Original Contribution

Poor, Unsafe, and Overweight: The Role of Feeling Unsafe at School in Mediating the Association Among Poverty Exposure, Youth Screen Time, Physical Activity, and Weight Status

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This study applied socioecological and cumulative risk exposure frameworks to test the hypotheses that 1) the experience of poverty is associated with feeling less safe at school, and 2) feeling less safe is associated with engaging in poorer weight-related behaviors, as well as an increased probability of being overweight or obese. Data were from the ongoing Québec Longitudinal Study of Child Development, initiated in 1998 with a population-based cohort of 2,120 Québec (Canada) infants 5 months of age and their parent or primary caregiver. Measures of youths’ (age, 13 years) self-reported feelings of safety, screen time, physical activity, and objectively assessed weight status were collected in 2011. Family poverty trajectory from birth was assessed by using latent growth modeling. As hypothesized, exposure to poverty was associated with feeling less safe at school and, in turn, with an increased probability of being overweight or obese. The association was most pronounced for youths who experienced chronic poverty. Compared with youths who experienced no poverty and felt unsafe, those who experienced chronic poverty and felt unsafe were nearly 18% more likely to be obese (9.2% vs. 11.2%). Although feeling unsafe was associated with screen time, screen time did not predict weight status.

birth cohort; Canada; obesity; safety; structural equation modeling; television; trajectory

Abbreviations: CFI, comparative fit index; RMSEA, root mean square error of approximation; SD, standard deviation.

In North America, obesity is particularly prevalent among youths who live in poverty (1, 2). Disadvantage predisposes youths to multiple risks, including chronic health problems, acute infections, higher hospital admission rates, and more disability days (3–5). A stress and coping perspective suggests that differences in well-being and health can be explained by not only personal strengths (e.g., resilience) but also the social context (6). Part of the association between early childhood poverty and obesity is explained by the cumulative exposure to physical (e.g., crowding) and social (e.g., family turmoil) risks (7). Youths experiencing poverty are more likely to reside in disadvantaged neighborhoods, potentially exposing them to poorer food environments, fewer appealing infrastructures designed to promote physical activity (8, 9), and greater psychosocial stressors (2).

Addressing the prevalence of childhood obesity from a socioecological standpoint requires consideration of the multiplicity of factors contributing to obesity. In reviews of childhood obesity literature, the school is identified as a potential environmental influence on youths’ weight-related behaviors and consequent weight gain (1) and as a key entry point for interventions aimed at preventing obesity (10). For instance, the school setting can have positive effects on physical activity levels through the implementation of class curriculum or by providing staff training (11). School-related stressors, such as lack of teacher support, low school socioeconomic status, and classroom rowdiness, have also been linked to decreased physical activity (12, 13), while youths’ experiences at school (e.g., perceiving themselves as poor students) have been linked to their weight status (14).
This study builds on previous research linking school-related stressors to poorer health (15) by focusing on a specific psychosocial stressor, namely, feeling unsafe at school. Although feeling less safe in the neighborhood is linked to decreased physical activity (16) and obesity (17) among youths, little research has considered the effects of feeling unsafe at school. The concept of feeling unsafe at school may reflect the overall social and physical environment of the school and the surrounding neighborhood, and it may also capture youths’ personal sense of a lack of safety due to their experiences at school (e.g., victimization) and personal traits (18, 19). We focus on youths’ feelings of safety at school as opposed to victimization or objective measures of school safety (e.g., based on reported incidents of school violence), as evidence suggests that youths’ own perceptions are statistically and clinically more important indicators of stress (6). Furthermore, even after adjustment for objective measures of the school climate and safety (e.g., victimization), feeling unsafe at school is associated with deleterious health outcomes (20, 21).

The study therefore adds to the literature on individual-level pathways linking poverty to obesity, which have yet to consider youths’ feelings of safety at school. A primary aim was to investigate if the association between poverty and weight status is mediated by feelings of safety at school. We hypothesized that youths who experience poverty feel less safe at school, as youths from lower socioeconomic backgrounds tend to perceive their school as being more dangerous (22, 23). Because the experience of poverty throughout the life course predisposes youths to cumulative risk exposures, this study considers the association between youths’ poverty trajectory (notably the experience of chronic, early and later childhood poverty) and outcomes. We also consider potential moderated associations between feelings of safety at school and weight status, depending on the poverty trajectory.

Feeling unsafe at school could additionally contribute to poorer weight-related behaviors by leading to decreased participation in extracurricular activities, including involvement in athletic teams (22), poorer general physical and emotional health (24, 25), and potentially greater stress felt at home given the continuity in stressors in the school and home contexts (26). We therefore further hypothesized that feeling less safe at school was also associated with spending more time in front of screens and decreased physical activity.

We simultaneously test these 2 central hypotheses, adjusting for potential confounders including maternal body mass index (weight (kg)/height (m)^2), victimization at school, and the school safety climate. Maternal body mass index can be an indicator of a less healthful family environment and may explain intergenerational associations between socioeconomic status and obesity (27). Victimization contributes to perceived school safety (28), as well as to a range of psychosocial and health problems (29), while the overall school safety climate can also come to negatively impact youths (30). The study therefore takes into account the complex pathways linking poverty to weight-related behaviors and weight status.

**METHODS**

This study draws on data from the Québec Longitudinal Study of Child Development (QLSCD), a prospective cohort study.
study designed to improve knowledge about the psychosocial development of children. This study began in 1998 with a representative population-based birth cohort of 2,120 infants 5 months of age and their parent or primary caregiver. Details on sample selection and procedure have been published elsewhere (31). In the initial cohort, 49.1% were girls, and 72% were defined by their primary caregiver as being Canadian. Individuals who report being Canadian tend to have English or French as a mother tongue and were born in Canada, with both parents born within Canada (32). Families were reinterviewed yearly, except in 2007 and 2009. Our analyses draw largely on measures from the 12th wave, collected in 2011 ($n = 1,234$). This represents the most recent wave of the study and the first secondary-school measure of youths’ feelings of safety at school. Compared with youths in the baseline study wave, youths in the 12th wave were less likely to come from families who fell below the poverty line (12% vs. 24.5%), were more likely to be born from Canadian mothers (66.3% vs. 63.7%), and were less likely to be boys (46.1% vs. 50.9%). Youths completed the computer-assisted survey at home with an interviewer. Measures of poverty and maternal body mass index were obtained from earlier waves, including

#### Table 1. Descriptive Statistics for Total Sample and by Weight Status for Youths Aged 13 Years, Québec Longitudinal Study of Child Development, 1998–2011

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall ($n = 1,234$)</th>
<th>Not Overweight/Obese ($n = 862$)</th>
<th>Overweight ($n = 268$)</th>
<th>Obese ($n = 100$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Mean (SD)</td>
<td>No.</td>
<td>% Mean (SD)</td>
<td>No.</td>
</tr>
<tr>
<td>Feeling safe at school</td>
<td>4.13 (0.91) 1,230</td>
<td>4.20 (0.86) 859</td>
<td>4.08 (0.95) 267</td>
<td>3.73 (1.09) 100</td>
</tr>
<tr>
<td>Physical activity</td>
<td>3.93 (1.77) 938</td>
<td>3.99 (1.79) 667</td>
<td>3.79 (1.79) 202</td>
<td>3.69 (1.5) 67</td>
</tr>
<tr>
<td>Screen time</td>
<td>1,171</td>
<td>823</td>
<td>252</td>
<td>92</td>
</tr>
<tr>
<td>Computer</td>
<td>0–5 hours</td>
<td>55.82</td>
<td>55.02</td>
<td>58.80</td>
</tr>
<tr>
<td>Physical activity</td>
<td>3.93 (1.77) 938</td>
<td>3.99 (1.79) 667</td>
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</tr>
<tr>
<td>Internet</td>
<td>0–5 hours</td>
<td>66.78</td>
<td>66.47</td>
<td>67.86</td>
</tr>
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</tr>
<tr>
<td>Television</td>
<td>0–5 hours</td>
<td>62.16</td>
<td>63.21</td>
<td>60.53</td>
</tr>
<tr>
<td>Internet</td>
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<td>823</td>
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<td>92</td>
</tr>
</tbody>
</table>

Abbreviation: SD, standard deviation.

a Estimated poverty trajectories for those missing from the 12th wave but with at least some earlier measures of poverty ($n = 878$) are as follows: reference group (i.e., no poverty, 65.15%); chronic poverty (19.36%); early childhood poverty (8.88%); later childhood poverty (6.61%).

b Weight (kg)/height (m$^2$).
Table 2. Structural Equation Models Predicting Weight Status, Weight-Related Behaviors, and Feelings of Safety at School for Youths Aged 13 Years, Quebec Longitudinal Study of Child Development, 1998–2011

<table>
<thead>
<tr>
<th>Model and Variable</th>
<th>Weight Status</th>
<th>Screen time</th>
<th>Physical Activity</th>
<th>Feeling Safe at School</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probit P Value</td>
<td>R², %</td>
<td>β P Value</td>
<td>R², %</td>
</tr>
<tr>
<td>Model 1*</td>
<td>1.4</td>
<td>8.9</td>
<td>0.03</td>
<td>6.1</td>
</tr>
<tr>
<td>Age</td>
<td>−0.05</td>
<td>0.03</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Male</td>
<td>0.04</td>
<td>−0.03</td>
<td>0.23 &lt;0.001</td>
<td>0.02</td>
</tr>
<tr>
<td>Screen time</td>
<td>−0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity</td>
<td>−0.10 &lt;0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s BMI</td>
<td>0.27 &lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty</td>
<td>0.07 &lt;0.05</td>
<td>−0.04</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Early childhood poverty</td>
<td>0.00</td>
<td>0.03</td>
<td>−0.02</td>
<td></td>
</tr>
<tr>
<td>Later childhood poverty</td>
<td>−0.02</td>
<td>0.01</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Indirect associations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty → mother’s BMI</td>
<td>0.04 &lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early childhood poverty → mother’s BMI</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Later childhood poverty → mother’s BMI</td>
<td>0.02 &lt;0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2*</td>
<td>11.4</td>
<td>0.8</td>
<td>6.1</td>
<td>4.1</td>
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<tr>
<td>Age</td>
<td>−0.04</td>
<td>0.03</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Male</td>
<td>0.03</td>
<td>−0.04</td>
<td>0.23 &lt;0.001</td>
<td>−0.16 &lt;0.001</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity</td>
<td>−0.10 &lt;0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s BMI</td>
<td>0.27 &lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty</td>
<td>0.06</td>
<td>−0.04</td>
<td>0.07</td>
<td>−0.09 &lt;0.01</td>
</tr>
<tr>
<td>Early childhood poverty</td>
<td>−0.01</td>
<td>0.02</td>
<td>−0.02</td>
<td>−0.06 0.07</td>
</tr>
<tr>
<td>Later childhood poverty</td>
<td>−0.03</td>
<td>0.01</td>
<td>0.02</td>
<td>−0.05 0.07</td>
</tr>
<tr>
<td>Feeling safe at school</td>
<td>−0.16 &lt;0.001</td>
<td>−0.07 &lt;0.05</td>
<td></td>
<td>−0.00</td>
</tr>
<tr>
<td>Indirect associations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty → FSS</td>
<td>0.01 &lt;0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty → mother’s BMI</td>
<td>0.04 &lt;0.001</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Early childhood poverty → FSS</td>
<td>0.01 0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early childhood poverty → mother’s BMI</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Later childhood poverty → FSS</td>
<td>0.01 0.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Later childhood poverty → mother’s BMI</td>
<td>0.02 &lt;0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table continues

from a complementary health component collected when youths were aged 10 years. Participants provided signed, informed consent at each round. This study received approval from the ethics review boards of the Institut de la statistique du Quebec, the Centre Hospitalier Sainte-Justine, and the Faculty of Medicine of Universite de Montreal.

Outcome measure: weight status

Youths’ height and weight were measured by trained interviewers. By use of recommended age- and sex-specific cut-points (33), youths were categorized as not overweight/obese (= 1) (70%) (reference group), overweight (= 2) (22%), or...
obese (= 3) (8%). Underweight youths (5%) were included in the “not overweight/obese” category. Weight status was analyzed as a categorical ordinal variable.

Main mediating variables

Youths reported, in 3 separate items, how much time per week they spent on average over the past 3 months on the computer, on the Internet, and watching television (1 = no time, 2 = less than 1 hour, 3 = 1–2 hours, 4 = 3–5 hours, 5 = 6–10 hours, 6 = 11–14 hours, 7 = 15–20 hours, 8 = more than 20 hours) (question items are available online at http://www.iamilbe.stat.gouv.qc.ca). Self-reported screen time has been established as a valid and reliable predictor of cardiometabolic risk factors, such as obesity (34, 35). In the statistical models, each item was used as an observed indicator (i.e., manifest variable) of a latent variable representing screen time. Each item loaded significantly on the factor (P’s < 0.001).

Youths reported how many days a week (0–7 days) they do physical activity at home, at school, or elsewhere (excluding...
physical education classes at school and walking). Similar measures have been established as being valid and reliable measures of physical activity (36).

Feelings of safety at school were measured on the basis of youths’ agreement with the statement, “I feel safe at my school” (1 = strongly disagree, 2 = disagree, 3 = unsure, 4 = agree, 5 = strongly agree). This measure has been shown to have validity and reliability in terms of both predictors (e.g., sociodemographics) (37) and predicting outcomes (e.g., well-being) (24). This measure was analyzed as a categorical ordinal variable.

Main independent variable: poverty trajectory

Measures of poverty were obtained for every wave collected between 1998 and 2011 (except for the 2002 wave when the timing of data collection precluded measuring family poverty), representing a total of 11 data points. “Poverty” was defined as having a family household income (before taxes) that fell below the Canadian low-income cutoff of that year. Family poverty trajectory was estimated in Mplus, version 7.11 (Muthén and Muthén, Los Angeles, California), by using latent class growth analysis. The results identified nonlinear growth curves based on estimated intercepts, slopes, and a quadratic term for each trajectory. Youths were classified into their most likely trajectory. Based on previous findings (38), the interpretability of the identified trajectories, and the fit statistics (39), a 4-trajectory model was retained (Figure 1). The 4 trajectories of exposure to poverty reflected 1) no poverty (reference group) (68.56%), 2) chronic poverty (14.49%), 3) early childhood poverty (8.76%), and 4) later childhood poverty (8.19%).

Covariates

Covariates included youths’ age, sex, maternal body mass index, victimization at school, and the school safety climate. Youths reported how often since the beginning of the school year they experienced 5 forms of victimization at school (e.g., “a youth from your school pushed, hit, or kicked you”) (1 = never, 2 = rarely, 3 = often, 4 = very often). A latent variable representing victimization was estimated, and each item loaded significantly on the factor ($P's < 0.001$). Youths’ language or math teacher reported whether “students don’t feel safe,” “there are areas that students are afraid to go to,” and “students are easily bullied” (1 = completely disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree, 6 = completely agree). A latent variable reflecting an unsafe school climate was estimated, and each item loaded significantly on the factor ($P's < 0.001$).

Mothers reported their weight and height when youths were aged 10 years; body mass index was computed as weight (kg)/height (m)².

Statistical analysis

Four structural equation models were estimated by using Mplus, version 7.11. While the longitudinal nature of the study allowed us to measure the experience of poverty over time, the current analysis is partly cross-sectional because of the timing of measurement of key outcomes. Structural equation modeling is a useful analytical method for longitudinal and cross-sectional data, as it permits testing both the fit of hypothesized directional relations between variables and the structure of relationships with the observed data (40, 41). This modeling approach has previously been used to demonstrate cross-sectional direct and indirect associations between environmental correlates (e.g., parent reports of neighborhood safety) and adolescent obesity (42).

The first structural equation model (model 1) estimated the direct association between poverty trajectory and the probability of having a “not overweight/obese,” overweight, or obese weight status. Model 2 simultaneously estimated the associations between poverty trajectory, maternal body mass index, and weight-related behaviors and weight status. In model 3, youths’ feelings of safety at school were added to the model to test the hypotheses that youth poverty is indirectly associated with weight-related behaviors and with weight status through feelings of safety at school. Finally, model 4 controlled for youths’ age and sex; took into account the association among poverty trajectory, maternal body mass index, and youths’ weight status; allowed physical activity and screen time to correlate; allowed victimization and the school safety climate to correlate; and set correlations between poverty trajectory groups to 0.

The models were estimated by using the weighted least-squares mean- and variance-adjusted method with missing data. This method is appropriate for ordinal variables and uses all available information in estimating parameters, therefore providing better estimates of associations than complete case analysis. Estimated parameters are comparable to those obtained by using full information maximum likelihood estimation (43, 44) when missing data assumptions are met (45). To meet these assumptions, all observed variables were allowed to correlate with an auxiliary variable associated with attrition, in this case, family socioeconomic status when youths were aged 5 months (46). At least partial data were available for all youths; the analytical sample therefore includes all youths ($n = 2,120$). Reported indirect associations are based on the product of coefficients method, and standard errors are delta method standard errors (47).

RESULTS

Youths’ mean age was 13.14 (standard deviation (SD), 0.26) years, and 54% were girls in the 12th wave (Table 1). In general, youths tended to agree that they felt safe at school with the mean = 4.13 (SD, 0.91), although nearly 20% of the youths were unsure or disagreed. Youths reported doing physical activity approximately 4 days per week with the mean = 3.93 (SD, 1.77), and they tended to report spending less than 15 hours on television and computer screens and on the Internet.

The results of model 1 suggested a good fit with the data ($$\chi^2 = 0.46, df = 3, P > 0.05$$, comparative fit index (CFI) = 1, root mean square error of approximation (RMSEA) = 0.00). Youths who experienced chronic poverty were more likely to have an overweight or obese weight status than those
who experienced no poverty (Table 2). Early and later childhood poverty were not associated with weight status.

With adjustment for weight-related behaviors, youths who experienced chronic poverty continued to be more likely to be overweight or obese than those who experienced no poverty (model 2: $\chi^2 = 33.27$, df = 23, $P > 0.05$, CFI = 0.99, RMSEA = 0.02). Youths who experienced chronic poverty reported doing marginally more physical activity than those who experienced no poverty, and higher levels of physical activity were associated with a lower probability of having an overweight or obese weight status. Still, there was no significant indirect association between poverty and weight status through physical activity. There was no significant association between poverty and screen time nor between screen time and weight status. However, the analyses revealed indirect associations between experiencing chronic or later childhood poverty and an increased probability of having an overweight or obese weight status, through increased maternal body mass index.

The results of model 3 ($\chi^2 = 38.90$, df = 26, $P > 0.05$, CFI = 0.99, RMSEA = 0.02) suggested a direct association between feeling safer and being less likely to be overweight or obese. The results also supported the hypothesized indirect association. Youths who experienced chronic poverty felt less safe at school and, in turn, were more likely to be overweight or obese. Youths who experienced early and later childhood poverty also tended to feel less safe than those who experienced no poverty, resulting in marginally significant indirect associations with weight status. Youths who felt safer at school also reported spending less time in front of screens. Adjustment for victimization weakened the association between feeling safe at school and screen time, although feeling safe continued to be associated with weight status (model 4: $\chi^2 = 333.77$, df = 123, $P < 0.001$, CFI = 0.97, RMSEA = 0.03) (Figure 2). Victimization indirectly contributed to the association between poverty and weight status. Specifically, youths who experienced chronic poverty reported higher levels of victimization and, in turn, felt unsafe at school, which was associated with an increased likelihood of being overweight or obese. This model also identified indirect associations between sex, victimization, and screen time and weight status. Boys were more likely to report being victimized at school, which
was associated with increased screen time and an increased likelihood of being overweight or obese.

Poverty exposure was found to moderate the association between feeling unsafe at school and weight status. Predicted probabilities based on the parameters estimated in model 4 suggested that feeling safer led to the biggest decrease in the probability of having an overweight or obese weight status for youths who experienced chronic poverty (Figure 3). The models were also estimated by using a design-based method that accounted for school clustering (48, 49). Because very few youths attended the same school (mean = 2.68) and the results did not change substantially when accounting for school clustering (refer to Appendix 1), these models were not retained.

**DISCUSSION**

Building on research that identifies a link between early childhood poverty and cumulative risk exposures for obesity (7), the present findings suggest that feeling unsafe at school represents a further risk for obesity. Our results suggest that the experience of chronic and early childhood poverty is associated with feeling less safe at school. For these youths, feeling less safe at school acts as a cognitive appraisal linking poverty to an increased probability of being overweight or obese. The study also reveals 2 additional pathways linking poverty to weight status: victimization at school and maternal body mass index (Table 3). Accounting for these indirect pathways reduced the direct association between chronic poverty and weight status. The results support findings suggesting a familial transmission of weight status (50), and they underscore the prohibitive role of family poverty in terms of youths’ opportunities for healthy weights and weight-related behaviors (51).

Youths who experienced chronic poverty report feeling unsafe at school mainly because of their increased experience of victimization. This finding is supported by evidence suggesting that youths in low-income schools face less favorable school environments, including an increased exposure to school violence (52). However, those who experienced early childhood poverty reported feeling less safe independently of victimization, suggesting that additional psychosocial processes are at play. For instance, youths who experienced early childhood poverty may feel less safe in part because of perceived vulnerability, which has been found to link poverty to feeling less safe among adults (53).

The association between early childhood poverty and feeling less safe at school in adolescence may also be indicative

Table 3. Pathways Linking Poverty to Youths’ Increased Probability of Being Overweight or Obese for Youths Aged 13 Years, Québec Longitudinal Study of Child Development, 1998–2011

<table>
<thead>
<tr>
<th>Mediating Variable</th>
<th>Environment</th>
<th>Potential Mechanism</th>
<th>Most at-Risk Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling less safe at school</td>
<td>School environment</td>
<td>Psychological distress  Poorer psychophysiological health</td>
<td>Boys Youths who experience chronic or early childhood poverty</td>
</tr>
<tr>
<td>Experiencing more victimization at school</td>
<td>School environment</td>
<td>Increased screen time Feeling less safe at school</td>
<td>Boys Youths who experience chronic poverty</td>
</tr>
<tr>
<td>Higher body mass index of mother</td>
<td>Family environment</td>
<td>Psychological distress  Social retreat  Diet</td>
<td>Youths who experience chronic or later childhood poverty</td>
</tr>
</tbody>
</table>

Figure 3. The moderating role of poverty trajectory on the association between feeling safe at school and the probability of having a not overweight/obese, overweight, or obese weight status for youths, Québec Longitudinal Study of Child Development, 1998–2011. Based on unstandardized regression coefficients from model 4, predicted probabilities are for a boy aged 13 years. Values for screen time, victimization, physical activity, and mother’s body mass index were held at the mean. Values for feeling unsafe were set at the minimum (=1) and for feeling safe were set at the maximum (=5). Lines with circle endpoints are probabilities of having a not overweight/obese weight status. Lines with diamond endpoints are probabilities of having an overweight weight status. Lines with no endpoint markers are probabilities for those who experienced chronic poverty, dotted lines are probabilities for those who experienced early childhood poverty, dotted lines are probabilities for those who experienced later childhood poverty, and full lines are probabilities for those who experienced no poverty.
of the accumulation of the effects of adversity on indicators of psychophysiological stress over time, a process referred to as allostatic load (54). This psychosocial stress pathway could help to explain why weight-related behaviors do not fully mediate the direct association between feeling less safe at school and weight status. Still, our results support research that suggests that experiencing psychological distress is associated with engaging in poorer weight-related behaviors and with less healthy weights (55, 56).

It is also possible that neighborhood features help to explain the association among the experience of poverty, feelings of school safety, and weight status. Parent-reported neighborhood disorder and a lack of social cohesion have been shown to contribute to youths’ decreased feelings of safety at school (57), while less youth-reported neighborhood social cohesion is associated with poorer self-reported health (58). However, adding parent-reported neighborhood-level social cohesion to the models did not help to explain outcomes or reduce the strength of the association between feelings of school safety and weight status. Future research should investigate whether youths’ neighborhood perceptions help to explain the observed associations, given their association with feelings of safety at school (18).

Strengths of this study include the use of a large population-based birth cohort, with special attention paid to differences in youths’ family poverty trajectory from early childhood to adolescence. Use of structural equation modeling also allows the simultaneous observation of direct and indirect associations between poverty and weight status. Limitations include the cross-sectional analysis, which precludes drawing conclusions regarding causality and the directionality of associations; for example, the association between youths’ weight status and victimization may be bidirectional as opposed to unidirectional (59). Forthcoming waves of the study should allow for the replication of these findings with longitudinal measures of feelings of safety and weight status, and they should provide more robust estimates of the causal and directional links than the current cross-sectional analyses. Although the cohort experienced attrition, we attempt to redress this limitation by using recommended statistical methods to include as much information as possible from youths and families who experienced poverty and were more likely to desist from the study over time. Although the study made use of valid and reliable self-reported measures of screen time and physical activity, measurement error could help to explain why there was no significant association found between screen time and weight status and between youths’ experiences at school and their level of physical activity. Furthermore, the results suggest that youths experiencing chronic poverty tended to be more physically active than those who experienced no poverty. Previous research suggests that this difference may be due to poorer youths’ increased use of active transportation (31, 60). Future investigations relying on more objective and comprehensive assessments of weight-related behaviors (e.g., use of personal computer tablets, use of active transportation) and other factors linked to overweight and obesity (e.g., diet) may reveal additional pathways.

Improving youths’ weight-related behaviors and reducing obesity rates require that we address the obesogenicity—or obesity-promoting features—of youths’ environments (61, 62). Increasing youths’ feelings of safety at school is therefore 1 potential intervention that could buffer the association between poverty and overweight. Such interventions may be particularly important for youths who experience early childhood and chronic poverty, as their weight status is most strongly associated with feelings of safety at school. These interventions would be especially beneficial for boys, who report more victimization at school and may therefore be particularly likely to experience rejection or neglect by peers, engage in poorer health habits, and in turn experience more behavioral, emotional, and health problems (63). Improving perceptions of school safety should therefore be part of comprehensive interventions designed to reduce obesity rates and fight the effects of poverty on overweight and obesity. In addition to targeting actual school violence (e.g., by decreasing victimization), interventions could work toward increasing feelings of safety at school by improving the quality of youths’ relationships with their teachers and the school climate (e.g., student respect and appreciation) (37, 64).

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APPENDIX

Design-based structural equation modeling (in Mplus, version 7.11) was used to adjust for school-based clustering. Intraclass correlations of 0.05%–45.3% were low to moderate (Appendix Table 1). On average, very few youths attended the same school (mean = 2.68), with 41% of schools attended by only 1 youth. This design-based approach accounts for clustering by adjusting the standard errors for estimated parameters (48, 49) and has been shown to be more appropriate than a model-based approach when there are few observations per cluster (less than 5) and unbalanced cluster sizes (48). The results of the design-based structural equation modeling (n = 1,285) (Appendix Table 2) are largely comparable to those obtained by using the full analytical sample (n = 2,120) without taking clustering into account (refer to text).

Appendix Table 1. Intraclass Correlations for Observed Variables for Youths Aged 13 Years, Quebec Longitudinal Study of Child Development, 1998–2011

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intraclass Correlation, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight status</td>
<td>6.7</td>
</tr>
<tr>
<td>Screen time (3 items), range</td>
<td>0.5–2.7</td>
</tr>
<tr>
<td>Physical activity</td>
<td>2.8</td>
</tr>
<tr>
<td>Feelings of safety</td>
<td>12.1</td>
</tr>
<tr>
<td>Poverty trajectory, range</td>
<td>3.4–29.7</td>
</tr>
<tr>
<td>School safety climate (3 items), range</td>
<td>25.6–45.3</td>
</tr>
<tr>
<td>Victimization (5 items), range</td>
<td>0–2.1</td>
</tr>
<tr>
<td>Maternal body mass index</td>
<td>7.1</td>
</tr>
</tbody>
</table>
### Appendix Table 2. Design-Based Structural Equation Models Predicting Weight Status, Weight-Related Behaviors, and Feelings of Safety at School for Youths Aged 13 Years \((n = 1,285)\), Québec Longitudinal Study of Child Development, 1998–2011

<table>
<thead>
<tr>
<th>Model and Variable</th>
<th>Weight Status</th>
<th>Screen Time</th>
<th>Physical Activity</th>
<th>Feeling Safe at School</th>
<th>Victimization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probit</td>
<td>P Value</td>
<td>(R^2), %</td>
<td>(\beta)</td>
<td>P Value</td>
</tr>
<tr>
<td>Model 1(^a)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
<td>−0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen time</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic poverty</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early childhood poverty</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Later childhood poverty</td>
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</tr>
<tr>
<td>Model 2(^b)</td>
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<tr>
<td>Male</td>
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<td></td>
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<td></td>
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<tr>
<td>Physical activity</td>
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<td>&lt;0.05</td>
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<tr>
<td>Mother’s BMI</td>
<td>0.27</td>
<td>&lt;0.001</td>
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<tr>
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<td>&lt;0.05</td>
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<td>−0.03</td>
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<td></td>
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<td>0.02</td>
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<tr>
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</tr>
<tr>
<td>Later childhood poverty → mother’s BMI</td>
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<td>Model 3(^c)</td>
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<tr>
<td>Mother’s BMI</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Chronic poverty → FSS</td>
<td>0.01</td>
<td>&lt;0.05</td>
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</tr>
<tr>
<td>Chronic poverty → mother’s BMI</td>
<td>0.04</td>
<td>&lt;0.001</td>
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<tr>
<td>Early childhood poverty → FSS</td>
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</tr>
<tr>
<td>Early childhood poverty → mother’s BMI</td>
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<tr>
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<td>0.02</td>
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<tr>
<td>Model and Variable</td>
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<td>Screen Time</td>
<td>Physical Activity</td>
<td>Feeling Safe at School</td>
<td>Victimization</td>
</tr>
<tr>
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<td>--------------</td>
</tr>
<tr>
<td></td>
<td>Probit</td>
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<td>R², %</td>
<td>β</td>
<td>P Value</td>
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<tr>
<td><strong>Model 4</strong>&lt;sup&gt;d&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
<td>Age</td>
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<td>−0.06</td>
<td>4.1</td>
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<td>Screen time</td>
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<tr>
<td>Physical activity</td>
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<tr>
<td>Mother’s BMI</td>
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<tr>
<td>Chronic poverty</td>
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<td>&lt;0.055</td>
<td>0.07</td>
<td>&lt;0.05</td>
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<tr>
<td>Early childhood poverty</td>
<td>−0.01</td>
<td>0.02</td>
<td>−0.03</td>
<td>0.02</td>
<td>−0.06</td>
</tr>
<tr>
<td>Later childhood poverty</td>
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<td>0.00</td>
<td>−0.03</td>
<td>0.00</td>
<td>−0.03</td>
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<tr>
<td>Feeling safe at school</td>
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<td>−0.04</td>
<td>&lt;0.01</td>
<td>−0.01</td>
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<tr>
<td>Victimization</td>
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<td>&lt;0.01</td>
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<td>Unsafe school climate</td>
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<td>Chronic poverty→ FSS</td>
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</tr>
<tr>
<td>Chronic poverty→ victimization</td>
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<td>&lt;0.05</td>
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<td>Chronic poverty→ victimization→ FSS</td>
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<td>&lt;0.05</td>
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<tr>
<td>Chronic poverty→ mother’s BMI</td>
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<td>Later childhood poverty→ mother’s BMI</td>
<td>0.03</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; FSS, feeling safe at school.

<sup>a</sup> All regression and probit coefficients are standardized, and tests are 2 sided.
<br><sup>b</sup> In model 2, compared with mothers in the reference group, those in the chronic poverty ($β = 0.14, P < 0.001$) and later childhood poverty ($β = 0.08, P < 0.01$) groups had a higher BMI. There was no significant difference in mother’s BMI between those in the reference and early childhood poverty groups ($β = 0.01, P > 0.05$). Physical activity level and screen time were not significantly correlated ($r = −0.05, P > 0.05$).
<br><sup>c</sup> In model 3, the association between poverty trajectory and mother’s BMI and also the residual correlation between physical activity and screen time were comparable to results reported for model 2.
<br><sup>d</sup> In model 4, the association between poverty trajectory and mother’s BMI and also the residual correlation between physical activity and screen time were comparable to results reported for models 2 and 3. Victimization and the school safety climate were not significantly correlated ($r = −0.05, P > 0.05$).