School Environment and Adolescent Depressive Symptoms: A Multilevel Longitudinal Study

WHAT'S KNOWN ON THIS SUBJECT: Research indicates that adolescents who perceive their school to have a positive socioeducational environment are at reduced risk of developing depressive symptoms. However, there is limited evidence that school environments can influence adolescent emotional health independently from individual perceptions.

WHAT THIS STUDY ADDS: This multilevel longitudinal study shows that better school socioeducational environments, as assessed at the school level, reduce the prospective risk of depressive symptoms in adolescents. This association is shown to be independent from confounders and stronger in girls than boys.

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abstract

OBJECTIVE: It remains unclear whether school environments can influence the emotional health of adolescents. In this large-scale prospective study, we use multilevel modeling to examine whether the school socioeducational environment contributes to the risk of developing depressive symptoms in secondary school students.

METHODS: As part of a longitudinal study on school success in disadvantaged communities, 5262 adolescents from 71 secondary schools were followed annually. Socioeducational environment was assessed by a composite measure of social climate, learning opportunities, fairness and clarity of rules, and safety. Depressive symptoms were evaluated by using the Center for Epidemiologic Studies Depression scale. Multilevel regressions tested the association between school socioeducational environment in grade 8 and depressive symptoms in grades 10 to 11, adjusting for previous depressive symptoms in grade 7 and potential confounders at the individual and school levels.

RESULTS: Modest but significant variation in depressive symptoms was found between schools (intraclass correlation = 3.3%). School-level socioeducational environment in grade 8 was predictive of student depressive symptoms in grades 10 to 11, even after adjusting for potential school and individual confounders. This association was slightly stronger for girls. Student perceptions of school socioeducational environment were also predictive of depressive symptoms. Other school-level factors, including school size, were not predictive of depressive symptoms once socioeducational environment was taken into account.

CONCLUSIONS: Adolescents who attend a secondary school with a better socioeducational environment are at reduced risk of developing depressive symptoms. School environments appear to have a greater influence on risk in adolescent girls than boys. *Pediatrics* 2013;131:e702–e708

Depressive symptomatology is 1 of the most common and disabling mental health problems in adolescents.[1,2] Both clinical and subclinical symptoms of depression during adolescence can impair social, emotional, and/or cognitive development[3] and lead to multiple adverse consequences on functioning in adulthood, including poor educational and occupational attainment, other mental health disorders, and suicide.[4–8] Adolescence is a key period for the development and prevention of mood difficulties, because the prognosis tends to be poorer when these difficulties emerge in adolescence as opposed to adulthood.[9]

Schools represent a universal and influential context of youth development. Based on ecological models, researchers have long argued that schools can exert a strong influence not only on the intellectual growth, but also on the social and emotional well-being of students.[10] Although structural (eg, school size) and compositional (eg, aggregate student characteristics) aspects of schools can influence student adjustment,[11] past work particularly emphasizes the degree to which school environments provide adequate socioeducational support to relevant developmental needs of students, such as competence, autonomy, and relatedness.[10,12,13] Consistent with this idea, positive aspects of school socioeducational environments, such as good student–student and student–teacher relationships, teacher support, student connectedness, and classroom management practices, have been reported to reduce the risk of depressive symptomatology in students.[14–17]

However, evidence regarding the association between school socioeducational environment and student depressive symptomatology is limited in several ways.[17] Most importantly, the large majority of studies have only examined the way students perceive their school

environments in single-level designs. This makes it impossible to determine whether the associations reported in these studies should be attributed to student perceptions, school characteristics, or both. Although typically interpreted as potential impacts of school environments, these associations may, in fact, capture well-documented cognitive biases in adolescents who are vulnerable to depression.[18] A few multilevel studies did show a link between school or class context at the school level and depressive symptoms,[19,20] but most of these studies have been cross-sectional and did not control for previous depressive symptoms, limiting our understanding of the direction of the relation.

The most compelling empirical strategy to examine potential contributions of school socioeducational environment to the risk of student depressive symptoms is to use both a multilevel and longitudinal design, controlling for baseline levels of depressive symptoms. To our knowledge, only 1 study used such a design. Kasen and colleagues unexpectedly found school-level social facilitation (ie, the degree to which educational environments foster social interaction and discussion among students and teachers) to predict increases in student depression over time.[21] Mixed evidence has also been characteristic of studies based on student perceptions only, with some studies showing a positive association between perceived school climate and lower depressive symptoms,[22,23] but not others.[24,25]

In this study, we use longitudinal multilevel modeling in a large population-based prospective sample of adolescents to examine the association between overall school socioeducational environment and adolescent depressive symptoms over time. We investigate this relation adjusting for previous depressive symptoms and relevant potential confounders that have pre-

viously been associated with depressive symptomatology at the individual and school levels, including family adversity and relationships,[26,27] associated internalizing (anxiety) and externalizing (conduct) problems,[28,29] and school size.[30] Furthermore, although this is not our main focus, we examine whether perceived socioeducational environment at the student level is predictive of depressive symptoms. Finally, because adolescent girls have been shown to be at increased risk of developing depressive symptomatology when exposed to environmental adversity in comparison with boys,[31] we test whether the longitudinal association between school socioeducational environment and depressive symptoms differs by sex.

METHODS

Participants

Participants were followed annually from grade 7 through grade 11 (2003–2008) as part of a large-scale evaluation assessing the impact of a governmental initiative to improve school success in disadvantaged communities (communities at the lower 30th percentile of Quebec's population according to employment rate and level of education).[32] The complete cohort contained 6758 students for whom active and informed parental consent was obtained (77% of all eligible participants). The students attended 71 secondary schools across the province of Quebec, Canada. From these, 61 were selected through a stratified random-sampling procedure to represent the 200 secondary schools located in disadvantaged communities in Quebec in terms of geographical location, size, and language. An additional 10 schools from communities of average socioeconomic level were used as a control group for the evaluation. The total sample comprises 60 French-speaking and 11 English-speaking schools, 12 small

schools (199 students or less), 36 mid-size schools (200–999 students), and 23 large schools (1000 students or more).

For this study, we retained all participants who were aged 12 or 13 and were present at the administration of surveys in grade 7 in Spring 2004. There was no follow-up for missing students. The remaining sample consisted of 5262 students from 71 schools, with an average of 74 students per school. The sample was mostly Quebec-born whites (85.6%) and was approximately equally represented by sex, with slightly more girls than boys (girls = 52.3%).

Procedure

Data were collected via self-reported questionnaires administered in class by teachers and trained research assistants. The Institutional Review Board of the University of Montreal approved all study procedures, and informed consent was obtained from all study participants. School socioeducational environment was measured in late Fall 2004 and early Winter 2005 (grade 8). Depressive symptoms were assessed in Spring 2007 and Spring 2008 (grades 10–11). Potential confounders, including previous depressive symptoms, were measured in Spring 2004 (grade 7). Information on the outcome measure of depressive symptoms in grades 10 to 11 was available for 68.7% of participants. Missing data on potential confounders in grade 7 ranged from 0% to 21.5%. The average response rate in New Approaches, New Solutions (NANS) schools for the socioeducational environment measure at level 2 was 73.4% (SD = 12.0). More details on missing data are available in Data Analysis and the Supplemental Information.

Measures

Depressive Symptoms

Depressive symptomatology was assessed by using the Center for Epidemiologic Studies-Depression (CES-D) questionnaire.[33] The CES-D is a 20-item scale (α = .90) which requires participants to report how they felt or behaved in the past week. The scale has been validated in adolescents both in English and French.[34,35] Mean CES-D scores in grades 10 and 11 were used to capture a representative measure of depressive symptomatology.

School Socioeducational Environment

School socioeducational environment was assessed by using the Socio-Educational Environment Questionnaire, which was validated in a sample of >70 000 adolescents from 159 secondary schools.[36] This multidimensional measure taps 4 higher-order dimensions: social climate, learning opportunities, fairness and rules, and safety. Social climate is measured by student–student (5 items, α = .90) and teacher–student relationships (5 items, α = .84). Learning opportunities refer to academic and social opportunities and are derived from 6 subscales: teacher pedagogical practices (8 items, α = .89), teacher classroom management practices (4 items, α = .86), opportunities for decision-making about school life (4 items, α = .80), extracurricular activities (5 items, α = .86), educational climate (7 items, α = .92), and academic and social support to students experiencing difficulties (5 items, α = .80). Fairness and rules is assessed by 5 subscales: clarity of rules (6 items, α = .83), implementation of rules (4 items, α = .82), surveillance (3 items, α = .63), climate of justice (3 items, α = .90), and equity in the implementation of rules and adult behaviors (4 items, α = .86). Finally, safety is measured by climate of security (5 items, α = .80) and school violence (reverse-coded) (12 items, α = .90). The 4 higher-order dimensions were derived from a preliminary confirmatory factor analysis,

standardized into Z scores, and averaged into global school socioeducational environment.

Socioeducational environment at the school level (level 2) was created by aggregating the individual scores of the subjects of this longitudinal cohort (grade 8), as well as the scores of all students within each school that were part of the original evaluation (students from grades 7–11). This school-level measure was thus built from the aggregated score of an average of 584 students per school, a much larger sample than the restricted longitudinal sample used in the current study. Perceived socioeducational environment at the student level (level 1) was the score reported by each student.

Potential Individual and School Confounders

We considered a wide range of potential student-level and school-level confounders when we assessed the association between school socioeducational environment and depressive symptoms. At the individual level, we controlled for initial demographic and psychosocial characteristics of participants at secondary school entry: gender (0 = boy; 1 = girl), ethnicity (0 = Quebec born white; 1 = other), family adversity (a cumulative index of 9 risk factors such as low maternal education and parental occupational prestige), previous CES-D depressive symptoms (α = .87), delinquent behaviors (6-item scale, α = .94),[37] school anxiety (6 items, α = .79),[38] intelligence (Raven matrices),[39] as well as communication (6 items, α = .85) and conflict with parents (3 items, α = .73).[37] At the school level, we controlled for school size and socioeconomic status (official area data), as well as school language (0 = French; 1 = English) and exposure to the governmental intervention (0 = control; 1 = intervention).

Data Analysis

We examined the association between school socioeducational environment in grade 8 and subsequent depressive symptoms in grades 10 to 11 by using multilevel regression in Mplus 6.12.[40] Because students were asked to report information at the school level and consistent with conceptual and measurement advances on school-level effect,[41] we tested a pure association between school-level socioeducational environment (level 2) and subsequent depressive symptoms at the student level (level 1). Perceived socioeducational environment at level 1 was specified as a group-mean–centered variable to remove all school-level variation and thus represented the difference between the perception of participants and the mean perception in their respective school.

We first investigated unadjusted and adjusted associations between socioeducational environment in grade 8 and subsequent depressive symptoms in grades 10 to 11. In a second step, we tested moderation by gender. This was done by deriving a random slope between gender and depressive symptoms and predicting this slope by school-level socioeducational environment. To retain all available participants and reduce potential bias associated with attrition (see the Supplemental Information), missing data were taken into account by using multiple imputation. We devised an H0 imputation strategy in Mplus 6.12 taking into account the multilevel structure of the data and the distribution of variables (continuous and categorical). Analyses were performed on 100 imputed data sets.

RESULTS

Descriptive Statistics

Table 1 shows the descriptive statistics for the main study variables. An unconditional multilevel model indicated that depressive symptoms varied significantly at the individual and school levels, although the proportion of total variation observed at the school level was fairly modest (intraclass correlation 1 = 3.3%). This is consistent with previous studies[17] and does not preclude explaining school-level variation in depressive symptoms by relevant level-2 factors.

Prospective Association Between School Socioeducational Environment and Student Depressive Symptoms

Table 2 shows the results of longitudinal multilevel models examining the association between school socioeducational environment in grade 8 and student depressive symptoms in grades 10 to 11. Unadjusted associations are presented in the left-end column. At the school level (level 2), better socioeducational environment in grade 8 was found to significantly predict lower depressive symptoms in grade 10 to 11. This school-level predictor reduced between-school variation in depressive symptoms by ~40% (σ^2 = 2.69 to σ^2 = 1.70). Increased risk of depressive symptoms was also found in larger and English-speaking schools in unadjusted analyses, although school size was only a marginally significant predictor. At the student level (level 1), perceived school socioeducational environment was associated with lower subsequent depressive symptoms. In other words, students who perceived their school environment to be more positive than the average student in their school were at lower risk of developing depressive symptoms over time. All other potential individual confounders in grade 7 were associated with depressive symptoms in grades 10 to 11 in unadjusted analyses.

The right-end column of Table 2 next shows adjusted associations between school socioeducational environment in grade 8 and depressive symptoms in grades 10 to 11. At school level (level 2), adjustment reduced but did not eliminate the association between school socioeducational environment and subsequent depressive symptoms. On the other hand, school size and language became nonsignificant. At the individual level (level 1), perceived school socioeducational environment remained among the strongest predictors of subsequent symptoms after adjustment.

Moderation by Sex

We tested a cross-level interaction between school socioeducational environment and sex in predicting depressive symptoms. To do so, we derived a random slope from the link between sex at the student level (level 1) and depressive symptoms and predicted this slope by socioeducational environment at the school level (level 2). School socioeducational environment was found to marginally predict this random slope ($B_{[1\ SD\ unit]}$ = 0.62, confidence interval = −0.09 to 1.32; $P <$ .10), indicating a slight interaction effect. We decided to examine this marginal effect, because cross-level interactions are particularly difficult to detect.[42] Decomposition of the interaction suggests that school socioeducational environment tended to have a stronger predictive effect on depressive symptoms in girls (B = −

TABLE 1 Means and SDs of Depressive Symptoms in Grade 7 and Grades 10 to 11

	Mean (SD)		
	Total Sample	Girls	Boys
Depressive symptoms (grade 7)	13.9 (9.7)	14.9 (10.6)	12.7 (9.0)
Depressive symptoms (grades 10–11)	13.4 (9.6)	14.0 (9.8)	12.9 (9.5)

	Depressive Symptoms in Grades 10–11, Unstandardized Coefficient (95% CI)	
	Unadjusted	Adjusted
Level 2 fixed effects		
School socioeducational environment (1 = SD)	−1.24 (−1.79 to −0.69)***	−0.63 (−1.20 to −0.06)*
School size (1 = SD)	0.49 (−0.09 to 1.08)†	0.01 (−0.55 to 0.57)
Intervention (1 = yes)	−0.54 (−2.22 to 1.15)	−0.60 (−1.69 to 0.50)
Language (1 = English)	2.16 (1.05 to 3.28)***	0.41 (−0.63 to 1.46)
School SES (1 = SD)	−0.22 (−0.83 to 0.40)	−0.06 (−0.66 to 0.55)
Level 1 fixed effects		
Perceived school socioeducational environment (1 = SD)	−1.63 (−1.95 to −1.30)***	−0.88 (−1.24 to −0.51)***
Baseline depressive symptoms (1 = SD)	3.10 (2.76 to 3.43)***	2.38 (1.99 to 2.77)***
Sex (1 = male)	−1.17 (−1.84 to −0.49)***	−0.24 (−0.75 to 0.27)
Ethnicity (1 = non Quebec born white)	1.00 (0.12 to 1.88)*	0.22 (−0.01 to 0.45)†
Family adversity (1 = SD)	1.15 (0.85 to 1.45)***	0.49 (0.10 to 0.79)**
Delinquent behaviors (1 = SD)	0.97 (0.61 to 1.34)***	−0.40 (−0.80 to 0.00)*
Social anxiety (1 = SD)	1.56 (1.22 to 1.90)***	0.51 (0.18 to 0.84)**
Communication with parents (1 = SD)	−1.26 (−1.57 to −0.95)***	−0.15 (−0.56 to 0.26)
Conflict with parents (1 = SD)	1.65 (1.31 to 1.99)***	0.34 (−0.05 to 0.73)
Intelligence (1 = SD)	−1.39 (−1.77 to −1.01)***	−0.94 (−1.30 to −0.57)***

CI, confidence interval; SES, socioeconomic status.

*** $P < .001$;

** $P < .01$;

* $P < .05$;

† < 0.10.

0.76, CI = −1.24, −0.24) than boys (B = −0.26, CI = −0.79, 0.23).

DISCUSSION

With the use of a multilevel and longitudinal design, the current study showed a prospective association between school socioeducational environment and subsequent depressive symptoms in adolescents. Although we found relatively modest school-level variation in depressive symptoms (intraclass correlation = 3.3%) consistent with estimates reported in previous studies,[17] school socioeducational environment emerged as the strongest predictor of this variation beyond multiple school and individual factors, including previous depressive symptoms.

School socioeducational environment may influence student emotional development in several ways. First, schools have been argued to foster healthy development when their environment adequately supports the mastery by students of age-specific developmental tasks.[13] Secondary schools that better support students, notably by matching their needs for relatedness, competence, and autonomy with relational care and opportunities for expression and mastery, can be expected to foster better social and emotional adjustment.[11,12] Such schools may foster an increased sense of connectedness or belonging in students.[24] Adolescents who feel connected to their school tend to have better peer relationships, motivation, and achievement,[43] and have been repeatedly found to be at reduced risk of emotional problems, including depressive symptomatology.[15,17,44]

Alternatively, school socioeducational environments may influence the development of depressive symptoms in students via stressful life events. Schools with a poorer socioeducational environment can be the source of a variety of stressors consistently linked to depressive symptoms, including in-terpersonal stress, academic stress, and high-intensity adverse events.[45,46] Importantly, poorer school socioeducational environments may exert chronic and unavoidable stress, which is more strongly linked to mood disruptions than acute life events or episodic stress.[47]

Our results suggest that the association between school socioeducational environment and depressive symptoms may be stronger for girls. This finding is consistent with research on gender differences in depression, which suggests that girls develop complex biopsychosocial vulnerabilities during adolescence that place them at increased risk of mood difficulties, such as increased biological and cognitive reactivity to stress.[31,48,49] Importantly, these vulnerabilities are thought to be activated specifically when girls are exposed to negative and stressful circumstances. As such, positive, coherent, and secure school environments may constitute an important ecological buffer against mood vulnerabilities in girls. Moreover, the relational component of school socioeducational environments may be of particular significance. Because girls become increasingly interpersonally oriented during adolescence,[50] school environments characterized by healthy student–student and student–teacher relationships may provide a supportive soil for affective development that is particularly potent during the sensitive period of adolescence.

Interestingly, we found residual perceptions of school environment by students to be predictive of subsequent depressive symptoms. Students who were positively biased in the appreciation of their school environment compared with the average perception in their school were at decreased risk of experiencing later depressive symptoms. Consistent with these results, developmental models emphasize that ecological effects do not solely depend

on the objective environment, but also the way individuals subjectively interpret and construct this environment.[51] Our results suggest that school socioeducational environments may matter at these 2 levels: a subjective level, captured by student perceptions, and a more objective level, approximated by shared school-level perceptions.

The key strength of this study is a well-controlled, multilevel, and longitudinal design. Nonetheless, some limitations must be acknowledged. First, response rates on school-level measures were not equivalent in all schools. This raises the possibility of a positive bias in low-responding schools because of selection of more motivated students. Supplementary analyses (Supplemental Information) based on available information on participants who did not respond to school-level measures suggest that these participants would indeed have evaluated their environment more negatively than participants who provided responses and thus that the quality of the environment was probably overestimated in low-responding schools. However, because poorer socioeducational environments were found in low-

responding schools, it appears likely that a stronger rather than weaker association between school environment and student depressive symptoms would have been observed with equal responding in all schools. Second, all key study measures were based on student self-report, including school-level environment. However, student-based assessments of school environments at level 2 were found to be highly correlated with teacher-based assessments in NANS (r = 0.73).[36] Third, sample size at the school level was relatively modest. This notably limited our capacity to examine specific dimensions of school socioeducational environment. Fourth, the sample in this study was mainly limited to schools and students from disadvantaged areas. Results may not generalize to all types of schools (eg, private schools).

Future studies with a larger sample of schools should attempt to clarify which aspects of school socioeducational environments are more strongly linked to adolescent depressive symptomatology than others. Furthermore, research to come could complement our findings by clarifying the antecedents (eg, school structure) of positive

school socioeducational environments and the proximal mechanisms (eg, increased school belonging and connectedness, reduced stressful life events) by which these environments may decrease the risk of depressive symptoms.

This study has important policy implications. In recent years, there has been a growing interest in "whole school" and "health promoting school" approaches that aim to improve student adjustment by building protective school ecologies rather than solely focusing on individuals.[52] However, evidence in favor of such ambitious policies has been weak.[17] Our results lend some of the first compelling support to the notion that fostering supportive school socioeducational environments may result in reduced risk of depressive symptoms in student populations, although schoolwide effects may be of limited magnitude.

ACKNOWLEDGMENTS

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Pediatrics 2013;131;e702
DOI: 10.1542/peds.2012-2172 originally published online February 11, 2013;

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