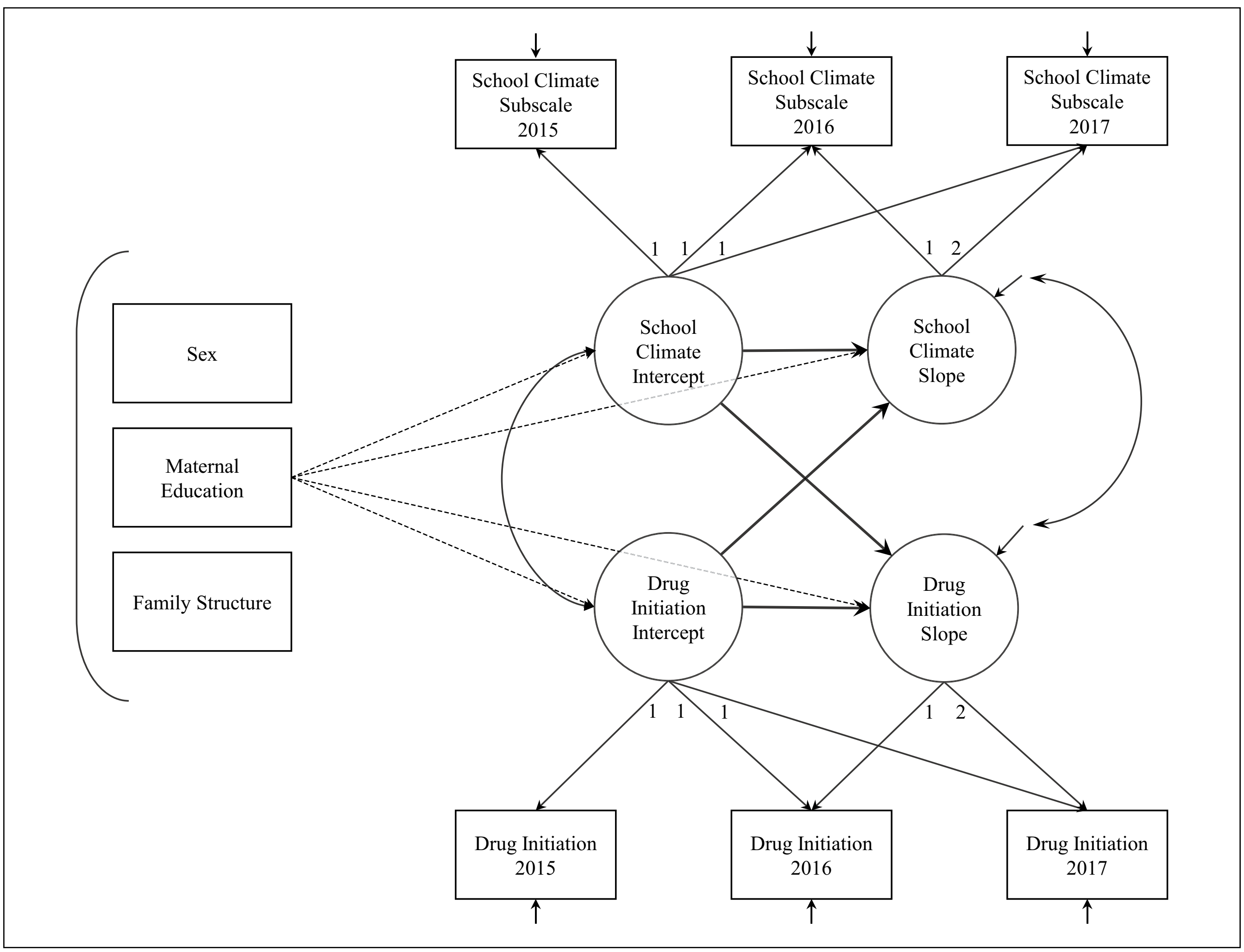

Figure 1. Parallel growth model for school climate and substance initiation.

initiation. Our results suggest a possible causal direction that supports the importance of a positive school climate to prevent substance use initiation. Analyses produced three main findings: (1) school climate may delay substance use initiation over time, (2) perceptions of school climate decreased over time, and (3) substance use initiation increased over time.

Regarding school climate specifically, positive student–teacher relationships presented slightly stronger effects than the other subscales across all models. Cross-sectional studies have consistently suggested that nurturing relationships between students and teachers is a salient factor that contributes to student outcomes (Zullig et al., 2015). A systematic review by Fletcher et al. (2008) outlined the importance of a school's culture and how it may affect drug use. Their review generally concluded that when students mutually respect and feel connected to school, they are less likely to use drugs. Our findings support their conclusion and suggest that a positive school climate may be important for the duration of schooling. Additionally, by reviewing the correlations between intercepts, we are better able understand how school climate affects substance use initiation between years. Our findings suggest that students who maintained higher perceptions of school climate at each time point were less likely to have initiated substance use between years.

Consistent with other studies (see Heilbrun et al., 2018; Niehaus et al., 2012), school climate subscales also decreased over time. This finding is important because if a positive school climate has the ability to delay substance use initiation, preserving or improving a positive school climate may be a goal on its own. This study's findings may also suggest that a "transition effect" may be present and may interrupt students' connection with school as they acclimate to a new environment (Madjar & Cohen-Malayev, 2016). Hence, perceptions of school climate may take on a new meaning as students get older. For middle school students, strengthening a positive school climate may entail promoting activities that improve bonding relationships and connectedness in school (Goodenow, 1993). For high school students, supporting academic focus and subject specialization as they prepare for adulthood may be more beneficial (Scott et al., 2014). This study's findings suggest a potential transitionary effect, but more studies are needed to better understand how school climate changes between middle and high school and how this may affect systemic outcomes.

As students grew older, the possibility of initiating any substance increased. This finding was anticipated given what is known about developmental impacts among at-risk youth (Mason et al., 2017). In addition, students who initiated any substance use demonstrated reduced perceptions of a positive school climate. As mentioned previously, student perceptions of a positive school climate may delay substance use initiation but decline over time as students grow older. Thus, substance use initiation may be an important indicator for students who require additional support (Briesch et al., 2017).

Lastly, group comparisons from sensitivity analysis revealed a few notable differences between a middle school only and a high school only sample. In the middle school only group, students who initiated either electronic or combustible cigarettes use at an early age presented stronger diminishing effects of perceptions of school climate, but school climate's impact on substance use initiation was also more substantial. However, without any influence from initiation of substances, high school students' perceptions of school climate demonstrated steeper declines over time. These findings support the position that there may be a difference in school climate's importance between middle and high school students. From a primary prevention point of view, our findings suggest that middle school may the best last time to intervene (Mann et al., 2016). This may hold especially true when considering school climate as a universal strategy in a MTSS framework. More research in this area is needed to better understand the relationships between school climate, substance use initiation, and potential group differences.

Limitations

First, our sample was obtained from a large group of mostly White middle school students from 16 schools in West Virginia. Findings may be limited in their representativeness to other regions of the United States. Nevertheless, the three counties sampled contain a spectrum of students who live in chronic rural poverty and report high rates of adolescent substance use that exceed national estimates (U.S. Department of Health & Human Services & Office of Adolescent Health, 2017). Second, the potential issue of nonmatched students may exacerbate the limited representativeness. However, the mechanism that may cause nonmatching may be difficult to distinguish. Fortunately, even when participant attrition is high, parameter estimates are still likely to be accurate (Gustavson et al., 2012). Third, student self-reported information is subject to acquiescence and recall bias. However, testing of similar risk factors such as substance use in cross-sectional and longitudinal studies have demonstrated strong accuracy with reliability coefficients ranging from .61 to .82 (Brener et al., 2002; Zullig et al., 2006). Fourth, substance use initiation measures were relatively unbalanced and may diminish precision. Modeling actual number or order categories of substances used may provide additional and/or alternative information for prevention research (Buu et al., 2012). Fifth, although a binary response option to indicate students' biological sex is common practice in school health research, including a measure that assesses multiple levels of gender may provide additional and useful information. Last, our study only modeled three aspects of school climate. The school climate literature is diverse and considers many aspects of the socio-organizational structures of schools. However, the three subscales chosen for this study are consistently used and found in other school climate studies.

Implications for Practice

Primary Finding 1. A positive school climate may delay substance use initiation.

Recommendation 1. School-based prevention frameworks like MTSS require continued research to better understand how nonacademic factors like school climate may influence desired student outcomes (Rooney et al., 2015). Preventing substance initiation at early ages will continue to be shaped by forces beyond the classroom, but as our findings suggest, what happens *in school* may affect what happens outside school. To better understand the complexity within school systems, future research should compare perceptions of school climate among substance initiators and noninitiators by using comprehensive student profiles.

Primary Finding 2. Positive perceptions of school climate appeared to decrease over time.

Recommendation 2. Based on what we have learned, bonding teacher relationships, respect for school rules, and positive motivation toward academics all seem to be important to students throughout school (Mann et al., 2018). Investing in school climate as a universal intervention may bolster new opportunities for schools to prevent substance use initiation (Resnick et al., 2012). In middle schools, it may be practical to select strategies specific to improving healthy student-teacher relationships that enhance classroom connectedness and reduce alienation (Blum, 2005). In high school, classroom instruction or programmatic policy that encourages preparation for adulthood may be more useful (Larusso et al., 2008). Although more research and practice-tested guidelines are necessary, how school climate information is used may support school-based policy and prevent less-than-ideal student outcomes.

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