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Characteristics of the School Setting and Health Outcomes Across the Lifecourse

By

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in

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in the

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Abstract

A substantial body of empirical evidence has found a connection between education and health. An emerging area of research interest is links between characteristics of school settings and health. An inductive case can be made: characteristics of the school setting, including school inputs, student body demographics, and school culture, are associated with educational attainment, which is, in turn, a key social determinant of health. This dissertation assesses the links between characteristics of the school setting and health outcomes directly.

The existing small evidence base assessing the association between class size reduction and student health outcomes is inconclusive. I conducted a quasi-experimental analysis to evaluate the impact of North Carolina's elementary class size reduction policy on student sedentary behavior, using an instrumental variables approach. I observed no association between class size and screen time (recreational television and/or electronic device use), after accounting for grade size and school size, year fixed effects, and clustering at the school and district level. These findings suggest that, in state-wide policy implementation settings, there do not appear to be any immediate spillover benefits of class size reduction policies on student health.

Little is known about the extent to which characteristics of the school setting are associated with health outcomes in adulthood, especially in recent decades. I analyzed data from a recent, nationally representative American cohort, the National Longitudinal Survey of Youth 1979 cohort, to explore this question. After adjusting for confounders, high school socioeconomic composition, but not racial/ethnic composition or dropout prevalence, was weakly associated with both obesity and poor self-rated health at age 40. However, after adding adult educational attainment to the model, only the weak association between high school socioeconomic composition and obesity remained statistically significant. Future research should explore possible mechanisms, and also if findings are similar for elementary and middle school composition. These results suggest that policies that seek to break the link between socioeconomic composition and negative outcomes, like Title I, remain important but may have few spillover effects onto health.

Researchers consider positive school climate to be multidimensional and essential for a supportive school setting. I systematically review the relationship between school climate and students' mental health in the K-12 grades. I identified 40 studies that examined the association between school climate and psychological functioning and met the eligibility criteria. The majority of studies used internalizing and/or externalizing symptoms as the outcome(s) of interest; measures of school climate were more heterogeneous. U.S. middle and high school populations were most frequently studied. Ninety percent of studies found an association between at least one measure of school climate and at least one domain of psychological outcomes. However, there was also room for potential single source bias, since most articles used student reports of both school climate and mental health, and potential residual confounding, since results sometimes differed depending on if the study was cross-sectional or longitudinal in nature.

In conclusion, it appears that some characteristics of the school setting are associated with some health outcomes, although it depends on the specific school setting constructs and health outcomes and the time point at which the health outcomes are measured.

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Introduction

Schooling is a formative component of Americans lives growing up; the only setting in which they spend more time is their home (Cohen, 2010). Yet high-quality school environments are unevenly distributed across the country, with schools serving low-income youth, youth of color, and urban youth being more likely to have “unsatisfactory” physical environments (Jones, Brener, & McManus, 2003). At the same time, public health researchers have found that education is a social determinant of health, but have focused primarily on the effect of educational attainment, rather than other dimensions of the educational experience (Cohen & Syme, 2013). Education researchers consider the educational experience to have many different domains. Here, I braid together the education and public health literatures to provide a background for understanding how the educational experience and health may interrelate.

While each individual student has his or her own experience as a student attending school, there are characteristics of the school setting and the educational experience that are shared across students attending the same school. While overall quality can be difficult to quantify, I argue that many indicators of quality can be operationalized into one of four categories: school inputs, school composition, school culture, and school outcomes. The majority of education policies focus on shaping school inputs (e.g., school finance policies (Verstegen & Jordan, 2009) and lawsuits (West & Peterson, 2007)), school composition (e.g., desegregation (Echenique, Fryer, & Kaufman, 2006)), or school culture (e.g., no excuses policies (Fryer, 2011)), with the end goal of shaping positive student outcomes.

School inputs. School inputs have been a subject of perennial interest, especially because these are the changes that can be addressed with money. One realm of school inputs is the teacher workforce; teacher salary (Figlio, 1997), teachers’ own educational attainment (Croninger, Rice, Rathbun, & Nishio, 2007), teaching experience (Rockoff, 2004), teacher certification (Goldhaber & Brewer, 2000), and professional development (Harris & Sass, 2011) are all often used to indicate quality, although evidence is mixed. More recently, value-added measures that seek to identify the effect of a particular teacher on student outcomes have risen in prominence but current approaches to estimating these measures have many flaws (Rothstein, 2010). Other domains of school inputs exist, including class size (often operationalized as student-teacher ratio) (Glass & Smith, 1979; Knudsen, Heckman, Cameron, & Shonkoff, 2006; Krueger, 2003), per pupil spending (Brasington, 1999), school resource adequacy (Grubb, Goe, & Huerta, 2004), and the physical quality of the school facility (Cellini, Ferreira, & Rothstein, 2010; Roberts, 2009).

School composition. In addition to the budget and facilities of a school, the composition of a school’s population is also relevant. School composition is often discussed in terms of race/ethnicity, socioeconomic position, and gender. From segregation to desegregation and to resegregation (Reardon, Grewal, Kalogrides, & Greenberg, 2012), the racial/ethnic make-up of schools has been a constant topic of education policies. These policies have included developing desegregation orders to comply with *Brown v. Board of Ed* and related lawsuits (Henderson, 2004) and busing (Mickelson, 2001). An additional body of literature has considered the implications of racial mismatch between faculty and students (Renzulli, Parrott, & Beattie, 2011). While the majority of school composition literature and policy may be focused on race/ethnicity, socioeconomic composition is also important and is associated with educational outcomes (Palardy, 2013). The percent of students eligible for free or reduced-price lunch is often used as an indicator of socioeconomic composition, but is nevertheless imperfect (Harwell

& LeBeau, 2010). In particular, students become eligible for free or reduced-price lunch either by income (less than 185% of federal poverty level) or participation in other programs (including having a foster child present or participating in federal financial assistance programs that have their own income eligibility criteria, such as TANF) (Harwell & LeBeau, 2010). A major education policy, Title I of the Elementary and Secondary Education Act (now called No Child Left Behind), acknowledges that socioeconomically disadvantaged students require more educational inputs, and identifies “Title I schools” (schools where $\geq 40\%$ of students are eligible for free lunch) to receive additional, compensatory resources (Diemer, Mistry, Wadsworth, López, & Reimers, 2012). Finally, a separate literature has focused on gender composition: in particular, single-sex education, with mixed evidence (Goodkind, 2012; Signorella, Hayes, & Li, 2013).

School culture. In comparison to school inputs and school composition, which are both relatively quantifiable, school culture is often much more difficult to measure quantitatively. School climate and culture speak to the collective, interpersonal environment of the school, including how students, teachers, administrators, parents, and other community stakeholders interrelate with each other (J. Cohen, McCabe, Michelli, & Pickeral, 2009). These interpersonal interactions can materialize in many domains, including vis-à-vis safe and supportive settings (Eliot, Cornell, Gregory, & Fan, 2010), classroom climate (Mitchell & Bradshaw, 2013), and teacher turnover (Loeb, Kalogrides, & Béteille, 2012). Student connectedness to the school (Waters, Cross, & Shaw, 2010) and student satisfaction with school (Samdal, Nutbeam, Wold, & Kannas, 1998) can follow.

School outcomes. School outcomes are often used as a barometer of quality by reflecting how inputs, composition, and culture interrelate to affect student outcomes. School outcomes are often measured using standardized tests, including the high-stakes standardized tests now ubiquitous in the era of No Child Left Behind (McGuinn, 2006). However, other metrics can be used, including high school dropout rates (Barile et al., 2012) and subsequent earnings in adulthood (Chetty, Friedman, & Rockoff, 2011). Notably, though, school outcome measures do not enable us to understand how exactly those other components interrelate, instead only summarizing their combined effect. Thus, it is instead better to think of these as long-term outcomes of interest.

One of my dissertation papers focuses on school inputs (elementary class size), one focuses on school composition (characteristics of the student body where the participant attended high school), and one focuses on school culture (school climate).

Links between the educational experience and health

Social class is a fundamental determinant of health and disease (Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004) and is associated with the persistence of health inequalities (Adler & Rehkopf, 2008; Link, Phelan, Miech, & Westin, 2008). One of several components that determine social class standing, education contributes to cumulative advantage (DiPrete & Eirich, 2006) across the life course (Ross & Wu, 1996), and is strongly associated with both morbidity (Cutler & Lleras-Muney, 2006; Fiscella & Kitzman, 2009; Goessling, 2007; Muennig, 2007; Yen & Moss, 2006) and mortality (Galea, Tracy, Hoggatt, Dimaggio, & Karpati, 2011; Muennig, Fiscella, Tancredi, & Franks, 2010; Wong, Shapiro, Boscardin, & Ettner, 2002; Woolf, Johnson, Phillips, & Philipsen, 2007). Formal education—from preschool to grade school to college and beyond—is also one of the social determinants of health for which there are clear policy pathways for intervention (Low, Low, Baumler, & Huynh, 2005; Steptoe et al., 2011; Woolf et al., 2007).

Uncertainty exists, however, as to the specific elements of education that are important in influencing health. The educational experience is a combination of both quantity and quality. The amount of education attained is the easiest of these components to measure (Muennig, 2007), and most research to date has focused entirely on educational attainment as a social determinant of health. But there are also many nuances, including the training of teachers, classroom interactions, and school environment. Additionally, the historical context of the study population matters as well: many researchers have found that there is interaction between educational attainment and race for health outcomes (Cohen, Rehkopf, Deardorff, & Abrams, 2013; Rohit et al., 2007), and it is possible that this is due to differences in school quality stemming from historical segregation (Johnson, 2010).

Among the most transformative educational policies in the last century in America was desegregation. Desegregation was associated with improved school quality for non-White students, which was in turn associated with self-rated health (Johnson, 2010), a measure of health that has been shown to be important in the prediction of future health outcomes (DeSalvo, Bloser, Reynolds, He, & Muntner, 2005; Jylha, 2009). For White students, no change in school quality or health outcomes was observed (Johnson, 2010).

Other state and district policies include class size. The educational and economic impacts of small class size have been summarized elsewhere (Glass & Smith, 1979; Knudsen et al., 2006; Krueger, 2003). In elementary school, class size appears to play a role. The Tennessee STAR study randomized elementary school students to different class sizes and provided persuasive evidence for the benefits of small class size policies including positive cognitive and academic outcomes and increased quality-adjusted life years (Muennig & Woolf, 2007); but paradoxically also increased early mortality (Muennig, Johnson, & Wilde, 2011). These conflicting findings merit further investigation and suggest the need to design studies to follow participants across the life course. However, the results of wide implementation suggests that small class size alone does not impact health if accompanied by lower educational quality (Finn & Achilles, 1999; Ritter & Boruch, 1999), which may also imply lower health impacts.

Other school-level policies and programs that have been introduced have a mixed and evolving research base. These include curricula and programming to promote positive school climate and school-level stated commitments to social and emotional development (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Kuperminc, Leadbeater, & Blatt, 2001; Loukas & Murphy, 2007; Loukas & Robinson, 2004). Growing evidence suggests that school facility quality and the school environment (Akom, 2011; Cohen, 2010; Mohai, Kweon, Lee, & Ard, 2011; Ozer, 2007) and school-based health centers (Clayton, Chin, Blackburn, & Echeverria, 2010; Low et al., 2005; Woolf et al., 2007) have positive educational and health benefits.

For other domains, the link to health outcomes has been hypothesized but not yet observed empirically. For example, parental engagement in elementary school (Jeynes, 2005; Link et al., 2008) and high school (Jeynes, 2007; Yen & Moss, 2006) is associated with student academic achievement, and parental engagement at home has implications for other health outcomes (Gilman, Kawachi, Fitzmaurice, & Buka, 2003; Shonkoff, 2011), so it is likely that parental engagement in school is also relevant for education as a social determinant of health but I found no systematic evidence to support this expectation.

In summary, different measures of the quality of the educational experience at different points in time have been found to be associated with different health outcomes, but these are often cohort-, time-, and context-specific.

Central research question

How does the quality of the educational experience affect health outcomes across the life course? Here, I define the quality of the educational experience as characteristics of the school setting, including school inputs, the composition of the students at the school, and the school culture.

For my first specific aim, I examine the association between North Carolina's class size reduction policy, as one type of school input, and *child health behavior*, using an instrumental variable approach.

For my second specific aim, I examine the association between high school student composition and *adult health outcomes* in the National Longitudinal Survey of Youth 1979 cohort, using regression.

For my third specific aim, I systematically review the literature on school climate and *mental health among students K-12*.

Rationale

Examining the relationship between different dimensions of the quality of the educational experience and three different health outcomes in three different nationally representative datasets from recent decades provides new perspectives and potential nuances to social epidemiology's current understanding of education as a social determinant of health. This knowledge could then be applied to identifying school characteristics that may confound and/or modify the effect of school-based health interventions, as well as for informing cost-benefit analyses of educational policies to address some of these dimensions of the quality of the educational experience. There are also implications for practice, including informing how school-based programs are targeted.

Class Size Reduction: Assessing Implications for Student Health Behaviors

Introduction

While many have studied the relationship between educational attainment and health, there is increasing interest in how characteristics of the educational experience may serve as independent social determinants of health. So far, as described below, three experimental analyses in a single, historic study population (Tennessee STAR) have considered the association between class size and health outcomes, with mixed results. The present study seeks to add new knowledge by applying a quasi-experimental design to a different, more recent state-wide population: students in the last decade in North Carolina public schools.

Class size reduction policy

Class size reduction is one of the American public's most preferred education policies (Mishel, Rothstein, Krueger, Hanushek, & Rice, 2002; D. E. Mitchell & Mitchell, 2003), and empirical evidence also suggests that it is beneficial for academic outcomes. In one of the most influential education experiments, the Tennessee STAR study randomly assigned elementary school students to smaller or larger classes. In this study, small classes were defined as 13-17 students, and large classes were defined as 22-26 students; these class sizes were maintained for four years (kindergarten through 3rd grade) (Nye, Hedges, & Konstantopoulos, 2000). Researchers analyzing these data concluded that class size was associated with improved K-12 academic outcomes (Krueger, 1999). However, as class size reduction policies became implemented in more wide-scale settings, questions arose regarding the extent to which the Tennessee STAR study was generalizable to non-experimental, scaled-up statewide settings (Mishel et al., 2002). Statewide class size reduction policies, which have tended to focus on grades K-3, have varied in class size goals (Chingos, 2013), but have almost all set class size goals at numbers greater than the small class size in the Tennessee STAR study.

A number of observational studies on class size have yielded both positive and null results on academic performance (Hanushek, 1997; Krueger, 2003). However, principals may make decisions when creating class sizes that could introduce and/or exacerbate confounding of the relationship between class size and student outcomes (including teacher quality and/or student quality). Therefore, quasi-experimental and experimental analyses are preferable. Natural experiments have taken advantage of quasi-random changes in the number of students in a grade and the implications for class size due to regulations in Connecticut (Hoxby, 2000), Israel (Angrist & Lavy, 1999), and Norway (Leuven, Oosterbeek, & Rønning, 2008), with mixed results: an inverse association between class size and academic outcomes was observed in Israel (which has a wide range of possible class sizes) and Norway but not Connecticut.

The vast majority of research on class size reduction policy has focused on academic outcomes (Chingos, 2013). A burgeoning literature using Tennessee STAR and observational data suggests that class size reduction is associated with increased earnings (Chetty et al., 2011), and employment (Wilde, Finn, Johnson, & Muennig, 2011) in adulthood.

Class size and health

There are many reasons why characteristics of the school setting could affect health outcomes. Briefly, social settings more generally are associated with health outcomes (Hawe, Shiell, & Riley, 2009; Trickett & Rowe, 2012; Tseng & Seidman, 2007), and the amount of time per day youth spend in school is second only to the amount of time they spend sleeping (BLS, 2015), suggesting that school is a particularly relevant social setting for youth. Additionally, the quality of the educational experience is associated with health outcomes across the lifespan

(Cohen & Syme, 2013). More specifically, it is plausible that class size has health benefits beyond the education and labor outcomes already documented through several possible pathways (figure 1). First, students in smaller classes report stronger engagement in their school (Dee & West, 2011). Increased school engagement is in turn associated with positive health outcomes (e.g., non-risky behaviors, psychological outcomes) in adolescence (Cleveland, Feinberg, Bontempo, & Greenberg, 2008; Witherspoon, Schotland, Way, & Hughes, 2009). For example, time spent on homework is sometimes used as a measure of school engagement (Dotterer & Lowe, 2011); increased homework time is in turn associated with reduced risky behaviors (Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2007) and reduced recreational electronics use (Vandewater, 2006), a marker of sedentary behavior (Rey-Lopez et al., 2012). Second, students in smaller classes display on average more pro-social behavior (Finn, Pannozzo, & Achilles, 2003), which in turn is associated with improved health (Carlo, Crockett, Wilkinson, & Beal, 2010). A third possible mechanism is that, in smaller classes, teachers may have stronger relationships with each student (Graue, Hatch, Rao, & Oen, 2007), and having a positive relationship with a non-parental adult is associated with positive youth development (Bowers et al., 2014), which is in turn associated with improved adolescent health (e.g., self-rated health, non-risky health behaviors) (Hoyt, Chase-Lansdale, McDade, & Adam, 2012).

The ideal designs to examine the relationship between class size and health are randomized controlled experiments and quasi-experimental designs. Only three papers have used either of these designs to date. All three used the experimental Tennessee STAR data, with death and disability in early adulthood as study outcomes. One study found no association between class size and disability status in early adulthood (age 18-28) (Wilde et al., 2011), while another reported higher mortality through age 29 among those who had been in small classes (Muennig, Johnson, & Wilde, 2011). However, these are both relatively rare outcomes for the age range assessed: the effect documented by Muennig et al. was based on fewer than 150 deaths. The third study combined estimates of the effect of class size reduction on educational outcomes from the Tennessee STAR data with information from other data sources to conclude that class size reduction could increase the probability of high school graduation, which could in turn increase the number of quality-adjusted life years (Muennig & Woolf, 2007). While these results are interesting, the literature requires new work because the evidence from these three papers is mixed and only comes from a single, less resource-constrained study population.

Study overview

In this study, I use a quasi-experimental design to examine the association between class size and health behaviors in a large-scale policy implementation setting. I use observational data from the most recent decade of students attending North Carolina public schools and quasi-experimental analysis methods to assess the impact of 3rd grade class size on sedentary behavior in childhood, using an instrumental variables approach (Angrist & Lavy, 1999).

The overall goal of the instrumental variables approach is to identify an instrument (in this case, expected class size) that is associated with the primary exposure of interest (in this case, observed class size) and could only be associated with the outcome of interest (in this case, student health) via observed class size, and there are no other variables that are associated with both the instrument and the outcome. In this study, my instrumental variable approach assumes that North Carolina's K-3 class size policy was implemented consistently. Since North Carolina's class size policy has sharp upper limits for class size, small natural variations in grade size can sometimes lead to drastic changes in class size. Given the empirical evidence to date

and the potential mechanisms outlined above, I hypothesize that smaller class size may be associated with reduced screen time, a measure of sedentary activity.

Policy background

North Carolina implemented their class size reduction policy program over several years, beginning in the late 1990s, with a confluence of legislative and judicial actions. In 1997, the North Carolina Supreme Court determined in response to an education adequacy school finance lawsuit that the state constitution required North Carolina to provide all children with a quality public education, and that this mandate was not currently met (Ness & Mistretta, 2009). Then, while running for election in 2000, soon-to-be-Governor-Elect Michael Easley called for reducing class size to an average of 18 students for elementary grades, with a focus on grades K-3. He continued to strongly advocate for this policy over his two terms in office (Associated Press, 2013a; Ness & Mistretta, 2009). Several bills were passed to help fund this initiative. The 2004 appropriations bill (House Bill 1414) provided full funding for class size reduction for kindergarten through 3rd grade (NMRS, 2004), and funding was renewed every year through 2013 (Associated Press, 2013b; Hui, 2013; Wagner, 2013). For the 2012-2013 school year, districts were funded to support one teacher for every 18 kindergarteners and for every 17 1st-3rd graders (Associated Press, 2013b). The 2013-2015 education budget passed in 2013 decreased the dedicated funding that supported reduced class sizes (Wagner, 2013), but the average maximum class size allowed remained the same (average of 21 students per class, and up to a maximum of 24 students per class for grades K-3) (NCDPI, 2014). Other streams of funding, including education-themed vanity license plates, had also helped support class size funding, but those funding streams no longer focus specifically on class size (Educ/Higher Educ Committee, 2014).

In addition to the appropriations funding, there was also money available through the state lottery. House Bill 1023, which created a state-run lottery to fund class size reduction in addition to other education-related activities, was passed and then-Governor Easley signed it into law in August 2005 (Ness & Mistretta, 2009). This act provided funding towards reducing class size to an average of 18 students in “early grades” (50% of lottery revenue was dedicated towards class size reduction and pre-kindergarten) (*North Carolina State Lottery Act*, 2005).

Concurrently, beginning in 1999, there was federal legislation (U.S. Public Law 106-113, section 310) that provided money to states to reduce class size in 1st-3rd grades to an average of 18 students per class. North Carolina distributed this money to school districts beginning in the year 2000, with funding levels determined by the number of children in poverty and the total number of students in the district. This then led to a subset of schools being able to have smaller classes; the Wake County district, which includes Raleigh, received \$1.6 million, which it sent to 23 schools, for the 2001-2002 academic year (Speas, 2003). North Carolina also used federal stimulus money beginning in 2009 to help pay for increased education personnel (Bailey, 2012).

Methods

Study population

This study uses student- and school-level data for third graders attending North Carolina public schools for the years 2005-2011. These years were selected because it was after the class size reduction policy was fully implemented and before funding cuts hampered policy implementation. Students were nested within schools and school districts.

For each school year, class size information was collected at the beginning of the school year, and health was measured at the end of the school year. Data from multiple school years are used to increase statistical power.

In order to ensure that each student was in the dataset only once, student data from test dates that were not at the end of the traditional (not year-round) school year were excluded (n=537 for “other” test dates and n=72,989 for test dates from year-round schools). Additionally, classrooms that were designated as special education (n=19,142 classes) were excluded from the analyses. I also further restricted classes that had implausible values for class size (fewer than 9 students (n= 12,796 classes) or higher than 39 students (n=20)).

These data were made available by the North Carolina Education Research Data Center (NCERDC), a partnership between Duke University and the North Carolina Department of Public Instruction. NCERDC provides de-identified, confidential data on all students in all North Carolina public schools and information about the schools themselves. The [University] Committee for the Protection of Human Subjects approved this research.

Instrument for class size

I adapt Angrist and Lavy’s (1999) instrumental variable approach using the Maimonides rule in Israeli schools as an instrument to the North Carolina context. This relies on annual fluctuations in the grade size (number of students per grade cohort) and the strict cut-offs for class size at the elementary school level, and assumes that the exact number of students per grade is quasi-random. (Quasi-random means that, while the number of students in each grade was not randomly assigned for the purposes of this study, the number of students in each grade is a product of natural variation.) Angrist & Lavy used Israel’s Maimonides rule that no class should be more than 40 students; I use North Carolina’s official education policy, which states that all kindergarten-3rd grade classrooms must be 24 students or less, and the average class size in the local educational authority must be no higher than 21. For example, for a grade size of 24 students, there would be expected to be one class of 24 students; if, however, there were a grade size of 25 students one year due to natural variation in birth cohorts, the school would now have two classes, with 12-13 students in each class. (Notably, this rule goes into effect after the first 40 days of school, and the state provides funding to the school districts to support an average class size of 18. However, special education classrooms tend to be smaller (Chingos, 2012) and also often use more funds and could lower the average class size district-wide.) In short, the instrument variable I use assumes that all North Carolina schools follow the state’s policy perfectly; in reality, they do not, and therefore the expected class size under the policy (the instrument used in this analysis) sometimes differs from the observed class size.

While schools are allowed to request waivers to these class size limits for reasons including “significant growth” in the number of students in a grade and school due to military or business movements or for reasons that would increase the number of students in a class by no more than 2 (NCDPI, 2014), North Carolina government documentation notes that waivers are granted rarely and all waivers have to be reported to the state’s General Assembly annually. The form to request a waiver is relatively simple and so would be easy for the schools to complete; that form also asks if the school has received a waiver in the past two years, suggesting that this does occur (see <http://www.ncpublicschools.org/docs/fbs/accounting/forms/waiver-class-size.pdf>). In the dataset, an average of 2.6% of 3rd grade classes across 2005-2011 report class sizes of larger than 24 students and therefore must have received a waiver. (The percent granted waivers each year ranges from 2.1% to 3.1%.) However, for the purposes of the instrument creation, I assume that no waivers are granted.

I calculated the number of students in each grade by using the reported number of students in each of the self-contained general elementary classes (state course code 0000) and calculating the sum of students across all of these classes for any given school in any given year.

I use the number of students in the grade to calculate first the expected number of classes given the number of students in the grade, by dividing the total number of students in the grade by 24, and rounding up to the nearest integer. Then, I calculate the expected class size by dividing the total number of students in the grade by the expected number of classes. Then, I restricted to only 3rd grade classes.

Health outcome

Using this instrument for class size, I look at sedentary behavior. As part of students' annual participation (beginning in 3rd grade) in end of grade tests, in addition to answering traditional academic questions, students also answer one question related to health behaviors: television (TV) watching and recreational electronics use.

Screen time is typically self-reported. A systematic review of studies concludes that children (defined as ages 3-18) report screen time relatively reliably and validly (Lubans et al., 2011) (for studies that reported correlation coefficients, correlation coefficients ranged from 0.68-0.80; for studies that reported intraclass correlation coefficients (ICCs), ICCs ranged 0.60-0.81; for studies that reported kappas, kappas ranged from 0.42-0.55); even though accuracy could be improved, children who are the same age tend to report screen time with a similar level of accuracy (Alexander, Wartella, & Brown, 1981; van der Voort & Vooijs, 1990). Student-reported TV watching in and of itself is associated with adverse health outcomes in adolescence (Hardy, Dobbins, Denney-Wilson, Okely, & Booth, 2009; Marshall, Biddle, Gorely, Cameron, & Murdey, 2004) and into adulthood (Hancox, Milne, & Poulton, 2004). Child-reported screen time has also been determined to be an effective proxy for sedentary behavior more generally (Rey-Lopez et al., 2012), and is inversely associated with time spent being physically active (Crespo et al., 2001).

Among children, a systematic review of the literature has found that sedentary time (most commonly measured as television watching) was inversely associated with aerobic fitness (Chinapaw, Proper, Brug, van Mechelen, & Singh, 2011), another systematic review found that television watching was associated with body fatness (Marshall et al., 2004), and others have found childhood television watching to be associated with obesity in childhood (Crespo et al., 2001) and adolescence (Hancox & Poulton, 2006). Weekday television viewing during childhood and adolescence is also associated with poorer health in adulthood, including higher body mass index (Viner & Cole, 2005) and lower cardiorespiratory fitness (Hancox et al., 2004), and lower educational attainment by adulthood (Hancox, Milne, & Poulton, 2005). There is also experimental evidence of the association between television watching and other media use and child health more generally: a randomized controlled trial among third and fourth grade students found that an intervention to reduce television and other screen time was associated with decreased BMI and other measures of body fatness (Robinson, 1999).

For the 2005 and 2006 survey years, students were asked about their time spent watching television (a question also used in NHANES' survey of children (Crespo et al., 2001)); from 2007 on, the question was expanded to ask about time spent using electronics, including TV, video games, and computers, recreationally. From 2005 through 2008, the response options were ordered categories of 0, ≤ 1 , 1-2, 2-3, 3-4, 4-5, and ≥ 6 hours/weekday. For 2009 through 2011, the ordered categories were 0, ≤ 1 , 1-3, 3-5, 5-10, and >10 hours/weekday. A continuous variable (hours of TV/recreational electronics use per weekday) was created by coding each

categorical response as the median response as needed (i.e., 0.5, 1.5, etc.), with the final response in the set coded as 0.5 more hours/weekday than the lower bound of the range (i.e., 6.5, 10.5).

Analytic approach

First, descriptive statistics were calculated, including means, medians, and frequencies. Then, I assessed the strength of the association between the instrument (expected class size) and observed class size using a regression equation of observed class size = intercept + β_1 *expected class size + β_2 *(vector of covariates) + error. A priori, a strong instrument was defined as having a t-statistic of at least 10. Several iterations of covariates were included in this regression model to assess what covariates, if any, might still be associated with both observed and expected class size and worth including in the instrumental variable regression model, even though this quasi-experimental design assumes that any variability in the instrument is due to chance (Campbell & Stanley, 1963). The covariates were all versions of the number of students in the grade (grade size) and the number of students in the school (school size); the overarching constructs were chosen a priori (Gershenson & Langbein, 2015) and then modeled flexibly (i.e., quadratic, cubic, reciprocal, and/or indicator variables).

Then, I assessed the relationship between my instrumental variable, expected class size and my outcome of interest, student health, accounting for clustering at the grade and school level and adjusting for covariates identified in the previous regression, leading to the following regression equation where i = district, j = school, and k =student: $\text{sedentary behavior}_{ijk} = \text{intercept}_{ijk} + \text{intercept}_{ij} + \text{intercept}_i + \beta_1 * \text{instrument for class size}_{ijk} + \beta_2 * \text{gradesize}_{ijk} + \beta_3 * \text{gradesize}_{ijk}^2 + \beta_4 * \text{gradesize}_{ijk}^3 + \beta_5 * (1/\text{gradesize})_{ijk} + \beta_6 * \text{schoolsize}_{ij} + \text{error}_{ijk} + \text{error}_{ij} + \text{error}_i$

Results

Instrument development

Table 1 comparing descriptive statistics for class size-related observations to calculations based on instrument implementation. The expected class size (per the instrument) was on average 1.1 students higher than observed. Almost all (96.9%) grades were within ± 1 classes between the observed and expected number of classes based on the instrument, and 71.4% of grades had the same number of classes observed as expected.

Figure 2 illustrates the expected class size, the instrument of interest, with the 25th, 50th (median), and 75th percentile class size values for each grade size. The instruments tracks relatively closely with the median and almost exactly with the 75th percentile, and the alignment is stronger for smaller grade sizes: it is almost exact for grade sizes under 100 and visually similar for grades sizes up to 200. (Due to a smaller sample size, there is much more statistical noise in the graphical depiction for grades of 200-300 students; figure available upon request.) Given that the average North Carolina elementary grade size is approximately 100 students, it is likely that the noise observed in the larger grade sizes may be due to a smaller number of observations, and so I restricted the sample to grades of 200 students or fewer.

Table 2 reports the results from regressing the expected class size on the observed class size to assess the strength of the instrument. In this table, the units of analysis are all third-grade classes from 2005-2006 through the 2010-2011 academic years. From these tables, I determined that it is worth including grade size, modeled flexibly with square, cube, and reciprocal terms included, school size, and school year in the models. The instrument's strength (as measured by the t-statistic; a general rule of thumb is that a t-statistic larger than 10 is considered strong) appeared to be robust to restrictions on grade size, and the inclusion of indicator variables for small and medium grade size. The results of the final row mean that for every 1-student increase

in expected class size (the instrument), there is an associated increase of 0.232 (95%CI: 0.193, 0.270) students, after accounting for grade size modeled flexibly (grade size, grade size squared, grade size cubed, the reciprocal of grade size, and indicator variables for small and medium grade size), school size, and fiscal year, after restricting to just those with a grade size of less than 200 students.

Study population descriptive statistics

Table 3 reports the descriptive statistics for the study population. On average, students reported 2.34 hours per weekday of TV watching or recreational electronic use. The average expected class size was 21.3 students, and the interquartile range was 20.25 to 22.75 students. The average grade size of 96.8 was approximately equal to the average elementary grade size of 100 reported by North Carolina. The student population was demographically diverse: approximately half of students identified as white, 27% were black, and 12% were Hispanic. Thirteen percent of students were eligible for free or reduced price lunch.

Analytic statistics

Table 4 reports the results of a three-level model assessing the relationship between expected class size and reported hours of recreational TV/other electronics use in the sample of 662,265 3rd grade students, after controlling for grade size (measured flexibly) and accounting for clustering at the local education authority (LEA), or district, level (188 LEAs) and at the school level within LEAs (1,378 schools). There is no statistically significant association between expected class size and TV watching after adjusting for grade size, grade size squared, grade size cubed, the reciprocal of grade size, school size, indicator variables for small and medium grade size, and year fixed effects, and accounting for clustering at the school and district levels.

Discussion

This quasi-experimental design is a novel, robust way to assess the association between class size and students' health outcomes. This study is the first to assess the association between class size and child health, and is externally valid to present-day statewide populations. While randomized controlled trials are often deemed even more robust than quasi-experimental designs such as instrumental variables analysis, randomized controlled trials are often implemented in highly restricted settings more removed from real-world policy dynamics, which exist in this study. The null association I found adds to the mixed evidence on the potential spillover health effects of class size reduction policies.

My analysis of data from North Carolina differs in several ways from the three health studies using Tennessee STAR data. These North Carolina findings likely reflect some of the externalities involved in state-wide implementation of a class size reduction policy, and are likely more generalizable to other real-world policy settings. Furthermore, the Tennessee STAR study defined small classes as 17 students, which, in North Carolina today, would be approximately 1-2 standard deviations lower than the mean observed class size, and so the frame of reference may not be as relevant to current policymaking. Additionally, most students in the STAR study received the same class size for four years (K-3), whereas I assess the effect of a smaller class size for just one year (3rd grade). These combined factors suggest that the studies that have estimated the health effects of class size reduction using Tennessee STAR data are estimating the effects of a more complicated and extreme class size reduction effort, but are also potentially less generalizable than my analyses here. The Tennessee STAR health studies looked at more severe outcomes (disability and mortality) than examined in this study, and in adulthood;

in that population, class size was not associated with disability and smaller class size was associated with earlier mortality. Adding the evidence from this North Carolina study suggests that elementary class size reduction policy does not appear to have any spillover benefits for health.

This study was both internally and externally valid. A quasi-experimental analysis is a rigorous way of estimating the impact of class size because it seeks to remove the potential for unmeasured confounding. The high t-statistic suggests that the instrument used in this instrumental variable analysis was strong. Nevertheless, I still maintained a conservative approach by accounting for other grade size and school size related variables that could be associated with expected class size and television and electronics use. For external validity, this study used a census sample of North Carolina public school students, ensuring that this study is certainly generalizable to North Carolina. I also argue that this study is more widely generalizable because it assesses the implementation of a class size policy similar to policies implemented elsewhere in the USA. Others have written about the externalities associated with class size reduction policies, which can include lowering selectivity when hiring teachers (Dieterle, 2015), and quasi-experimental studies, unlike externally funded experimental studies, have any of these effects built into the outcome data collected.

Nevertheless, there were also limitations. I was only able to look at the association between expected class size and student outcomes among third grade students since kindergarteners, 1st graders, and 2nd graders did not take tests and therefore had no student-level outcome data. In the first version of the question about television and electronics use, there was not a clear response option for any students who watched more than 5 but less than 6 hours of television or used other electronics per weekday, which made the question imperfect. All iterations of this question focused on television and electronics use during the week and had contiguous categories. While some may express concern about the utility of a child-reported measure of average screen time, it is a well-established measure that has been used over multiple decades and is associated with clinical metrics of health. Additionally, children report weekday screen time (what they reported in this study) more accurately than weekend screen time (Rey-Lopez et al., 2012), and the weekdays comprise the majority of the week. For the purposes of overall sedentary behavior, however, weekday and weekend screen time are correlated (Rey-Lopez et al., 2012). Nonetheless, self-reported screen time is also only a single measure of sedentary behavior (albeit one of the most commonly used measures), which is in turn only one health dimension. Additionally, this analysis did not account for the fact that some school districts had class size reduction policies that were more stringent than the state.

While class size reduction policies can be one way of achieving higher-quality education (Krueger, 1999), and a burgeoning body of research suggests that high-quality education may affect health (Cohen & Syme, 2013), it does not appear that this inductive case is supported by an empirical association between class size reduction and child health. Future research should examine other state-wide populations and pursue longer follow-up periods with more diverse health outcomes to determine if the benefits of multiple years of smaller classes accumulate and/or if any benefits are seen over a longer time frame.

High School Composition and Health Outcomes in Adulthood

Introduction

Myriad researchers have identified education as a key social determinant of health. However, the empirical research to support this claim focuses almost entirely on educational attainment; in general, the more education people attain, the more likely they are to be healthy (Adler & Rehkopf, 2008; Muennig, 2007; Yen & Moss, 2006). Education, however, is comprised of not only the amount attained (*quantity*) but also the *quality* of the education, including characteristics of the school setting. A recent review of research on education and health suggests that the quality of the school experience is relevant for health (Cohen & Syme, 2013). In recent decades, education researchers and practitioners have focused on policies to improve the school setting. For example, there is a long history of education policies focusing on school composition—primarily racial/ethnic, but also socioeconomic—with the goal of positive life outcomes for students. Little is known, however, about the extent to which such school setting characteristics, especially in the decades following court-mandated desegregation, are associated with health outcomes in adulthood (Figure 3). This paper investigates the relationship between the composition of the high school student body and health outcomes at age 40 in a recent, nationally representative American cohort.

School composition

Social epidemiologists—the branch of public health concerned with social determinants of health—have studied neighborhoods and health, yielding a rich literature investigating compositional effects, or the extent to which *aggregate* characteristics of neighborhood residents may be associated with health outcomes among individuals living in those neighborhoods (Diez Roux & Mair, 2010; Do & Finch, 2008; Ross & Mirowsky, 2008). Consistent with this social epidemiologic literature, the present study approaches the question of school compositional effects in the same way. Specifically, I consider to what extent high schools' racial/ethnic composition, socioeconomic composition, and academic composition may be associated with health outcomes in adulthood.

I first provide a conceptual and historical context for investigating these educational exposures. From segregation to desegregation and to resegregation, the racial/ethnic make-up of schools has been a major concern of education policies and debates (Echenique, Fryer, & Kaufman, 2006). In 1896, the *Plessy v. Ferguson* case presented the concept of “separate but equal” as a justifiable rationale for segregation; until *Brown v. Board of Education* in 1954, K-12 schools segregated by race/ethnicity were the norm, even though laws passed after the Civil War had begun the path towards desegregation in other arenas and in some states (Ravitch, 2001; Tyack, 1974). *Brown v. Board of Education* was a landmark case that prohibited *de jure* school segregation (that is, school segregation required by law), but several states were resisted desegregation policies into the 1960s (Ravitch, 2001). Desegregation was heavily contested in courts and in society more generally (Henderson, 2004). A variety of policies nationwide were implemented, including busing (Mickelson, 2001) and racial balance (Rothstein, 2013), to ensure that schools were no longer officially segregated by race. Some districts chose to take these policies a step further by actively encouraging integrated schools through policies like school assignment procedures that took race into account (Orfield, Frankenberg, & Garces, 2008). However, in more recent decades, the desegregation policies unraveled and schools are resegregating, or become more demographically homogenous (Orfield & Eaton, 1997). Resegregation is driven by *de facto* residential shifts that create more racially/ethnically

homogenous neighborhoods and/or school districts (Reardon, Grewal, Kalogrides, & Greenberg, 2012) and courts opting away from continued enforcement of desegregation policies (Orfield & Frankenberg, 2014). There is also increasing *de facto* socioeconomic segregation (Duncan & Murnane, 2011).

While the majority of school composition literature and policy may be focused on race/ethnicity, socioeconomic composition is also important and is associated with educational outcomes (Palardy, 2013). The percent of students eligible for free or reduced-price lunch is often used as an indicator of socioeconomic composition, but is not always reflective of income (Harwell & LeBeau, 2010). In particular, under the National School Lunch Program, students become eligible for free or reduced-price lunch either by income (less than 185% of federal poverty level) or participation in other programs (including having a foster child present in the home or participating in federal financial assistance programs that have their own income eligibility criteria, such as TANF) (Harwell & LeBeau, 2010). A major education policy, Title I of the Elementary and Secondary Education Act (ESEA), acknowledges that socioeconomically disadvantaged students require more educational resources, and identifies “Title I schools” (schools where $\geq 40\%$ of students are eligible for free lunch) to receive additional, compensatory resources (Diemer, Mistry, Wadsworth, López, & Reimers, 2012).

Aggregate student body demographics are not the only school composition characteristics that can affect student educational and developmental outcomes. A different measure of school composition more closely tied to academics is the proportion of students who leave school before graduation. Schools with low graduation rates have been termed “dropout factories” by some education researchers and practitioners and have been a source of concern among people working in education policy and education reform (Osgood, 2012). Dropout rates are correlated with aggregate academic performance at the school level (Glennie, Bonneau, Vandellen, & Dodge, 2012). At the individual level, dropping out of high school is associated with adverse outcomes including crime, as part of the “school-to-prison pipeline” (Cramer, Gonzalez, & Pellegrini-Lafont, 2014), and adolescent pregnancies (Marcotte, 2013).

These three school composition characteristics have been affected by historical trends and are meaningful for educational outcomes. This paper builds upon that foundation and focuses on any potential associations between those variables and health.

Social patterning of health

There are several possible reasons why school composition in high school could be associated with health outcomes in adulthood. Generally, the life course literature suggests that settings in childhood and adolescence are relevant for health later in life (Cohen, Janicki-Deverts, Chen, & Matthews, 2010). An inductive case for a link between high school composition and adult health could include mechanisms such as school climate, peer effects, and economic opportunities.

Conceptualizing and assessing health. Health can be framed as a global construct related to quality of life that can also be operationalized via anthropometric measurements of specific health characteristics. When considering the social patterning of health outcomes, it can be useful to see if similar trends emerge across different health outcomes, as would be suggested per the fundamental causes of disease theory (Link & Phelan, 1995). For the purposes of this paper, I focus on two: self-rated health, a global measure of health, and obesity, an anthropometric measure of a specific facet of health. In addition to being meaningful health outcomes themselves, they are also clinically significant harbingers of other adverse health outcomes. For example, both self-rated health (DeSalvo, Bloser, Reynolds, He, & Muntner,

2005; Idler & Benyamini, 1997; Jylha, 2009) and obesity (Flegal, Graubard, Williamson, & Gail, 2005; Guh et al., 2009) are strongly associated with morbidity and mortality.

Empirical data on social patterning. It has also been well-documented that there is a social patterning of both self-rated health and obesity, such that those with more education report better self-rated health (Subramanian, Kim, & Kawachi, 2002) and are less likely to be obese (Cohen, Rai, Rehkopf, & Abrams, 2013a). Race/ethnicity may modify the association between educational attainment and both self-rated health (Liu & Hummer, 2008) and obesity (Cohen, Rehkopf, Deardorff, & Abrams, 2013b). When race/ethnicity modifies the association between educational attainment and other health variables, that may reflect differences in educational quality (Cohen & Syme, 2013); an alternate explanation is that education leads to more social mobility and opportunity for people of some races/ethnicities more than others for both men (Bloome & Western, 2012) and women (Maralani, 2013). This paper explores the potential role of educational quality.

However, I identified only three studies that examined the relationship between measures of the educational experience and adult self-rated health. In one quasi-experimental study of children born in the 1950s-1970s who lived in US communities that had segregated schools, court-ordered desegregation was associated with improved school quality for non-White students, which was in turn associated with self-rated health in adulthood (Johnson, 2010). For White students, no change in school quality or health outcomes was observed (Johnson, 2010). Among children born in the 1950s in Scotland, those who attended primary schools where a higher proportion of students' fathers had professional and managerial jobs reported better self-rated health approximately forty years later (Dundas, Leyland, & Macintyre, 2014). More recently, in the U.S. National Longitudinal Study of Adolescent Health (Add Health), where students attended high school in the mid-1990s, school socioeconomic composition was associated with self-rated health, and the association between school racial/ethnic composition and self-rated health varied by race/ethnicity (Goosby & Walsemann, 2012). However, this study did not adjust for individual-level measures of childhood socioeconomic position. To the best of my knowledge, no research has focused on adult obesity as an outcome, but a 2004 survey of adolescents found that school racial composition was associated with BMI cross-sectionally among girls only (Bernell, Mijanovich, & Weitzman, 2009).

Potential pathways for social patterning of health. There are several possible pathways by which high school socioeconomic composition, for example, could affect adult health outcomes (figure 2). School climate is one possible mechanism: teachers at schools with a more socioeconomically disadvantaged student body report poorer school climate (Jain, Cohen, Huang, Hanson, & Austin, 2015), and school climate is inversely associated with BMI in preadolescents (Gilstad-Hayden et al., 2014), and adolescent overweight and obesity is associated with obesity and other negative morbidity and mortality outcomes in adulthood (Park, Falconer, Viner, & Kinra, 2012; Reilly & Kelly, 2011). Peer effects are another possible mechanism. Since youth from lower-income families have, on average, poorer health and are more likely to be overweight and obese, schools with a higher proportion of lower-income students also likely have a higher proportion of students with overweight and obesity and poorer general health. The peer effects literature finds that people have similar health behaviors and health outcomes to their peers (Christakis & Fowler, 2007; Pachucki & Goodman, 2015). And the life course literature suggests that health outcomes in adolescence affect health in adulthood (Bauldry, Shanahan, Boardman, Miech, & Macmillan, 2012; Raphael, 2013; Sawyer, Afifi, Bearinger, & Blakemore, 2012). Additionally, simply by high school composition affecting

students' academic outcomes contemporaneously (Caldas & Bankston, 1999; Ryabov, 2011), those high school academic outcomes are then associated with education and labor outcomes in early adulthood, including college enrollment (Engberg & Wolniak, 2014), college graduation (Niu & Tienda, 2013; Roderick, Coca, & Nagaoka, 2011), employment (Hout, 2012), and income (Hout, 2012), which are in turn associated with self-rated health (Hudson, Puterman, Bibbins-Domingo, Matthews, & Adler, 2013; Meyer, Castro-Schilo, & Aguilar-Gaxiola, 2014) and obesity (Cohen, Rai, Rehkopf, & Abrams, 2013a; Cohen, Rehkopf, Deardorff, & Abrams, 2013b; McLaren, 2007).

A handful of other studies have considered how school composition may relate to other health outcomes. One study found a cross-sectional association between physical activity and both school-level median household income and racial/ethnic composition in Add Health adolescents (Richmond, 2006). Two studies have considered school racial composition and depression among Add Health participants. In this population, school racial composition is associated with depressive symptoms in adolescence cross-sectionally (Walsemann, Bell, & Maitra, 2011b) and also into early adulthood (Walsemann, Bell, & Goosby, 2011a) for blacks. And in a cohort of older African American adults born in the 1930s-1950, attending desegregated (as opposed to segregated) schools was associated with lower sense of control and poorer physical performance (Wolinsky et al., 2012). The current small body of research suggests that it is worth continuing to explore any potential associations between school composition and health, especially in a national sample that can control for childhood socioeconomic position.

Interaction between individual and school characteristics

It is also worth considering if individual demographic characteristics interact with school-level demographic characteristics to affect health outcomes. For example, individual race/ethnicity or socioeconomic position may modify the association between these high school student body composition characteristics and the adult health outcomes. While some have found no difference in the relationship between school composition and student educational outcomes by individual socioeconomic status (Rumberger & Palardy, 2005), others have found that both individual and group-level socioeconomic position are associated with health outcomes (Rundle et al., 2012), and so it is possible that these different levels could interact.

Rationale for present study

Here, I investigate the association between racial/ethnic composition, socioeconomic composition, and academic composition of the high school study participants attended with their self-rated health and obesity at age 40. I also investigate the extent to which these associations are modified by individual-level race/ethnicity and socioeconomic position. As described earlier, the three school composition variables were chosen for their relevance in education history and policy, and the two health variables are two conceptually different, clinically relevant, socially patterned constructs.

Methods

Data source

The National Longitudinal Survey of Youth 1979 cohort (NLSY) is a prospective longitudinal cohort study conducted by the USA's Bureau of Labor Statistics (CHRR, 2008). Using a complex multistage sampling approach, it recruited 14-21 year-olds in 1979 from randomly sampled households and has followed them prospectively since. This manuscript uses data through 2010. Seventy-six percent of the original cohort were alive, eligible, and continuing

to participate in 2010; excluding those who were deceased, the proportion retained was 80.6% (NLS, 2015). Some demographic groups of interest were oversampled; with weighting, the study was designed to be nationally representative (CHRR, 2008). The data used were de-identified and publicly available over the Internet; thus the [University] Institutional Review Board deemed these analyses exempt from review.

The sample size for calculating each of the odds ratios varied due to missing data; the smallest sample size used for the purposes of calculating an odds ratio was 3,704 (for model 3 for percent disadvantaged and obesity). This is 49.0% of those who were still participating in 2010 ($n=7565$), and 29.2% of the original sample ($n=12,686$). This level of attrition is relatively common for comparable longitudinal cohort studies (Cohen, Rehkopf, Deardorff, & Abrams, 2013b), and research suggests that the attrition in the NLSY would only bias estimates of associations between social factors and health towards the null (Quesnel-Vallée & Taylor, 2012).

School composition

School administrators reported high school characteristics. I identified three composition characteristics for this analysis: the percent of students classified as economically disadvantaged per National School Lunch Program guidelines, the percent of students who were White (given that the distribution of minority groups differs across the US, this was the most consistent way to consider the presence of minority students nationwide), and the percentage of students who entered 10th grade at the school but subsequently dropped out. (Dropout after 10th grade is used because typically students are not legally permitted to drop out before age 16, which typically occurs in 10th grade.)

Health outcomes

Individuals self-reported their health outcomes at age 40 or 41. Self-rated health was an ordered categorical variable. At age 40, participants rated their health on a 5-point Likert scale: as excellent, very good, good, fair, or poor. Although self-rated health is a very generic question, it has been found to be a very strong predictor of future morbidity and mortality (DeSalvo et al., 2005; Jylha, 2009), and is interpreted consistently across multiple subgroups (Burström & Fredlund, 2001; Chandola & Jenkinson, 2000).

Obesity was a binary variable, calculated as age 40-41 body mass index (BMI) ≥ 30 , where BMI = weight in kilograms / (height in meters, squared) (Committee, 1995). Obesity is often used instead of BMI as a continuous measure because it has greater clinical implications for morbidity (Visscher & Seidell, 2001) and mortality (Flegal et al., 2005). In the NLSY, BMI was calculated from regression-calibrated self-reported weight and height based on NHANES data of measured and recalled weight and height (Strauss & Thomas, 1996; Thomas & Frankenberg, 2002).

Analytic approach

I calculated odds ratios using logistic regression (obesity) or ordered logistic regression (self-rated health) in Stata 11.2, accounting for sampling design with survey weights.

I ran three models for each health outcome. The first model reported the results from a bivariate regression analysis (adjusted for no covariates). The second model adjusted for potential confounding variables: maternal and paternal educational attainment, childhood residential geography (urbanicity, growing up in the South), race/ethnicity (black, Hispanic, white), gender, birth year, and if the individual spoke a foreign language at home as a child. The third model adjusted for the same variables as model 2 and also adjusted for educational attainment at age 25 as a possible mediator (Baron & Kenny, 1986).

I also tested for interaction by two individual-level variables separately: race/ethnicity and socioeconomic position (as measured by maternal educational attainment, as a categorical variable of less than high school graduate, high school graduate but not college graduate, and college graduate or more). I added interaction terms to new models that adjusted for all of the variables in model 3. Since interaction analyses are typically underpowered (Selvin, 2004), I used an a priori p-value cutpoint of $p < 0.1$ to assess significance.

Results

Overall population

Out of the 7,961 respondents with information about both high school characteristics and self-rated health, 21.6% rated their health as excellent, 37.3% as very good, 27.9% as good, 11.0% as fair, and 2.2% as poor. In general, both those who were obese at age 40 and those with poorer health went to high schools with less advantaged student bodies, had less highly educated mothers and fathers, and had lower educational attainment themselves at age 25. More information about the distribution of characteristics is available in table 5.

Self-rated health

All of the ordered odds ratios for associations between measures of high school student composition and self-rated health were quite close to the null (table 6). While all of the bivariate ordered odds ratios (model 1) were statistically significant, after adjusting for confounders (model 2), no associations remained statistically significant. For all three school composition variables, the point estimates moved slightly closer to the null from model 1 to model 2, and the confidence intervals for model 1 and model 2 for each are mutually exclusive, suggesting that the covariates included in model 2 confound the associations of interest. In Model 3, after accounting for educational attainment at age 25, none of the ORs were significant.

Although there were no significant main effects after adjusting for childhood socioeconomic position and demographic confounders, I still tested for the interaction terms I had hypothesized a priori, since null main effects can mask significant associations in certain demographic subgroups. Interaction results were mixed.

For the association between the percent of students who were disadvantaged and self-rated health, there was a significant interaction by race/ethnicity ($p = 0.08$ for the set of interaction terms), implying that the association varied by race/ethnicity. However, each race/ethnicity-specific ordered OR was null (ordered OR for non-black non-Hispanics: 0.98 (95%CI: 0.96, 1.01); ordered OR for non-Hispanic blacks: 1.02 (95%CI: 0.99, 1.04); ordered OR for Hispanics: 1.02 (95%CI: 0.98, 1.06)). The student disadvantage- self-rated health association did not appear to vary by maternal education ($p = 0.67$).

For the relationship between student racial/ethnic composition and self-rated health, there was no significant interaction by individual race/ethnicity ($p = 0.51$) or maternal education ($p = 0.22$).

For the association between the percentage of students who dropped out and self-rated health, there was significant interaction by race/ethnicity ($p = 0.01$), such that ordered odds ratios for a five percentage point change remained null for whites (ordered OR: 0.99, 95%CI: 0.97, 1.01), but was significant at the $p = 0.05$ level for both blacks (ordered OR: 1.03, 95%CI: 1.00, 1.06) and Hispanics (ordered OR: 1.06, 95%CI: 1.01, 1.11). This means that for blacks and Hispanics, an increased proportion of students who dropped out was associated with increased odds of better self-rated health. Maternal education did not significantly modify this association ($p = 0.44$).

Obesity

From model 1 to model 2, the point estimates all moved closer to the null, suggesting that it is necessary to adjust for the covariates included in model 2 since they appear to confound the associations. After adjusting for potential confounders (model 2), no associations remained significant; the same was true after adding educational attainment at age 25 to the model (model 3) (table 7).

Despite no statistically significant main effects, I still investigated possible effect measure modification by individual-level characteristics. Neither race/ethnicity ($p=0.43$) nor maternal education ($p=0.66$) modified the association between percent of disadvantaged students in the high school and obesity at age 40; this was also true for the association between percent of 10th grade students who dropped out ($p=0.19$ for race/ethnicity; $p=0.92$ for maternal education). Further, there was no interaction by race/ethnicity found for racial/ethnic student composition ($p=0.42$), but there was an interaction by maternal education ($p=0.03$). Results from this interaction analysis suggested that among those whose mothers had graduated from college or beyond, a five percentage point increase in the proportion of the high school student body who were white was inversely associated with obesity at age 40 (OR: 0.97, 95% CI: 0.94, 1.00 ($p=0.04$)). There was no association for individuals whose mothers graduated from high school but not college (OR: 1.00, 95% CI: 0.98, 1.02) or whose mothers did not graduate from high school (OR: 1.00, 95% CI: 0.98, 1.02).

Discussion

This study used a U.S. national longitudinal cohort (NLSY79) to investigate the relationship of high school composition to key dimensions of adult health—self-rated health and obesity—controlling for key demographic and educational variables such as maternal and paternal educational attainment, childhood residential geography, gender, birth year, and speaking a foreign language as a child. The purpose of controlling for so many individual-level demographic and socioeconomic variables was to provide one of the most rigorous examinations to date of the relationship between high school composition and adult health in a nationally representative sample of Americans. While a large body of literature has documented associations between high school student composition and educational outcomes, there do not appear to be substantial spillover effects of high school composition for adult health, especially after controlling for the rich set of confounding variables included in my analyses.

All of the odds ratios for the associations between high school composition variables (racial/ethnic composition, socioeconomic composition, percentage of students who dropped out) and health (self-rated health, obesity) were null or close to the null. For self-rated health, while all bivariate associations were statistically significant, there were no longer any statistically significant main effects associations after adjusting for confounding. There was some effect modification by race/ethnicity and/or maternal education for the different high school composition variables; for both Blacks and Hispanics, an increase in the proportion of 10th grade students who dropped out before graduating was weakly but significantly associated with improved self-rated health. For obesity, the percent of students classified as disadvantaged was significantly, though weakly, associated with obesity at age 40, even after adjusting for educational attainment at age 25. The other student body composition characteristics were not statistically significantly associated with obesity after adjusting for covariates. Although there was no main effect between racial/ethnic school composition and adult obesity, there appeared to be effect measure modification by maternal education: in particular, only among individuals

whose mothers graduated from college, there was a significant, inverse association between percent of students who were white and obesity.

This study responds to calls by social epidemiologists studying neighborhoods and health to also consider how the school setting may relate to health (Diez-Roux, 2008), as well as those by life course epidemiologists suggesting the importance of adolescent experiences for health outcomes later in life (Viner et al., 2015). My findings suggest that any direct associations between high school student composition and health do not persist or persist only weakly into middle age. More specifically, this study builds upon others' findings that court-ordered racial desegregation had beneficial health outcomes (albeit only for blacks) (Johnson, 2010) and that socioeconomic position is of growing importance for education outcomes (Duncan & Murnane, 2011). In this population, it appears that socioeconomic student body composition may now be more relevant for health outcomes than racial/ethnic composition. The Scottish study that also examined school socioeconomic composition with a similarly long follow-up period (Dundas et al., 2014) found similarly weak but significant associations.

A major strength of this study is the analysis of a diverse, nationally representative cohort with over two decades of follow-up. Additionally, I was able to control for a rich set of socioeconomic variables from across the life course, to help isolate the role of school composition. I also had high-quality measures of school composition, because they were based on direct school administrator reports, rather than study participant recall or proxy measures like neighborhood composition. However, there were also limitations. Obesity was based on self-reported height and weight; to help address possible reporting bias, I used regression calibration to account for known ways in which Americans systematically misreport these measures. School composition could affect student outcomes through many possible pathways (figure 4). I encourage future researchers to explore possible mechanisms more comprehensively and also utilizing diverse analytic techniques. I also only had information about the high school student body, and not their elementary and/or middle school experiences. Future researchers could assess the extent to which the composition of participants' elementary, middle, and high schools may have different implications for health. Similarly, I only had school-level composition variables, when classroom composition may also be related to adult outcomes in more nuanced ways. For example, schools that are diverse at the school level may have tracking such that students go through school in classes that are much more homogeneous (Maran, 2000), and this within-school segregation may have implications for health (Walsemann & Bell, 2010). Additionally, the observational data also limited my ability to make causal inferences. While natural experiments existed to assess the health effects of desegregation through quasi-random timing of court decisions (Johnson, 2010), the trend of resegregation has happened more perniciously and less systematically over time, making it more difficult to isolate possible natural experiments. I encourage future researchers to identify creative natural experiments in the current context to further explore this question.

Results were relatively consistent across both obesity and self-rated health, suggesting that this may be illustrative of the relationship more generally between school composition and health. For both health outcomes, studied associations were weak, and no main effects were statistically significant after adjusting for confounding. For both self-rated health and obesity, I observed interactions between individual-level variables and school composition, although they did not appear consistently across health outcomes. The interaction findings for self-rated health were unexpected. The literature suggests that historically marginalized students, like students of color, would be more negatively affected by negative school characteristics because they have

fewer resources to counteract these negative effects in their home and community environments (Duncan & Murnane, 2011). However, I found that the proportion of students who dropped out from a participant's school was associated with improved self-rated health in adulthood for blacks and Hispanics only. This finding merits further inquiry and replication in other datasets to determine if this was due to chance or provides new insights regarding the complexity of the effects of cumulative disadvantage.

Education policymakers have already identified economic disadvantage as an issue for educational outcomes, and developed policies like Title I and free and reduced-priced meals to attempt to target this population. The findings of the present study suggest that high school composition may play a small role in the link between schooling and health outcomes that persist into adulthood, but that this question requires further investigation in other national cohorts.

School Climate and K-12 Student Mental Health: A Systematic Review

Introduction

School climate has been defined as the “heart and soul of a school” (Freiberg & Stein, 1999, p. 11). It is a key component of the learning environment (Freiberg & Stein, 1999). Given that youth typically spend at least 6 hours per day in schools (Bureau of Labor Statistics, American Time Use Survey results, 2011), second only to the amount of time spent sleeping, and the importance of social settings for mental health, it follows that the school environment is a particularly important setting to consider (Trickett & Rowe, 2012). Despite considerable debate and research regarding school climate over the past century, thus far there has been no systematic review that specifically considers the association between school climate and students’ mental health. This paper seeks to address this gap in the literature, focusing on K-12 populations.

This review seeks to synthesize the existing interdisciplinary literature on the topic to provide the field with a synopsis of the associations between school climate and mental health. I begin by conceptualizing school climate and mental health, and then move to considering theories and empirical evidence for possible pathways linking school climate and mental health in the literature. I then report on my systematic search for identifying articles, reporting the results, and discussing conclusions and implications.

Positive School Settings

Conceptualization. For the past century, defining school quality has been the source of much debate within the educational literature, starting with early work by Dewey (see, for example, Dewey (1916)). Theoretical work on school quality and the purpose of schooling emphasizes (a) increasing students’ understanding of the world, (b) developing positive dispositions that will promote autonomy (White, 1982), (c) helping students flourish, and (d) providing students with tools to engage in civic discourse (Brighouse, 2005) and promote their happiness (Noddings, 2003). The United Kingdom’s Good Childhood Inquiry panel (Layard & Dunn, 2009) identified “good” schools as having mutual respect between teachers, students, and families, and assessing and responding to emotional development and mental health—key characteristics of school climate.

Recent reviews of the literature conceptualizing school climate (J. Cohen, McCabe, Michelli, & Pickeral, 2009; Thapa, Cohen, Guffey, & Higgins-D’Alessandro, 2013) have sought to operationalize the overarching values of high-quality schools into characteristics of the school setting. They focus upon the collective, interpersonal environment of the school, including how students, teachers, administrators, parents, and other community stakeholders each interrelate with each other (J. Cohen et al., 2009). These interpersonal interactions can be observed across many domains, including through safe and supportive settings (Eliot, Cornell, Gregory, & Fan, 2010) that seek to minimize emotional and physical violence (Warnick, 2009), promote classroom climate (Mitchell & Bradshaw, 2013), and limit teacher turnover (Loeb, Kalogrides, & Béteille, 2012). Such positive school climates can lead to students’ feeling more connected to school (Waters, Cross, & Shaw, 2010) and more satisfied with school (Samdal, Nutbeam, Wold, & Kannas, 1998).

Methodological challenges. One challenge in assessing school climate is the need to address and potentially integrate the distinct perspectives of students, teachers, school administrators, parents, and families (Freiberg, 1999). A further complexity to be considered is that school climate dimensions are experienced and can be assessed at multiple levels, e.g. micro-level processes, such as individual-level students’ perceptions of their school (García

Bacete, Marande Perrin, Schneider, & Blanchard, 2014) as well as macro-level processes like implementation of education policies and reforms (Sarason, 1996).

Focus on Mental Health and Psychological Disorders

The school social setting may be a particularly important factor in influencing childhood and adolescent mental health; youth spend a large amount of their time in school and mental disorders often emerge in adolescence (Costello, Copeland, & Angold, 2011). Moreover, adolescent behavioral and emotional problems have been increasing in prevalence over recent decades (Collishaw, Maughan, Goodman, & Pickles, 2004). Currently, approximately 22% of American adolescents (age 13-18) are estimated to have a diagnosable mental disorder (Merikangas et al., 2010).

To date, despite a large number of studies on the topic, there has been no systematic synthesis. Here, I systematically review the literature to assess the relationship between school climate and mental health. I limited the scope of the review to studies that assessed established psychological disorders, such as depression or anxiety, or related symptomatology (I refer to this set of disorders and symptoms as “psychological functioning” throughout the rest of this paper). My focus on psychological disorders and their symptoms, as assessed with validated measurement techniques, assists in synthesizing a heterogeneous literature.

Goals of Present Review

This paper seeks to systematically review the peer-reviewed literature and synthesize what is known about associations between measures of school climate and measures of mental health disorders and symptoms. I organize the findings by domain of psychological functioning, study population, and study design. I use my understanding of the current state of the field to identify implications for future research and practice.

Method

A wide variety of terms are used for school climate and for different psychological functioning issues; I thus employed a far-reaching systematic search strategy using a range of relevant phrases and keywords (e.g., school climate, school culture, school social environment, mental health, psychopathology) across PubMed (a public health database), ERIC (an education database), PsycInfo (a psychology database), and Google Scholar completed in July 2015. This also provided a broader examination that accounted for the interdisciplinary nature of the literature on school climate and psychological functioning. For PubMed, ERIC, and PsycInfo, I reviewed all of the items elicited by the search terms. For Google Scholar, I reviewed the first 100 articles, and then, if more than 100 articles were listed, the first 100 and then until 50 in a row were deemed irrelevant. Articles were deemed eligible for inclusion if they reported any measures of correlation or association between measures of school climate and measures of psychopathology among K-12 students. I also reviewed reference lists of articles collected through the searches to identify any additional potentially relevant articles. I restricted my search to only peer-reviewed articles. No language restrictions were applied, but all studies identified were published in English.

Papers were thoroughly reviewed to identify: a) the study design: observational or experimental, and cross-sectional or longitudinal; b) the study population: age range and geography; c) how school climate was operationalized; d) who reported school climate; e) how psychological functioning was operationalized; f) who reported psychological functioning; and g) the direction of the measure(s) of association between school climate and mental health.

I focused on the direction of the measures of association (e.g., positive, inverse) rather than the specific effect size for several reasons. First, school climate and psychological

functioning were measured in the literature in myriad ways, preventing us from the possibility of a single meta-analysis. Second, even when the same school climate concepts and psychological outcomes were assessed, they were sometimes operationalized in different ways (with different scales or using a continuous measure versus a categorical measure). Third, the papers used heterogeneous analytic techniques (e.g., correlation coefficients, results from a multivariable regression model, coefficient in a regression model looking at another exposure-outcome relationship), leading to different estimates. Thus, I determined that the direction of the measure of the association was the lowest common denominator that would both be informative and could be captured across all studies.

Results

Overview of Results

My synthesis of study findings is organized by domain of psychological functioning, as measured by symptoms and/or diagnosis. I start by providing a broad overview of the 40 studies included in this review. With respect to dependent variables, most included some form of internalizing (e.g. anxiety, depression) or externalizing problems (e.g. aggression, substance use); one study (Kasen, Cohen, Chen, Johnson, & Crawford, 2009) considered personality disorders. Overall, positive school climate appeared to be inversely associated with psychological disorders. Ninety percent of the 40 studies reviewed reported a statistically significant association between at least one measure of school climate and at least one psychological outcome; 70% of the associations reported (n=141) were statistically significant. Studies reported an average of 3.5 school climate-psychological outcome associations (range: 1-9), and reported an average of 3 statistically significant associations (range: 0-7).

I was also interested in variation by method of assessment of school climate, study design, psychological functioning domain assessed, and age group. The majority of studies utilized student-reported measures of both school climate and psychological functioning (n=30); others had student-reported school climate and externally-reported psychological functioning (n=4) (Kasen et al., 2009; Kasen, Johnson, & Cohen, 1990; Visser et al., 2015; M.-T. Wang & Dishion, 2011). There was only one study that utilized a teacher-reported psychological outcome and student-reported school climate (the other outcome was student-reported) (Suldo, Gellay, Roth, & Bateman, 2015). Some used externally-reported school climate and a student-reported psychological outcome (n=3) (LeBlanc, Swisher, Vitaro, & Tremblay, 2008; Meilstrup et al., 2015; Virtanen et al., 2009). Only three studies used teacher-reported measures of both school climate and psychological outcomes (LeBlanc, Swisher, Vitaro, & Tremblay, 2007; Lee & Bierman, 2015; O'Brennan, Bradshaw, & Furlong, 2014).

Twenty-six of the 40 studies reported on U.S. populations. Four studied Canadians (DeWit et al., 2000; Freeman, Samdal, Băban, & Bancila, 2012; LeBlanc et al., 2007; 2008), and the rest were in Europe (with no more than 2 studies for any country) (Ellonen, Kääriäinen, & Autio, 2008; Freeman et al., 2012; Meilstrup et al., 2015; Oldfield, Humphrey, & Hebron, 2015; Stornes & Bru, 2011; Virtanen et al., 2009; Wissink et al., 2014), China (Bao, Li, Zhang, & Wang, 2015; Jia et al., 2009; Shang, Li, Li, Wang, & Siegrist, 2014), or Australia (Shochet & Smith, 2014).

Studies were relatively evenly divided between using cross-sectional data (n=23) and having temporal ordering of school climate and mental health with longitudinal data (n=17). Table 8 summarizes the studies reviewed; Table 9 organizes the key findings by psychological outcome and type of study. I now report on each of the studies, organized by psychological outcome, age group, and study design.

Internalizing Problems

General internalizing problems. In the nine studies summarized here, positive school climate generally appeared to be inversely associated with internalizing problems (Kasen et al., 1990; Kidd et al., 2006; Kuperminc, Leadbeater, Emmons, & Blatt, 1997; Meilstrup et al., 2015; Resnick et al., 1997; Shang et al., 2014; Stornes & Bru, 2011; Suldo et al., 2015; Suldo, McMahan, Chappel, & Loker, 2012).

Middle school students. The two studies that examined internalizing problems among middle school students utilized a cross-sectional design. Among Norwegian eighth graders perceived mastery climate (where effort and practice were emphasized) was associated with fewer emotional and behavioral problems, whereas a school climate emphasizing performance was associated with more problems (Stornes & Bru, 2011). A U.S. study considered student-perceived positive school climate and both student- and teacher-reported internalizing problems, and found that while positive school climate was inversely associated with student-reported internalizing problems among boys, there was no association among girls, or when using teacher-reported outcomes (Kuperminc et al., 1997).

High school students. Cross-sectional studies. There were three cross-sectional studies of high school students, all of which studied U.S. populations. In the southeastern United States, the strength of association between student-reported school climate and internalizing problems was more pronounced among girls than boys. Among girls, parental involvement in school and equitable access to school resources were each inversely associated with internalizing problems; among boys, only school order and discipline were uniquely inversely associated with internalizing problems (Suldo et al., 2012). In a study of public school students in the southeastern United States, internalizing symptoms were: not associated with school-based overt victimization, positively associated with school-based relational victimization, and inversely associated with school-based prosocial acts (Suldo et al., 2015). A third study, utilizing the National Longitudinal Study of Adolescent Health (Add Health), a large nationally representative cross-sectional sample of U.S. high school students, found that school connectedness was inversely associated with emotional distress and suicidal thoughts and behaviors (Resnick et al., 1997).

Longitudinal studies. Longitudinal analyses of the first two waves of Add Health found a more complex pattern than the cross-sectional analyses reported above: controlling for depressive symptoms at baseline and a history of prior suicide attempts, there was no association found between school connectedness and suicide attempts, with one exception. School connectedness was associated with a lower risk of suicide attempts among a particular subset of boys: those with a history of suicide attempts and poor peer relations but who reported strong parental support (Kidd et al., 2006).

Middle and high school students. Cross-sectional studies. Two studies, of Danish and Chinese populations, considered a combined population of both middle and high school students. In a national sample of Danish students ages 11-15, aggregate exposure to bullying was positively associated with internalizing symptoms after adjusting for covariates; there was no association, however, for the aggregate classroom dimensions of students' enjoying being together or school administrator-reported presence of anti-bullying policies and other bullying prevention initiatives (Meilstrup et al., 2015). Among urban students in southwestern China, across gender and in both middle school and high school, an effort-reward imbalance was positively associated with suicidal ideation (although the strength of the association varied by both gender and grade level) (Shang et al., 2014).

Longitudinal studies. One longitudinal study (Kasen et al., 1990) followed U.S. students in 4th-10th grades who attended the same school over a two year period. They found that social facilitation (a scale assessing teacher-led discussions regarding students' emotional or family problems) and school conflict interacted such that social facilitation was associated with increased general internalizing symptoms in high-conflict schools and decreased reported symptoms in low-conflict schools at the end of the study (Kasen et al., 1990).

Depressive symptoms. In 12 studies of middle school populations (Ellonen et al., 2008; Freeman et al., 2012; Jia et al., 2009; Loukas & Murphy, 2007; Loukas & Robinson, 2004; Loukas, Cance, & Batanova, 2013; Loukas, Suzuki, & Horton, 2006; Roeser & Eccles, 1998; Shochet & Smith, 2014; Virtanen et al., 2009; M.-T. Wang, 2009; Way, Reddy, & Rhodes, 2007), 3 studies of high school students (LaRusso, Romer, & Selman, 2008; C. Wang & Atwal, 2015; Žukauskienė, Raižienė, Malinauskiene, & Pilkauskaite-Valickiene, 2014) and six studies of both middle and high school students (Ellonen et al., 2008; Freeman et al., 2012; Jia et al., 2009; Joyce & Early, 2014; Kasen et al., 1990; Virtanen et al., 2009), positive school climate was often inversely associated with depressive symptoms cross-sectionally and, to a lesser extent, longitudinally. These relationships were sometimes modified by characteristics like gender.

Middle school students. Cross-sectional studies. There was one cross-sectional study of middle school students (Loukas & Robinson, 2004). This U.S. study considered four measures of student-reported school climate (peer cohesion, peer friction, peer competition, and overall satisfaction) and whether effortful control (the ability to control one's attention and emotion) modified the associations between these school climate measures and depressive symptoms. Among boys, depressive symptoms were inversely associated with cohesion and positively associated with both friction and competition; satisfaction, friction, and cohesion also each interacted with effortful control to affect depression. Among girls, satisfaction was inversely and friction was positively associated with depressive symptoms, and no interactions were observed (Loukas & Robinson, 2004).

Longitudinal studies. Five longitudinal cohorts were studied, four of which were in the U.S. Further longitudinal research by Loukas and Murphy (2007), following up on Loukas and Robinson's (2004) U.S. sample described above, reported different patterns than the initial cross-sectional analyses. Controlling for baseline depression, the same measures of school climate and effortful control no longer interacted to affect subsequent depressive symptoms; the only significant finding was a positive association between perceived friction and depressive symptoms, for both males and females (Loukas & Murphy, 2007). Additionally, the associations between school climate measures and depressive symptoms observed in the original cross-sectional study (Loukas & Robinson, 2004) were not present in the longitudinal analysis (Loukas et al., 2006). In a subsequent study with three waves of data, although inverse cross-sectional associations between school connectedness and adjustment problems were found within each wave, the only longitudinal finding was that adjustment problems in wave 1 were associated with school connectedness in waves 2 and 3 (Loukas et al., 2013). Additionally, boys with greater depressive symptoms had lower baseline school connectedness than boys with fewer depressive symptoms, but they all had equally low school connectedness by eighth grade (wave 3); there was no such pattern for girls (Loukas et al., 2013).

Among U.S. 8th grade students, school ability goal structure (which emphasizes competition and performance) was positively associated with depressive symptoms, while school task goal structure (which, in contrast, emphasizes mastery, effort, and growth) and positive

teacher regard were each inversely associated with depressive symptoms. There was no unique association between student autonomy and depressive symptoms (Roeser & Eccles, 1998).

A third U.S. study assessed trajectories of change in perceived school climate and rate of change in self-reported mental health among middle school students using three timepoints: 6th, 7th, and 8th grade. Declines in reported positive teacher support over time, peer support over time, opportunities for student autonomy, and clear and consistent rules were each associated with increased slopes for depressive symptoms over time (Way et al., 2007).

In Maryland public school students, all five school climate constructs (school performance goal structure, school mastery goal structure, promotion of autonomy, promotion of discussion, and teacher emotional support) assessed in 7th grade were associated with depressive symptoms in 8th grade. Performance goal structure was positively associated with depressive symptoms and the other four constructs were inversely associated, and these associations were partially mediated by social competence (M.-T. Wang, 2009).

The fifth study (Shochet & Smith, 2014), among students in 7th and 8th grades at 4 Australian schools, used data from 3 time points and found an inverse association between a positive classroom environment and CDI depressive symptom scores.

High school students. Cross-sectional studies. Two cross-sectional studies of high school students were identified. In the U.S., for students ages 14-18, teacher support, teacher regard for students' perspectives, and respect (student-teacher, teacher-student, and student-student respect) were each significantly inversely associated with depressive symptoms, as measured using questions from the Youth Risk Behavior Survey (LaRusso et al., 2008). In the second study, among Lithuanian students aged 14-20 attending secondary school, negative school climate was positively associated with depressive symptoms, and feeling safe at school and teacher support were negatively associated with depressive symptoms (Žukauskienė et al., 2014).

Longitudinal studies. There was one longitudinal study, which focused on Asian-Americans in two U.S. metropolitan areas who were either immigrants or children of immigrants. Positive school climate and perceived fairness in the school climate were both inversely associated with depressive symptoms, and negative peer interactions were positively associated with depressive symptoms (C. Wang & Atwal, 2015). This study also found that discrimination may fully or partially mediate each of these associations.

Middle and high school students. Cross-sectional studies. There were four cross-sectional studies of middle and high school students from seven countries. In one sample of Finnish 8th and 9th graders, student-reported classmate social support and teacher support were each independently inversely associated with student-reported depression (Ellonen et al., 2008). Among another sample of Finnish 8th and 9th grade students, a measure of school personnel-perceived trust and opportunities for participation was inversely associated with student-reported depression (Virtanen et al., 2009). Other school climate measures (support for innovation, orientation towards high-quality work, and accepted and clear goals) were not associated with depressive symptoms in that study.

Comparative studies suggested school climate-depression associations were similar across countries. Among urban middle school students in both the United States and China, student-perceived teacher support and peer support were uniquely inversely associated with depressive symptoms for both boys and girls, controlling for parental support (Jia et al., 2009). The magnitudes of the associations did not significantly differ between the United States and China. In another comparative study, 13- and 15- year-olds in Canada, Norway, and Romania

had inverse associations with similar magnitudes between positive school climate (a single measure that included teacher support and school pressure) and psychosomatic complaints (Freeman et al., 2012).

Longitudinal studies. There were also two longitudinal studies. One, described earlier, followed U.S. students in 4th-10th grade for ≥ 2 years (Kasen et al., 1990) and found that social facilitation was associated with increased mother-reported depressive symptoms in high conflict schools but fewer symptoms in low conflict schools (Kasen et al., 1990).

Another study using U.S. Add Health data (described earlier) looked at depressive symptoms and school connectedness, getting along with teachers, and feeling cared for by teachers (Joyce & Early, 2014). Both school connectedness and getting along with teachers were inversely associated with CES-D scores. They also studied interaction by being a member of the racial majority in the school and gender, but findings did not differ substantively.

Externalizing Problems

The only psychological functioning outcome for which I could find studies for all age ranges across the K-12 spectrum was externalizing problems. I identified two studies of elementary school populations (Lee & Bierman, 2015; O'Brennan et al., 2014), nine studies of middle school populations (Bao et al., 2015; Hung, Luebbe, & Flaspohler, 2015; Kuperminc et al., 1997; Kuperminc, Leadbeater, & Blatt, 2001; Reis, Trockel, & Mulhall, 2007; M.-T. Wang, 2009; M.-T. Wang & Dishion, 2011; M.-T. Wang, Selman, Dishion, & Stormshak, 2010; Way et al., 2007), eight studies of high school populations (DeWit et al., 2000; LeBlanc et al., 2007; 2008; Oldfield et al., 2015; Suldo et al., 2012; 2015; Wissink et al., 2014; Žukauskienė et al., 2014), and two studies of populations that included both middle and high school-aged youth (Kasen et al., 1990; Visser et al., 2015).

Elementary school students. *Cross-sectional studies.* One study used teacher reports of both school climate and student problem behaviors among elementary aged children in 5 Maryland school districts. They found an inverse relationship between positive school climate and problem behaviors (O'Brennan et al., 2014).

Longitudinal studies. A study of students in 3 Pennsylvania counties assessed the relationship between teacher-reported kindergarten school climate and teacher-reported aggressive behaviors in the first grade. Both student-teacher relationship closeness and positive classroom functioning were inversely associated with aggressive behaviors, even after controlling for pre-kindergarten behaviors (Lee & Bierman, 2015).

Middle school students. *Cross-sectional studies.* There were six cross-sectional studies of middle school students, most in the U.S. Among a national sample of U.S. middle-school students, aggregated student reports of teacher social support and quality of school life were inversely associated with aggressive behaviors (Reis et al., 2007).

In a study of middle school students described previously (Kuperminc et al., 1997), positive school climate was inversely associated with both student-reported externalizing problems among both boys and girls. However, when teacher-reported externalizing problems were used instead, the only association that remained significant was that positive school climate was inversely associated with teacher-reported externalizing behaviors. In addition to some differences in the strength of association by gender, there were also interactions between race/ethnicity and school climate. For example, the inverse relationship between perceived school climate and teacher-reported externalizing problems was only observed among non-African Americans (Kuperminc et al., 1997). Additionally, subsequent research suggested that

the association between positive school climate and externalizing problems may vary by students' self-reported psychosocial vulnerability (Kuperminc et al., 2001).

Among students in the U.S. Pacific Northwest, perceived academic support, school behavior management, teacher support, and peer support were each associated with teacher-reported problem behaviors in 6th grade; school behavior management moderated the association between student-reported deviant peer affiliation and problem behaviors (M.-T. Wang & Dishion, 2011). Among students in the U.S. Midwest, authoritative structure created by teachers and staff and classroom orderliness were both inversely associated with problem behaviors; there was no association between student support and problem behaviors (Hung et al., 2015).

One study of Chinese adolescents used Jia et al.'s school climate measures to create a summary score and found an inverse association between school climate and delinquent behaviors. While present for all students, this association was even stronger among students with lower effortful control (Bao et al., 2015).

Longitudinal studies. There were also three longitudinal studies of U.S. middle school students. In Way's (2007) longitudinal study of middle school students from 6th through 8th grade, declines in reported positive teacher support over time, peer support over time, opportunities for student autonomy, and clear and consistent rules were each independently associated with increased slopes for behavior problems (Way et al., 2007). A study of Maryland public school students described earlier (M.-T. Wang, 2009) investigated the relationship between perceived school climate and deviant behaviors from 7th to 8th grade (M.-T. Wang, 2009). All five school climate constructs assessed in 7th grade were associated with deviance in 8th grade, controlling for prior deviance and other covariates, and the association appeared to be partially mediated by social competence (M.-T. Wang, 2009). Students in the Pacific Northwest were followed from 6th-8th grade to examine perceived school climate in 6th grade (academic focus, discipline and order, peer relations, and student-teacher relations) and student-reported externalizing problem behaviors in 7th and 8th grade; higher perceived school climate was associated with a lower probability of problem behaviors and, among those with problem behaviors, a lower frequency of engaging in problem behaviors (M.-T. Wang et al., 2010).

High school students. Cross-sectional studies. Seven of the eight studies examining school climate and externalizing behaviors among high school students were cross-sectional, and most studied populations outside the U.S. Among high school students in the southeastern U.S., the association between student-reported school climate and student-reported externalizing problems varied by gender (Suldo et al., 2012). Among girls, peer interpersonal relations and parental involvement in school were uniquely inversely associated with externalizing problems, and only peer interpersonal relations was uniquely inversely associated with externalizing problems among boys (Suldo et al., 2012). In another study of students in the southeastern U.S. also described earlier, measures of school climate were not associated with teacher-reported aggressive behaviors (Suldo et al., 2015). Among Dutch urban high school students, there was no association between student-reported student-student relations or teacher-student relations and delinquent behavior (Wissink et al., 2014). Among a convenience sample of students attending a single high school in Northwestern England, school connectedness, as measured using the Psychological Sense of School Membership instrument, was not associated with conduct problems as measured using the Strengths and Difficulties Questionnaire (Oldfield et al., 2015).

A study of Canadian ninth graders found that undesirable school culture (which included student conflict, low teacher and peer support, unfair rules and discipline, low student autonomy, and low school spirit) was associated with conduct disorder, oppositional-defiant disorder, and

attention-deficit hyperactivity disorder (each measured continuously using checklists derived from DSM-III-R criteria) (DeWit et al., 2000). Another study, of students in Canadian francophone high schools, found that the teacher-reported academic emphasis of the school but not teacher working conditions was positively associated with teacher-reported classroom behavior problems (LeBlanc et al., 2007). Finally, in a sample of Lithuanian students described earlier, negative school climate and feeling safe at school (counter-intuitively) were both positively associated with delinquent behavior, and teacher support was inversely associated with delinquent behavior (Žukauskienė et al., 2014).

Longitudinal studies. The one longitudinal study of high school students, conducted in Canada, examined teacher-reported classroom behavior problems, academic emphasis of the class and school, teacher professional autonomy, teacher job satisfaction, and students' report of antisocial behaviors (LeBlanc et al., 2008). Classroom behavior problems were significantly positively associated with antisocial behavior (both violent and non-violent). In contrast to some of the other studies reviewed here, no interactions were observed between school climate measures or between any school climate measure and gender (LeBlanc et al., 2008).

Middle and high school students. There were two longitudinal studies of a combined middle and high school population. In the study described earlier with a population of both U.S. middle and high school students (Kasen et al., 1990), school conflict was associated with increased attention deficit, opposition, and conduct problems, and academic focus was associated with decreased opposition and conduct problems. These school climate features are different from the one (social facilitation) that was associated with internalizing symptoms.

Another study used county-level data from the U.S. state Georgia to assess the ecologic relationship between aggregate school climate at an earlier point in time and the prevalence of medicated ADHD among Medicaid recipients. They found that counties with a worse aggregate school climate score had, on average, a lower prevalence of medicated ADHD, even after controlling for demographic factors (Visser et al., 2015). Although the ecological fallacy prevents us from interpreting this association at the individual level, this study's counterintuitive finding is nevertheless worth considering.

Personality Disorders

One longitudinal study (Kasen et al., 2009) in New York state that began when students were in middle and high school and followed them through high school and into early adulthood assessed personality disorder using mother and youth responses to structured clinical interviews aligned with the most recent DSM criteria (i.e., DSM-III-R, DSM-IV). School conflict and school autonomy were positively and inversely, respectively, associated with Cluster A symptoms as defined by DSM-IV (e.g., paranoid, schizoid). Additionally, school learning focus was inversely associated with Cluster B symptoms (e.g., antisocial) and school conflict was positively associated with Cluster C symptoms (e.g., obsessive-compulsive) (Kasen et al., 2009).

Discussion

To the best of my knowledge, this is the first systematic review of the literature on the relationship between school climate and students' psychological functioning. This complements other reviews on related topics, including a prior review that found mixed evidence for the association between diverse school-level characteristics (e.g., social-emotional learning interventions, type of school, school policies, social support, school climate) and adolescent emotional health (Kidger, Araya, Donovan, & Gunnell, 2012) and a narrative review that concluded that there was an association between school climate and student well-being (Kutsyuruba, Klingler, & Hussain, 2015). Overall, in my comprehensive review that focused

specifically on mental health outcomes, I found that school climate was generally associated with psychological functioning, across a literature that measures each construct heterogeneously, although there is not uniform consensus across all populations and measures or by study design. In particular, I highlight that there were sometimes conflicting results in the same population depending on whether the analysis was cross-sectional or longitudinal, and I argue that the longitudinal findings are likely more robust. My observed findings are aligned with the socio-ecological model and person-environment fit to this context, as well as the potential health implications of how philosophers of education conceptualize good schooling. I now explore the nuances of these findings and identify important considerations for this body of research before discussing implications for research and practice.

Specific patterns of findings

Populations. Despite investigating the literature broadly across age groups and geographical locale, I note that 60% of the studies were among middle- and high-school populations in the U.S. Therefore, my inferences are thereby largely restricted to those groups. Middle school student populations were most frequently studied, followed by high school student populations. I found only two studies focused on elementary school-age children (Lee & Bierman, 2015; O’Brennan et al., 2014). School climate and psychological functioning were frequently associated, in the expected direction, in both middle and high school populations.

Although over half of the studies examined U.S. populations, the two studies that examined populations from multiple countries (Freeman et al., 2012; Jia et al., 2009) found similar school climate-mental health associations across countries. I also emphasize that I found no studies of African or Central or South American populations.

Measures of constructs of interest. Psychological outcomes. Most of the studies measured general internalizing or externalizing symptoms or depression. This is not necessarily a limitation, as internalizing and externalizing symptoms capture the most common issues in child and adolescent mental health, but these measures preclude a conclusion of whether school climate is associated with specific, diagnosable psychopathologies. One exception was depression, which was a primary outcome in 21 studies. That said, I acknowledge that in school-based samples, there can be relatively few students with clinical levels of psychopathologies (Achenbach, Rescorla, & Ivanova, 2012) and so may be less likely to be detected. Many studies considered both internalizing and externalizing behaviors in the same population, and tended to find that the same school climate constructs were associated with both mental health domains (Kuperminc et al., 1997; 2001; Loukas et al., 2006; 2013; Suldo et al., 2012; M.-T. Wang, 2009; Way et al., 2007), with two exceptions that had mixed findings (Kasen et al., 1990; Suldo et al., 2015).

School climate. Measures of school climate and mental health were quite heterogeneous across these studies. Nevertheless, the associations appeared to be robust regardless of how the constructs were measured. There are several examples of associations between specific school climate constructs and mental health outcomes that are consistent across study populations. For example, teacher support was inversely associated with depressive symptoms among middle (Jia et al., 2009; Roeser & Eccles, 1998; M.-T. Wang, 2009; Way et al., 2007) and high school students (LaRusso et al., 2008) and inversely associated with externalizing problems among middle school students (Reis et al., 2007; M.-T. Wang, 2009; M.-T. Wang & Dishion, 2011; Way et al., 2007). Similarly, peer support was inversely associated with depressive symptoms (Ellonen et al., 2008; Jia et al., 2009; Way et al., 2007) and externalizing behaviors (Way et al., 2007) among middle school students. In addition to considering sources of support, educators

often promote either a mastery (academic growth) or performance (academic achievement) climate in their classroom. Mastery climate was inversely associated with internalizing problems (Stornes & Bru, 2011), depressive symptoms (Ellonen et al., 2008; Roeser & Eccles, 1998; M.-T. Wang, 2009), and externalizing problems (M.-T. Wang, 2009) among middle school students. In comparison, performance climate was positively associated with internalizing problems (Stornes & Bru, 2011), depressive symptoms (Roeser & Eccles, 1998; M.-T. Wang, 2009) and externalizing problems (M.-T. Wang, 2009) among middle school students. Finally, Haynes's School Climate Survey scale, a global measure, was inversely associated with externalizing problems among middle school students (Kuperminc et al., 1997) and both internalizing and externalizing problems among high school students (Suldo et al., 2012).

Reporters for constructs of interest. I was also interested in who provided information on school climate and psychological functioning in each of the studies. The majority of the literature reviewed used student-reported measures of both school climate and psychological functioning. The one study that used both student and teacher reports for the same psychological outcome found different associations depending on the reporter (Kuperminc et al., 1997), including that, among girls, there was only a statistically significant for student-reported outcomes but not teacher-reported outcomes, suggesting that single source bias may be a concern. Only one study used different non-student reporters for both school climate (teachers) and psychological functioning (parents); this study found that positive school climate was associated with fewer negative psychological outcomes among elementary school students (Lee & Bierman, 2015). Additionally, for the three studies that used parent- or teacher-reported school climate measures and student-reported psychological outcomes (LeBlanc et al., 2008; Meilstrup et al., 2015; Virtanen et al., 2009), most of the findings were null. Of the studies that used student-reported school climate measures and parent- or teacher-reported psychological outcomes, the findings did not unilaterally support an inverse association between positive school climate and psychological functioning: results were mixed (Kasen et al., 1990; 2009; Suldo et al., 2015; Visser et al., 2015; M.-T. Wang & Dishion, 2011).

Study design. Temporality was another important consideration. The majority of the empirical evidence documenting an association between school climate and mental health was cross-sectional. Nevertheless, a growing number of longitudinal studies also found associations, and suggested that school climate can affect mental health over time. To explore this potential concern, I investigated the extent to which findings were sensitive to whether the study had been cross-sectional or longitudinal in populations where both types of studies had been published. In those populations, there were more and/or different statistically significant associations between school climate measures and mental health measures in the baseline cross sectional findings (Loukas & Robinson, 2004; Resnick et al., 1997) than in the longitudinal follow up results (Kidd et al., 2006; Loukas et al., 2013; Loukas & Murphy, 2007). I argue that the longitudinal findings likely more stringently estimate any true effect.

Potential publication bias. Publication bias is a common concern in systematic reviews that rely on the peer-reviewed literature, where statistically significant associations are often more likely to be published than null results. Studies often found at least one statistically significant association (among the typically multiple associations examined). Out of the 40 studies reviewed, only 4 had null findings for all of the school climate-mental health associations reported (Kidd et al., 2006; LeBlanc et al., 2008; Oldfield et al., 2015; Wissink et al., 2014). Interestingly, those four papers still reported other (non-school climate-mental health) associations that were statistically significant. In this way, I likely circumvented publication bias

for the findings from at least those four papers, since the null school climate-mental health findings got bundled together in the same paper with other statistically significant associations.

My search strategy also had limitations. Despite my best attempts at comprehensiveness, some papers that reported bivariate correlations between measures of school climate and psychological functioning while focusing on a different analysis may have eluded my search terms (e.g., (Liu & Lu, 2012)).

School Climate and Psychological Functioning: Possible Pathways

This review suggests that school climate and psychological functioning appear to be associated, so I now discuss possible pathways by which this association may occur. I draw from theories that posit that social settings influence health and mental health (e.g., (Hawe, Shiell, & Riley, 2009; Tseng & Seidman, 2007)), including the socioecological model (Bronfenbrenner, 1979) and person- and stage-environment fit (Eccles et al., 1993). These frameworks emphasize the influence of social environments on development and how these settings are part of larger systems with components that can interact to affect students' development and wellbeing. Relationships between different members of the school community are also important for having meaningful experiences in school (White, 2011).

Although my review simply seeks to synthesize the evidence for associations between school climate and psychological functioning—not the possible mechanisms—it is important to provide a conceptual frame for the rationale linking the two. It is well-established that social environments affect mental health outcomes (Mair, Diez-Roux, & Galea, 2008; Stansfeld & Candy, 2006; Toyokawa, Uddin, Koenen, & Galea, 2012). More specifically, research from diverse social science disciplines (Bronfenbrenner & Morris, 1998; García Bacete et al., 2014; Warnick, 2009) indicate that school social environment affects student mental health and wellbeing. Potential psychosocial pathways include social capital, stress, and empowerment. Students who feel deeper bonds to their school and their peers may have fewer stressors and/or more support in coping with stress and preventing or minimizing negative mental health symptoms (Catalano, Haggerty, Oesterle, Fleming, & Hawkins, 2004). On the other end of the spectrum, negative school climate can be a source of stress (Vieno, Santinello, & Galbiati, 2004), and school-related stressors are inversely associated with well-being (Murberg & Bru, 2004). Additionally, a literature review of observational and experimental research across multiple disciplines concludes that those who feel that they have agency and feel empowered have better health outcomes (Wallerstein, 2002).

In considering the relationship between school climate and psychological functioning, one must always acknowledge the complexities and possibilities of reverse causality. For example, psychological functioning can affect educational attainment and the educational experience such that students' collective psychological problems—such as high levels of aggression—may affect the school setting (Kessler, Foster, Saunders, & Stang, 1995). Relatedly, aggregate student mental health could affect school climate; in fact, some researchers have used aggregate mental health as a proxy for school climate (Harris, Duncan, & Boisjoly, 2002). With respect to students' individual mental health, students with mental health problems such as depression or anxiety may experience their school climate as less positive. Third, school climate and mental health may reflect similar underlying phenomena. For instance, some have defined school climate as the psychological or emotional health of the school as an organization and the extent to which the school is able to promote positive psychological outcomes amongst its students (Schultz, Glass, & Kamholtz, 1987). Additionally, other factors, such as transitioning into adolescence (Roeser & Eccles, 1998) or other health issues (La Salle & Hagermoser Sanetti,

2016), may be associated with both student reports of their school's health and their own mental health. The extent to which one is able to distinguish between these possible mechanisms—true causal effect, reverse causality, and confounding—in any given study can be difficult and depends on the study design and analytic approach. Longitudinal studies that control for psychological disorders at baseline, and also include reports of school climate and mental health from different sources, may enable stronger observations regarding which mechanisms appear most plausible.

Implications for Future Research

I suggest several directions for future research based on limitations of the existing literature, including comparing associations depending on who reported school climate (e.g., student, school staff, parents); comparing associations depending on the specific measures of school climate and psychological functioning used; analyzing the extent to which school- and student-level variables (e.g., school resources, student race/ethnicity) may interact with school climate to affect mental health; considering the effects of nested climates (e.g., both classroom and school climates); harnessing practitioner knowledge through participatory research; and generating experimental evidence to further test this observed association. I discuss each of these recommendations in detail below.

First, while a general relationship between school climate and student mental health has been observed, the relationship may nevertheless be sensitive to the reporter; future researchers should explore this possibility in greater depth. For example, school climate was reported by several different types of stakeholders (i.e., students, teachers), who may have differing perceptions of school climate. Only one study in this review directly compared student and teacher-reported psychological outcomes (Kuperminc et al., 1997); to the best of my knowledge, no studies have compared how the school climate-mental health association may differ depending on if students or others report school climate. These differing findings could be due to biased reporting or because these are measuring different underlying latent constructs. I encourage future researchers to gather multiple reporters' assessments of school climate within the same study population to be able to better understand these possible phenomena, as some new studies that have emerged since completing the systematic review are beginning to do (Leadbeater, Sukhawathanakul, Thompson, & Holfeld, 2015). It is also worth considering common method variance or single source bias. Some studies assessed school climate from one source and mental health from another source (e.g., student-reported school climate and externally-reported mental health (Kasen et al., 1990; 2009; Suldo et al., 2015; Visser et al., 2015; M.-T. Wang & Dishion, 2011), or externally-reported school climate and student-reported mental health (LeBlanc et al., 2008; Meilstrup et al., 2015; Virtanen et al., 2009)) to avoid single source bias, and these studies also observed associations between school climate and mental health. Future researchers should conduct more cross-validation work to further explore such possibilities. In particular, the highest quality would be studies which had different individuals report school climate and psychological functioning (e.g., teachers and clinicians, respectively) to avoid common method variance.

Second, the relationship between school climate and student mental health may also differ by the measures used. Some studies found associations between the same measures of school climate and diverse mental health outcomes (e.g., (M.-T. Wang, 2009; Way et al., 2007)). However, two studies (Kuperminc et al., 1997; Suldo et al., 2012) of different populations (by both geography and age) used the same measure of school climate (Haynes's School Climate Scale) and the same measures of mental health (Youth Self-Report (YSR) for internalizing and

externalizing symptoms) and stratified results by gender, and only reached the same conclusion for one of the four subsets: that the Haynes scale was inversely associated with YSR-measured externalizing symptoms for girls. School climate can also be conceptualized in myriad ways (M.-T. Wang & Degol, 2015), and that few studies reviewed here use the same school climate measures underscores this point. Future researchers should continue this line of work to more comprehensively understand particularly important dimensions of school climate for mental health promotion. Additionally, others have suggested that the school climate-mental health association may be stronger for positive mental health outcomes (e.g., global measure of well-being) than psychopathologies (Suldo et al., 2012), which merits further research.

Third, I encourage researchers to consider interaction between school-level variables (e.g., how multiple dimensions of school climate interact) and student-school interaction (e.g., interaction between student race/ethnicity and school climate). The articles included in this review found several effect measure modifiers, including school conflict levels, student gender, student race/ethnicity, and psychological vulnerability (Kasen et al., 1990; Kuperminc et al., 1997; 2001; Loukas & Robinson, 2004), but other effect measure modifiers likely exist as well. Much of the research reviewed examined the independent effects of multiple measures of school climate but did not necessarily consider how these different dimensions may relate to each other. Such research would increase the complexity of the analyses, so researchers may want to use techniques like agent-based modeling (el-Sayed, Scarborough, Seemann, & Galea, 2012) to account for thorough conceptual models that could include interactions and feedback loops between the individual and the school as well as within the school setting.

Relatedly, school climate may be particularly important for certain historically marginalized groups that have experienced historical trauma in schools. For instance, research has documented the health implications of historical trauma for Native Americans (Evans-Campbell, 2008), some of which occurred in school (Stout, 2012). School segregation and desegregation also had and continues to have implications for health of African Americans (R. C. Johnson, 2010). Associations between certain aspects of school climate and mental health may be more pronounced for students from these and other historically marginalized groups. Therefore, an understanding of social and cultural history should underpin the field's understanding of school climate and mental health, especially for those exploring any interaction by race/ethnicity.

Fourth, future researchers should consider the potential independent effects of multiple, nested levels of climate (i.e., both classroom and school climate). For example, classroom climate is related to but distinct from school climate, and teacher-reported classroom climate has been found to be associated with teacher-reported student emotional and behavioral problems (Somersalo, Solantaus, & Almqvist, 2002). Other studies used three-level hierarchical models to account for covariates at the individual, classroom, and school levels (O'Brennan et al., 2014). Agent-based modeling (el-Sayed et al., 2012; Nianogo & Arah, 2015) as well as multilevel models (E. C. Dunn, Masyn, Yudron, Jones, & Subramanian, 2014; Rabe-Hesketh & Skrondal, 2008), both of which allow for considering relationships between group-level exposures and individual-level outcomes, could be used to investigate questions like if a positive school classroom environment could be protective against a negative school-level environment, or vice versa, and if targeted intervention at particular levels within the school are merited.

Fifth, practitioners (e.g., principals, teachers, aides, counselors) have useful experiential knowledge based on classroom and clinical experiences with students that may be relevant for assessing potential pathways by which school climate may affect student mental health.

Community-based participatory research can increase the quality of the research and the connection to policy and practice (Balazs & Morello-Frosch, 2013; Minkler & Wallerstein, 2008), and can also empower the participants (Phillips, Berg, Rodriguez, & Morgan, 2010) in ways that could potentially have spillover benefits for school climate. Interesting topics for participatory research could include those identified above, such as engaging both school staff and students to understand how their conceptualizations of school climate may differ, and how this could inform one's understanding of how their reports of school climate may be associated with student mental health. Practitioners and students could also inform how one should examine the intersections of different measures of school climate through interaction and feedback loops. Such community-generated hypotheses and explanations should be systematically documented to inform hypotheses that could be tested, perhaps through community-based research.

Sixth, the cross-sectional evidence is large, and longitudinal research findings suggest that school climate affects mental health outcomes more than individual mental health outcomes affect school climate (Roeser & Eccles, 1998; Somersalo et al., 2002; Way et al., 2007). I encourage researchers to experimentally study the impact of school climate interventions on mental health outcomes, to further unpack the potential causal nature of these associations. These studies could also help elucidate the mechanisms by which school climate may affect mental health outcomes. Possible mechanisms include the extent to which students feel connected to their school, which is affected by school climate (Wilson, 2004), and which in turn affects mental health (Shochet, Dadds, Ham, & Montague, 2006; Witherspoon, Schotland, Way, & Hughes, 2009), but this may depend on the mental health outcome assessed (Loukas et al., 2006). Other mechanisms may include promoting healthy norms and/or sense of school belonging (LaRusso et al., 2008).

Implications for Schools

Public health practitioners and school leaders are increasingly interested in collaborating with one another (Cohen & Schuchter, 2013) due to links between health and academic performance (Michael, Merlo, Basch, Wentzel, & Wechsler, 2015) and education as a social determinant of health (Cohen & Syme, 2013). For example, school-based health centers are becoming more common (Clayton, Chin, Blackburn, & Echeverria, 2010) as they seek to simultaneously impact both academic and health/mental health outcomes (Bersamin et al., 2016), and school principals have identified mental health as an area of great need (Iachini, Pitner, Morgan, & Rhodes, 2016). This literature review of current evidence can inform such partnerships' work. One cannot conclude that intervening to improve school climate will necessarily improve mental health because these studies document only associations and are not necessarily causal. Nevertheless, both school climate and mental health are important for schools to consider (Doll, Spies, & Champion, 2012; Wang & Degol, 2015). Thus, I recommend using interventions that could improve both school climate and mental health. For example, Positive Behavioral Interventions and Supports (PBIS), which promotes positive mental health outcomes through tiered supports that operate both universally and that can be targeted for priority needs, also improves staff-reported school climate (Bradshaw, Koth, Thornton, & Leaf, 2008). And schoolwide PBIS, a subset of PBIS, seeks to change school staff behaviors to improve the school environment, with the goal of improving student outcomes (Bradshaw, Mitchell, & Leaf, 2010).

School-based mental health programs, which can be implemented by school-based health centers or by other staff, are another area of interventions that may simultaneously improve both dimensions of school climate and student mental health (Bruns, Walrath, Glass-Siegel, & Weist, 2004). In comparison to PBIS, where research has focused on school climate and educational

outcomes, school-based mental health programs have been found to impact a wide array of student mental health outcomes (Rones & Hoagwood, 2000), but they may affect only a subset of school climate dimensions (Bruns et al., 2004). In one review of interventions ranging from universal mental health education to programs focused on individuals with specific mental illnesses (Rones & Hoagwood, 2000), many of the interventions reviewed did not target a specific clinical syndrome, although those that did were more effective in addressing the mental health issue of particular focus. In contrast, another review (Wells, Barlow, & Stewart-Brown, 2003) specifically on universal, whole school interventions concluded that the interventions that sought to promote general mental health (e.g., self-efficacy) rather than prevent specific mental illnesses were more successful. However, both reviews agreed that sustained, high-quality program implementation—which may be affected in part by school climate, illustrating the types of feedback loops that complicate this line of research—increases the effectiveness of the program (Rones & Hoagwood, 2000; Wells et al., 2003). Nevertheless, not all school-based mental health programs successfully improve mental health and school climate, even if they are universal and seek to promote general mental health and simultaneously target a specific mental illness (in this case, depression) through a sustained, high-quality initiative (Sawyer et al., 2010).

This review, coupled with others' reviews of school climate and mental health interventions, suggests that schools may need to prioritize which outcome—school climate or student mental health—is a higher priority when selecting an intervention to implement, although it is likely that some school climate interventions may also affect mental health and some mental health interventions may also have spillover benefits for school climate. Additionally, schools will likely need to have a certain baseline level of positive school climate in order to successfully implement school-based mental health interventions. If schools choose to prioritize mental health, I recommend focusing on overall mental health rather than specific diagnoses. The studies reviewed tended to focus on internalizing and externalizing constructs, two broad constructs, therefore it is difficult to narrow in on specific mental health outcomes.

Conclusion

Future research should continue to explore the role of different reporters and different measures of school climate in association with mental health, as well as how the different characteristics may interrelate. I also encourage researchers and practitioners to develop experimental studies to assess the causal effect of school climate interventions on mental health and also the effects of mental health interventions on school climate to more comprehensively assess both the directionality and causality of the associations observed and to add to the body of research for practitioners interested in taking evidence-based action.

Conclusion

There are myriad characteristics of the school setting; this dissertation sought to examine how a subset were related to health outcomes across the life course. Among third grade students in North Carolina in 2005-2011, class size did not appear to be associated with sedentary behavior. Among a population of American adults who were adolescents in the 1970s, student body demographic composition was weakly, if at all, associated with health outcomes in adulthood, and this appeared to be mediated by adult educational attainment. In a systematic review of studies from around the world, some measures of school climate appeared to be associated with some measures of mental health among kindergarten through 12th grade students, although many of the studies reviewed had substantial limitations.

As researchers continue to untangle the role of education as a social determinant of health, school characteristics are an important domain to consider. Limited data currently exist to comprehensively explore such questions; I recommend that future researchers in education also collect health data, and future researchers in public health also collect more detailed education data. As public health practitioners seek to identify opportunities for upstream prevention, the school setting can sometimes be a useful place to act.

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Figures

Figure 1. Hypothesized pathways for how class size could be associated with child and adolescent health.

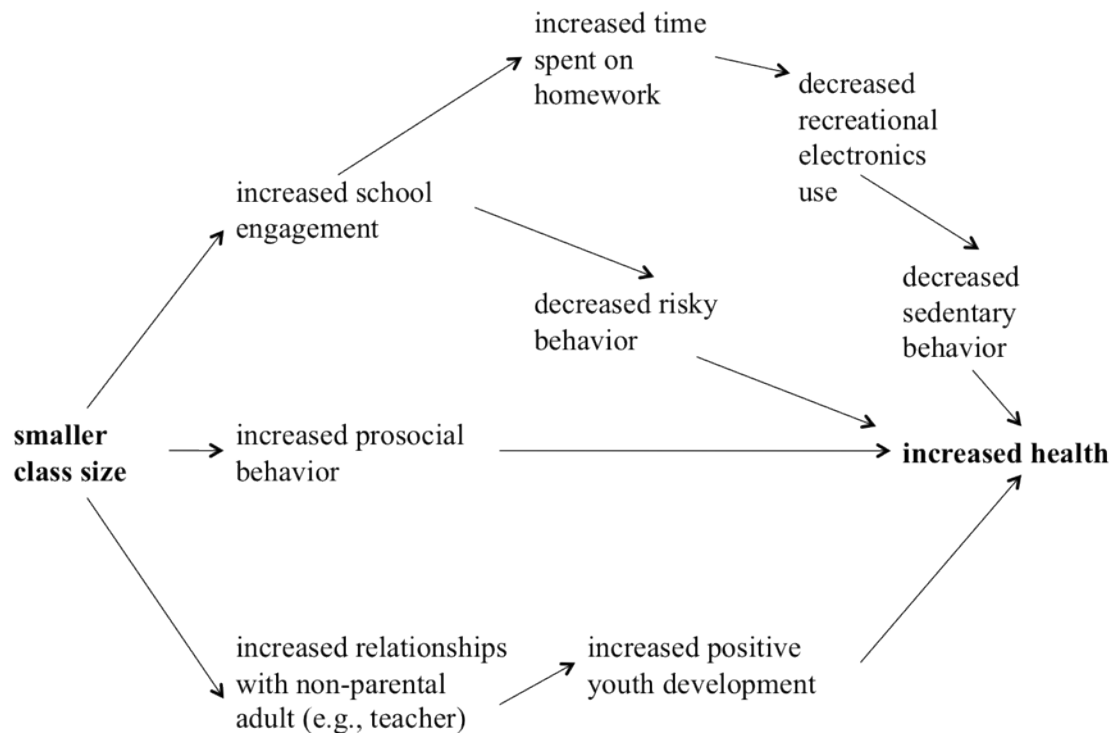


Figure 2. The 25th percentile, median, and 75th percentile for the observed class size for each grade size, and the expected class size for each grade size (as calculated by the policy instrument).

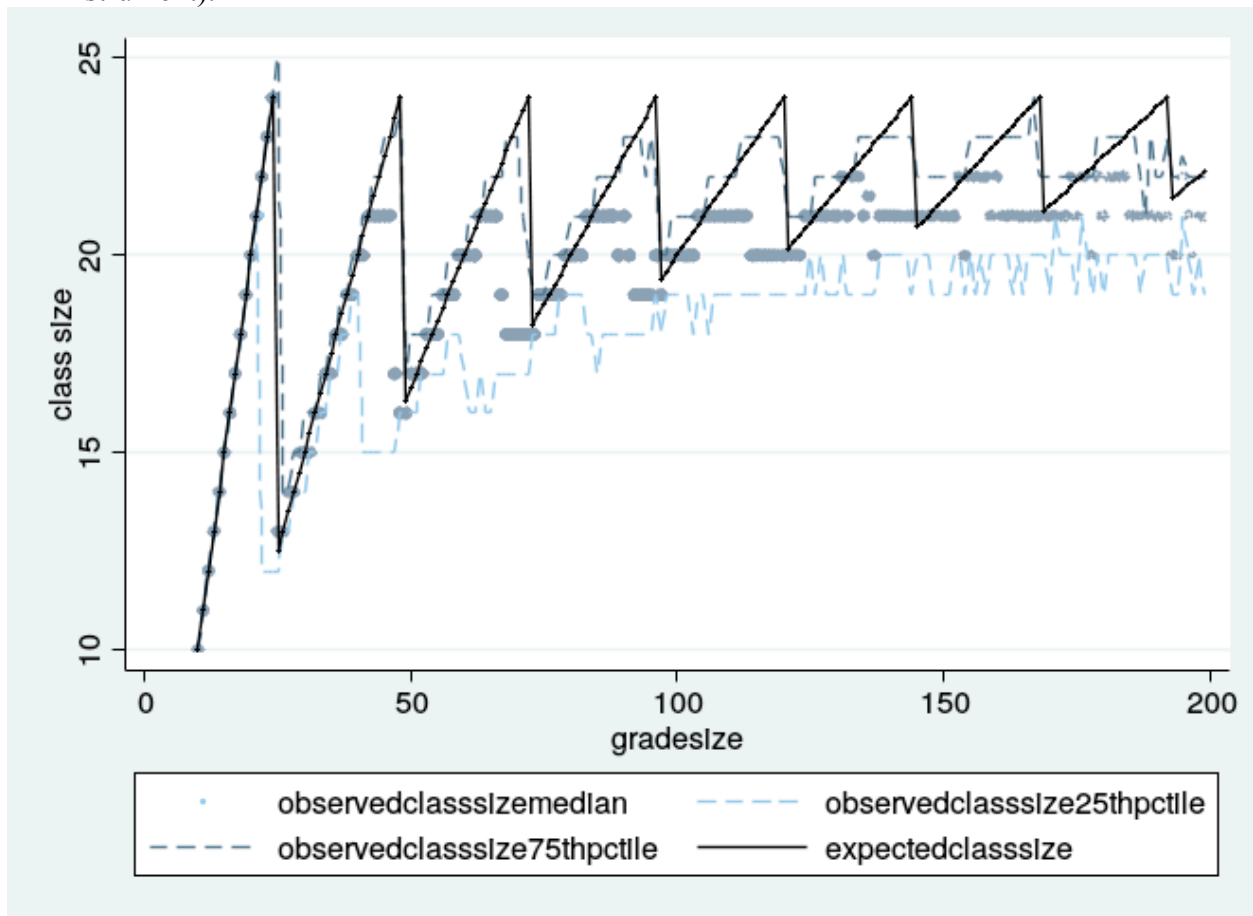


Figure 3. Educational historical context as related to present study.

Education history:

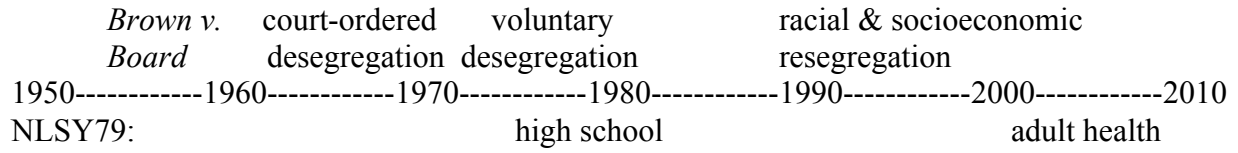
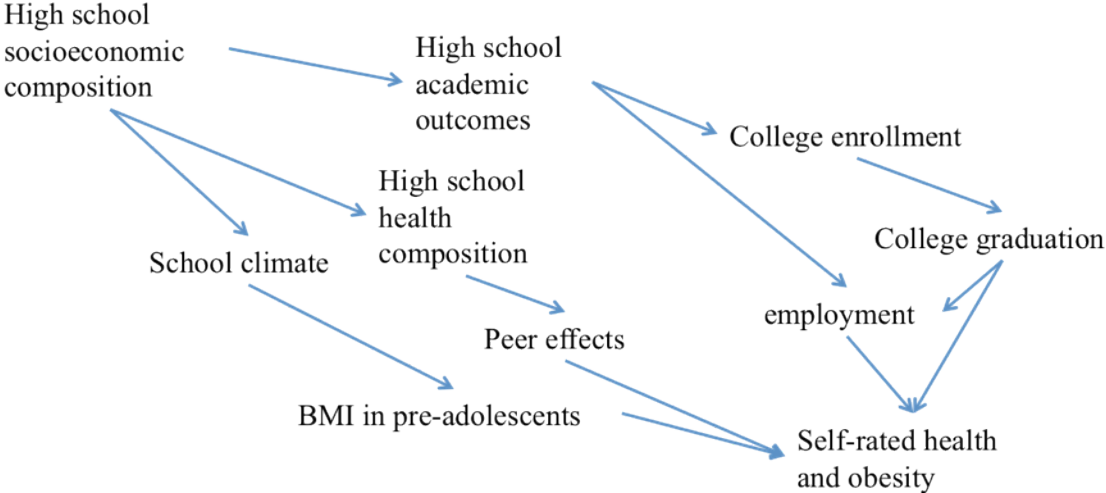


Figure 4. Possible mechanisms linking high school socioeconomic composition to self-rated health and obesity.



Tables

Table 1. Observed and expected (per instrument) class characteristics.

	Observed	Expected
Class size	n=153,137 classes Mean: 19.6 SD: 3.0 Median: 20 Range: 10-39 (based on exclusion criteria)	n=46,965 grades Mean: 20.7 SD: 2.4 Median: 21 Range: 10-24
Average class size for each grade	n=46,965 grades Mean: 19.5 SD: 2.9 Median: 19.8 Range: 10-38	n=46,965 grades Mean: 20.7 SD: 2.4 Median: 21 Range: 10-24
Number of classes	n=46,965 grades Mean: 4.12 SD: 1.85 Median: 4 Range: 1-19	n=46,965 grades Mean: 3.84 SD: 1.68 Median: 4 Range: 1-15

Table 2. Results of regression of expected class size on observed class size, including different sets of covariates.

Covariates included in model (n=35,676 3 rd grade classrooms unless otherwise noted)	Coefficient for expected class size	95% CI	t-statistic	p-value
Grade size and fiscal year	0.312	0.274, 0.350	16.09	p<0.0005
Grade size, grade size squared, fiscal year	0.251	0.214, 0.288	13.39	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, fiscal year	0.236	0.198, 0.273	12.44	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, fiscal year	0.235	0.198, 0.272	12.42	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, fiscal year if gradesize<100 (n=20,615)	0.250	0.208, 0.291	11.71	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, fiscal year if gradesize<200 (n=34,833)	0.235	0.198, 0.272	12.38	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, fiscal year if gradesize<300 (n=35,646)	0.235	0.198, 0.272	12.42	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, indicator variables for small and medium grade size, fiscal year	0.230	0.192, 0.268	11.83	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, indicator variables for small and medium grade size, fiscal year if grade size<300 (n=35,646)	0.230	0.191, 0.268	11.80	p<0.0005
Grade size, grade size squared, grade size cubed, reciprocal of grade size, school size, indicator variables for small and medium grade size, fiscal year if grade size<200 (n=34,833)	0.232	0.193, 0.270	11.84	p<0.0005

Table 3. Descriptive statistics of NCERDC study population.

	Mean or percent
Outcome	
Weekday TV watching/recreational electronics use, in hours (n=662,265)	Mean: 2.34 (SD: 2.45) Median: 2 (25 th percentile: 0.5; 75 th percentile: 3) Range: 0-10.5
Instrument	
Expected class size (n=662,265)	Mean: 21.3 (SD: 1.91) Median: 21.5 (25 th percentile: 20.25, 75 th percentile: 22.75) Range: 10-24
School-related variables	
Grade size (n=662,265)	Mean: 96.75 (SD: 41.85) Median: 93 (25 th percentile: 71, 75 th percentile: 120) Range: 10-199
School size (n=662,265)	Mean: 560.4 (SD: 202.4) Median: 546 (25 th percentile: 420, 75 th percentile: 691) Range: 10-1285
Demographic variables of interest	
Race/ethnicity (n=647,306)	American Indian: 1.5% Asian: 2.2% Black: 26.6% Hispanic: 11.8% Multi-racial: 4.0% White: 53.8%
Gender (n=660,632)	Female: 49.4% Male: 50.6%
Free/reduced price lunch eligibility (n=662,086)	Free lunch: 10.7% Reduced price lunch: 2.3% Full price lunch: 87.0%
Academic year (n=662,265)	2005: 13.4% 2006: 13.7% 2007: 14.3% 2008: 14.3% 2009: 14.9% 2010: 15.4% 2011: 14.1%

Table 4. Results of three-level regression model considering the association between expected class size and hours of TV/electronics use, accounting for covariates and clustering.

	Coefficient	SE	95%CI	p-value
Expected class size	0.000	0.002	-0.004, 0.004	$p=0.927$
Grade size	0.005	0.004	-0.003, 0.012	$p=0.216$
Grade size squared	0.000	0.000	0.000, 0.000	$p=0.219$
Grade size cubed	0.000	0.000	0.000, 0.000	$p=0.241$
Reciprocal of grade size	-0.008	1.721	-3.381, 3.364	$p=0.996$
School size	0.000	0.000	0.000, 0.000	$p=0.001$
Small grade size indicator	0.103	0.031	0.042, 0.163	$p=0.001$
Medium grade size indicator	0.017	0.015	-0.012, 0.046	$p=0.253$

Table 5. Descriptive statistics, presented for total NLSY79 population, by self-rated health status, and obesity status.

	Non-obese at age 40 (n=2764)	Obese at age 40 (n=1465)	Excellent/very good self-rated health (n=2870)	Good/fair/poor self-rated health (n=1882)	Total population (n=4224)
Proportion of weighted sample	65.4%	34.6%	63.5%	36.5%	100%
Mean Body Mass Index (SD)	25.0 (2.9)	34.8 (4.7)	27.2 (5.1)	29.6 (6.5)	28.1 (5.7)
% reporting health as excellent/very good	69.9%	51.5%	100%	0%	64.7%
High school student composition					
Mean percent of students classified as disadvantaged (SD)	17.9% (20.1%)	20.8% (21.7%)	17.5% (19.7%)	21.5% (22.5%)	18.8% (20.7%)
Mean percent of students who were White (SD)	80.1% (26.1%)	76.3% (28.7%)	80.3% (25.9%)	75.6% (28.7%)	78.9% (27.0%)
Mean percent of 10 th graders who subsequently dropped out (SD)	14.1% (20.8%)	14.3% (19.4%)	13.1% (19.1%)	15.8% (21.8%)	14.1% (20.4%)
Individual characteristics					
<i>Childhood socioeconomic position</i>					
Mean years of maternal education (SD)	11.9 (2.6)	11.4 (2.7)	12.0 (2.5)	11.2 (2.7)	11.7 (2.6)
Mean paternal education (SD)	12.1 (3.4)	11.7 (3.5)	12.4 (3.4)	11.3 (3.5)	12.0 (3.5)
Lived in an urban setting as a child	77.2%	73.8%	78.4%	73.0%	76.1%
Lived in the South as a child	31.1%	36.4%	29.8%	37.6%	32.7%
Spoke a foreign language as a child	12.1%	11.8%	12.3%	12.1%	12.0%
<i>Demographics</i>					
Hispanic	3.6%	5.2%	3.8%	5.2%	4.1%
Non-Hispanic Black	10.5%	16.5%	10.5%	16.3%	12.4%
Non-Black non-Hispanic	85.9%	78.3%	85.7%	78.5%	83.5%
Female	50.7%	49.5%	49.6%	51.6%	50.3%
<i>Educational attainment at age 25</i>					
Did not graduate from high school	10.8%	10.9%	9.1%	17.1%	10.9%
Graduated from high school but not college	64.5%	72.6%	63.4%	71.1%	67.0%
Graduated from college or beyond	24.7%	16.5%	27.5%	11.8%	22.1%

Sample size reported indicates all individuals for whom information was available on all three measures of high school student composition. For the total population column, the sample size reported is the number of individuals for whom information was available on all student composition measures and both health measures.

Table 6. Ordered odds ratios for self-rated health at age 40.

High school student composition characteristics	Model 1	Model 2	Model 3
Percent of students classified as disadvantaged (in 5 percentage point increments)	0.96 (95%CI: 0.95, 0.97) (n=5005)	0.99 (95%CI: 0.97, 1.00) (n=4191)	0.99 (95%CI: 0.97, 1.01) (n=4094)
Percent of students who were White (in 5 percentage point increments)	1.03 (95%CI: 1.02, 1.04) (n=5802)	1.00 (95%CI: 0.99, 1.02) (n=4863)	1.00 (95%CI: 0.98, 1.01) (n=4757)
Percent of 10 th graders who subsequently dropped out (in 5 percentage point increments)	0.97 (95%CI: 0.96, 0.98) (n=5638)	0.99 (95%CI: 0.98, 1.01) (n=4729)	1.00 (95%CI: 0.98, 1.01) (n=4624)

Model 1: bivariate association, adjusting for no confounders

Model 2: adjusts for parental (maternal and paternal) education, childhood residential geography (urbanicity, living in the south), speaking a foreign language as a child, birth year, race/ethnicity, and gender

Model 3: adjusts for variables listed in model 2 plus educational attainment at age 25.

All models use sampling weights (pweights) for national representativeness.

Table 7. Odds ratios for obesity at age 40.

High school student composition characteristics	Model 1	Model 2	Model 3
Percent of students classified as disadvantaged (in 5 percentage point increments)	1.03 (95%CI: 1.02, 1.05) (n=4464)	1.01 (95%CI: 0.99, 1.03) (n=3760)	1.01 (95%CI: 0.99, 1.03) (n=3704)
Percent of students who were White (in 5 percentage point increments)	0.98 (95%CI: 0.97, 0.99) (n=5166)	1.00 (95%CI: 0.98, 1.02) (n=4355)	1.00 (95%CI: 0.98, 1.02) (n=4294)
Percent of 10 th graders who subsequently dropped out (in 5 percentage point increments)	1.00 (95%CI: 0.99, 1.02) (n=5022)	0.99 (95%CI: 0.97, 1.01) (n=4238)	0.99 (95%CI: 0.97, 1.00) (n=4175)

Model 1: bivariate association, adjusting for no confounders

Model 2: adjusts for parental (maternal and paternal) education, childhood residential geography (urbanicity, living in the south), speaking a foreign language as a child, birth year, race/ethnicity, and gender

Model 3: adjusts for variables listed in model 2 plus educational attainment at age 25.

All models use sampling weights (pweights) for national representativeness.

Table 8. Summary of papers included in systematic review.

Citation	Country	Age when outcome assessed	Sample size	Study design	Measures of school climate	Internalizing problems	Externalizing problems	Personality disorders
Bao et al., 2015	Southern China	7 th -9 th grade	2,758	cross-sectional	Summary measure that included teacher support, student-student support, and opportunities for autonomy in classroom: -		Problem Behavior Scale	
DeWit et al., 2000	Southern Ontario, Canada	9 th grade	1,100	cross-sectional	Student perception of unfavorable school culture: + for conduct disorder, oppositional-defiant disorder, and attention-deficit hyperactivity disorder		Behavioral disorder symptom checklists from DSM-III-R	
Ellonen et al., 2008	Finland	8 th and 9 th grade	95,103	cross-sectional	Classmate social support: - Teacher support: - School social support: 0	Beck's Depression Inventory (BDI) short version		
Freeman et al., 2012	Canada, Norway, Romania (HBSC)	Ages 13 and 15	10,485	cross-sectional	Overarching scale: -	Psychosomatic complaints		
Hung et al., 2015	U.S. mid-western metropolitan area	6 th -8 th grades	2,212	cross-sectional	Authoritative teacher and staff support: - Classroom orderliness: - Student support: 0		Strengths and Difficulties Questionnaire - conduct problems section	
Jia et al., 2009	New York City, United States, and Nanjing, China	7 th grade	1,415	cross-sectional	Student-perceived teacher support: - Peer support: -	Kovacs's Children's Depressive Inventory (CDI)- short version		
Joyce & Early, 2014	United States (Add Health)	7 th -12 th grades	11,852	longitudinal	School connectedness: - Gets along with teachers: - Teachers care about you: 0	Center for Epidemiologic Studies-Depression scale (CES-D)		
Kasen et al., 1990	Upstate New York, United States	Ages 9-18	300	longitudinal	School conflict: + for attention deficit, opposition, and conduct problems; 0 for depression	Separation anxiety, overanxiety, depression from Diagnostic Interview Schedule for	Attention deficit, opposition, conduct problems from DISC-P	

					Academic focus: - for opposition and conduct problems; 0 for anxiety Social facilitation: + for anxiety, depression	Children-Parent edition (DISC-P)		
Kasen et al., 2009	Upstate New York, United States	~9-18 yrs	592	longitudinal	School autonomy and learning focus: - School conflict: +			Personality Diagnostic Questionnaire, Structured Clinical Interview, for DSM – IV
Kidd et al., 2006	United States (Add Health)	7 th -12 th grades	9,142	longitudinal	School connectedness: 0	Suicide attempts		
Kuperminc et al., 1997	United States (school in New York State metropolitan district)	6 th and 7 th grade	499	cross-sectional	Haynes et al.'s school climate survey (SCS): 0 for internalizing CBCL (boys and girls), - for internalizing YSR for boys, 0 for internalizing YSR for girls, - for externalizing YSR (boys and girls), + for externalizing CBCL for boys, 0 for externalizing CBCL for girls	Achenbach's Youth Self Report (YSR) Achenbach's Child Behavior Checklist (CBCL)	YSR CBCL	
Kuperminc et al., 2001	United States (school in New York State metropolitan district)	Ages 11-14	460	longitudinal	School Climate Scale (SCS): Positive perception of school environment: - for self-criticism, low efficacy (which are + with internalizing/externalizing issues)	YSR, Depressive Experiences Questionnaire for Adolescents	YSR	
LaRusso et al., 2008	United States	Ages 14-18	476	cross-sectional	Teacher support: - Teacher regard for student perspectives: - Respect: -	YRBS-measured depressive symptoms		
LeBlanc et al., 2007	Francophone Canada	9 th -12 th grades	1,399 teachers	cross-sectional	Academic emphasis: - Professional		Teacher-reported classroom	

					autonomy: 0 Job satisfaction: 0		behavior problems— Tremblay et al.'s Social Behavior Questionnaire for teacher-reported classroom behaviors	
LeBlanc et al., 2008	Quebec, Canada	Ages 15-16	1,233	longitudinal	School academic emphasis, differences in teacher autonomy and satisfaction: 0		Antisocial behaviors assessed with DISC-2	
Lee & Bierman, 2015	Pennsylvania, United States	Kindergarten through 1 st grade	164	longitudinal	Pianta's Student-Teacher Relationship Scale: - Classroom Assessment Scoring System (CLASS): -		Teacher Observation of Child Adaptation-Revised	
Loukas & Robinson, 2004	United States (suburban central Texas)	Ages 10-14	868	cross-sectional	Peer cohesion: - for boys, 0 for girls Peer friction: + Peer competition: + for boys, 0 for girls Overall satisfaction: 0 for boys, - for girls	CDI		
Loukas et al., 2006	United States (suburban central Texas)	Ages 10-14	489	longitudinal	My Class Inventory (MCI), 5 items from Add Health Student-perceived friction: + Cohesion: - Competition among students: 0 Overall satisfaction with classes: -	CDI	Strengths and Difficulties Questionnaire	
Loukas & Murphy, 2007	United States (suburban central Texas)	Ages 10 to 14	488	longitudinal	Peer cohesion: 0 Peer friction: + Peer competition: 0 Overall satisfaction: 0	CDI		
Loukas et al., 2013	United States (suburban central Texas)	Ages 10 to 14	296	cross-sectional	School connectedness: -	Adjustment problems CDI	Strengths and Difficulties Questionnaire (SDQ)	
Meilstrup	Denmark	Ages 11-	4,032	cross-	Classroom		HBSC	

et al., 2015	(HBSC)	15		sectional	climate enjoyable: 0 Aggregate bullying exposure: + Anti-bullying policies present: 0 Other bullying prevention initiatives: 0		Symptom Check List	
O'Brennan et al., 2014	Maryland, United States	Grades 1-5	8,750	cross-sectional	Organizational Health Inventory-Elementary School Version (summary measure of positive school climate): -		Teacher Observation of Classroom Adaptation-Checklist	
Oldfield et al., 2015	Northwestern England	High school	203	cross-sectional	School connectedness: 0		SDQ- conduct problems	
Reis et al., 2007	United States	6 th -8 th grades	111,662	cross-sectional	Teacher social support: - Quality of school life: - Teaching emphasis on understanding: - Student inclusion in policy/rule making process: - Cultural sensitivity education: -		Aggressive Behaviors Frequency Scale	
Resnick et al., 1997	United States (Add Health)	7 th -12 th grades	11,572	cross-sectional	School connectedness: -	Emotional distress Suicidality		
Roeser & Eccles, 1998	United States (1 school district)	8 th grade	1,046	longitudinal	Student autonomy: 0 School ability goal structure: + School task goal structure: - Positive teacher regard: -	CDI		
Shang et al., 2014	City in Southwestern China	Grades 7-12	1,004	cross-sectional	Academic effort: + for girls and high schoolers; 0 for boys and middle schoolers Academic reward: - for boys and high schoolers; 0 for girls and middle schoolers	Suicidal ideation		

					Effort-reward imbalance: +			
Shochet & Smith, 2014	Australia (Tasmania & New South Wales)	7 th and 8 th grade	504	longitudinal	Classroom Environment Scale: -	CDI		
Stornes & Bru, 2011	Norway	8 th grade	1,171	cross-sectional	Mastery climate: - Performance climate: +	Modified Hopkins Symptom Checklist		
Suldo et al., 2012	Southeastern United States (3 public high schools)	Ages 13-18	415	cross-sectional	Haynes's SCS: Peer interpersonal relations: - for internalizing and externalizing YSR for girls and boys Parental involvement in school: - for externalizing and internalizing YSR for girls, 0 for externalizing and internalizing YSR for boys.	YSR	YSR	
Suldo et al., 2015	Southeastern United States (2 public high schools)	Ages 14-18 (grades 9-11)	500	cross-sectional	Social Experience Questionnaire—Self-Report (SEQ-S) overt victimization: 0 for internalizing, 0 for externalizing SEQ-S relational victimization: + for internalizing, 0 for externalizing SEQ-S prosocial acts: - for internalizing, 0 for externalizing	Self-Report of Personality form of the Behavioral Assessment System for Children, 2 nd edition (BASC-2)-Adolescent Version	Teacher Rating Scale Form of the BASC-2	
Visser et al., 2015	Georgia, United States	Ages 11-17	150 counties	ecological longitudinal	Poorer Georgia Student Health Survey school climate score (aggregated at county level): -		Prevalence of medicated ADHD among Medicaid recipients	
Virtanen et al., 2009	Finland	8 th and 9 th grade	24,289	cross-sectional	School personnel-perceived trust: - Opportunities for	BDI short version		

					participation: - Support for innovation: 0 Orientation towards high-quality work: 0 Accepted and clear goals: 0			
Wang, 2009	Maryland, United States	8 th grade	1,042	longitudinal	School Climate Measure (Roeser & Eccles, 1998): Perceived school performance goal structure: + Promotion of mastery goals: - Support of autonomy and discussion: - Teacher emotional support: -	CDI	CBCL	
Wang et al., 2010	U.S. Pacific Northwest	7 th and 8 th grade	677	longitudinal	Academic focus: - Discipline and order: - Peer relations: - Student-teacher relations: -		Gresham & Elliot's Social Skills Rating System for student reports	
Wang & Atwal, 2015	Miami, FL, and San Diego, CA, metropolitan areas, U.S.	High school	1,465	longitudinal	Positive school climate: - Negative peer interactions: + Fairness: -	4 questions from CES-D		
Wang & Dishion, 2011	U.S. Pacific Northwest	6 th grade	1,030	longitudinal	Perceived academic support: - School behavior management: - Teacher support: - Peer support: - Deviant peer association: +		Soberman's Teacher Perception of Risk	
Way et al., 2007	One state in the United States	8 th grade	1,451	longitudinal	Teacher support: - Peer support: - Student autonomy: - Clear and consistent school rules: -	CDI	YSR	
Wissink et al., 2014	Urban areas in the Netherlands	ages 12-20	670	cross-sectional	Student-student relationships: 0 Teacher-student		Normative Deviance Scale for delinquent behavior	

Wissink et al., 2014	Urban areas in the Netherlands	ages 12-20	670	cross-sectional	Student-student relationships: 0 Teacher-student relationships: 0		Normative Deviance Scale for delinquent behavior	
Zukauskiene et al., 2014	8 schools in one region of Lithuania	High school (ages 14-20)	2625	cross-sectional	Negative school climate: + for both Feel safe at school: - for depression, + for delinquency	CES-D for children	Adapted Kerr & Stattin's Delinquency scale	

-: inversely associated with mental health outcome

+: positively associated with mental health outcome

0: not statistically significantly associated with mental health outcome

Studies are nationally representative of that country unless indicated with more details otherwise, with two exceptions: both Add Health and HBSC are nationally representative studies.

Abbreviations:

Add Health: the National Longitudinal Study on Adolescent to Adult Health

HBSC: Health Behaviors in School-Aged Children, a WHO-facilitated study that multiple countries complete

Table 9. Summary of findings by psychological outcome and study population.

Psychological Outcome	Elementary school: cross-sectional study	Elementary school: longitudinal study	Middle school: cross-sectional study	Middle school: longitudinal study	High school: cross-sectional study	High school: longitudinal study
Internalizing problems			Mastery climate: - Performance climate: + (Stornes & Bru, 2011) Academic effort: 0 Academic reward: 0 Effort-reward imbalance: + (Shang et al., 2014)	Social facilitation: + (Kasen et al., 1990)	School connectedness: - (Resnick et al., 1997) Haynes's School Climate Survey (SCS): - (Suldo et al., 2012) Global school climate: - (Freeman et al., 2012) Academic effort: + Academic reward: - Effort-reward imbalance: + (Shang et al., 2014) SEQ-S overt victimization: 0 SEQ-S relational victimization: + SEQ-S prosocial acts: - (Suldo et al., 2015)	School connectedness: 0 (Kidd et al., 2006)
Depressive symptoms			Cohesion: - Satisfaction: - Friction: + Competition: + (Loukas & Robinson, 2004)	Cohesion: 0 Satisfaction: 0 Friction: + Competition: 0 (Loukas & Murphy, 2007) School ability/performance goal structure: + School task/mastery goal structure: - Positive teacher regard/emotional support: - Student autonomy: 0/- (Roeser & Eccles, 1998; Wang, 2009) Promotion of discussion: - (Wang, 2009) Positive teacher support: - Peer support: - (Way et al., 2007; Jia et al., 2009) Student autonomy: - Clear and consistent rules: - (Way et al., 2007) Classmates social support: - Teacher support: - (Ellonen et al., 2008) School personnel-perceived trust: -	Teacher support: -, 0 (LaRusso et al., 2008; Zukauskienė et al., 2014) Teacher regard for student perspectives: - Interpersonal respect: - (LaRusso et al., 2008) School connectedness: - Get along with teachers: - Teachers care about you: 0 (Joyce & Early, 2014) Feel safe at school: - Negative school climate: + (Zukauskienė et al., 2014)	Positive school climate: - Negative peer interactions: + Fairness: - (Wang & Atwal, 2015)

				<p>Opportunities for participation: - (Virtanen et al., 2009)</p> <p>Social facilitation: + (Kasen et al., 1990)</p> <p>Classroom Environment Scale: - (Shochet & Smith, 2014)</p>		
Externalizing problems	<p>Organizational Health Inventory-Elementary School Version: - (O'Brennan et al., 2014)</p>	<p>Pianta's Student-Teacher Relationship Scale: -</p> <p>Classroom Assessment Scoring System (CLASS): - (Lee & Bierman, 2015)</p>	<p>Teacher social support: -</p> <p>Quality of school life: - (Reis et al., 2007)</p> <p>Haynes's scale: - (Kuperminc et al., 1997)</p> <p>Perceived academic support: -</p> <p>School behavior management: -</p> <p>Teacher support: -</p> <p>Peer support: - (Wang & Dishion, 2011)</p> <p>School climate summary measure: - (Bao et al., 2015)</p> <p>Authoritative teacher and staff support: -</p> <p>Classroom orderliness: -</p> <p>Student support: 0 (Hung et al., 2015)</p> <p>Classroom climate enjoyable: 0</p> <p>Aggregate bullying exposure: +</p> <p>Anti-bullying policies present: 0</p> <p>Other bullying prevention initiatives: 0 (Meilstrup et al., 2015)</p>	<p>Positive teacher support: -</p> <p>Peer support: -</p> <p>Student autonomy: -</p> <p>Clear and consistent rules: - (Way et al., 2007)</p> <p>School performance goal structure: +</p> <p>School mastery goal structure: -</p> <p>Teacher emotional support: -</p> <p>Student autonomy: -</p> <p>Promotion of discussion: - (Wang, 2009)</p> <p>Discipline and order: -</p> <p>Student-teacher relations: -</p> <p>Academic focus: 0</p> <p>Peer relations: 0 (Wang et al., 2010)</p> <p>School conflict: +</p> <p>Academic focus: - (Kasen et al., 1990)</p>	<p>Haynes's SCS: - (Suldo et al., 2012)</p> <p>Academic emphasis: -</p> <p>Professional autonomy: 0</p> <p>Job satisfaction: 0 (LeBlanc et al., 2007)</p> <p>Student-student relations: 0</p> <p>Teacher-student relations: 0 (Wissink et al., 2014)</p> <p>School connectedness: 0 (Oldfield et al., 2015)</p> <p>Negative school climate: +</p> <p>Feel safe at school: +</p> <p>Perceived teacher support: - (Zukauskienė et al., 2014)</p> <p>SEQ-S overt victimization: 0</p> <p>SEQ-S relational victimization: 0</p> <p>SEQ-S prosocial acts: 0 (Suldo et al., 2015)</p>	<p>Undesirable school culture: + (DeWit et al., 2000)</p> <p>Teacher-reported classroom behavior problems: + (LeBlanc et al., 2008)</p> <p>Poorer Georgia Student Health Survey school climate score: - (Visser et al., 2015)</p>
Cluster A personality disorder						<p>School conflict: +</p> <p>School autonomy: - (Kasen et al., 2009)</p>
Cluster B personality						<p>School learning</p>

disorder						focus: - (Kasen et al., 2009)
Cluster C personality disorder						School conflict: + (Kasen et al., 2009)

+: positive association

-: inverse association

0: null association

Studies that included both middle and high school students are categorized per the age of the majority of study participants at the end of the study.

If multiple citations appear, this means that the same school climate construct was examined in both of those studies, and the direction(s) of the association reported reflects the findings from both/all of those studies.