Community, Family, and Subjective Socioeconomic Status: Relative Status and Adolescent Health

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Abstract

Objective—Relative socioeconomic status (SES) may be an important social determinant of health. The current study aimed to examine how relative SES, as measured by subjective SES, income inequality, and individual SES relative to others in the community, is associated with a wide range of adolescent health outcomes, after controlling for objective family SES.

Method—Adolescents (13–16 years; $N = 2,199$) from the Quebec Child and Adolescent Health and Social Survey were included. Socioeconomic measures included adolescents' subjective SES; parental education and household income; community education/employment, income, and poverty rate; and community income inequality. Health outcomes included self-rated health, mental health problems, dietary and exercise health behaviors, substance-related health behaviors, reported physical health, and biomarkers of health. Best-fitting multilevel regression models (participants nested within schools) were used to test associations.

Results—Findings indicated that lower subjective SES was associated with poorer health outcomes. After accounting for family SES, lower community education/employment had an additional negative effect on health, while lower community income had a protective effect for certain health outcomes. There was less evidence for an independent effect of income inequality.

Conclusions—Findings highlight the importance of measures of relative SES that span across a number of levels and contexts, and provide further understanding into the socioeconomic gradient in adolescence.

Keywords

socioeconomic status; adolescence; health outcomes; subjective status; income inequality

The graded relation between socioeconomic status (SES) and health that occurs at all levels of SES has been well established (Adler et al., 1994), with pervasive incremental SES gradients in health shown during both adulthood and childhood (Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010). Comparatively less research has been conducted on socioeconomic inequalities in adolescent health (Currie et al., 2008). Existing evidence suggests SES gradients in health may be present inconsistently during adolescence. Chen,

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Martin, and Matthews (2006) found inverse gradients between parental SES and global health measures (parent ratings of health, activity limitations, school imitations) and acute conditions (injuries, respiratory conditions), while West (1997) found little evidence of parental SES gradients in self-rated health, acute illness, injuries, and mental health. Associations may also depend on the health outcomes or behaviors in question, as Goodman (1999) found that parental SES was associated with some health outcomes (self-rated health, depression, obesity), but not others (asthma, suicide attempts, sexually transmitted infections); and, in a review of the literature, Hanson and Chen (2007) found that parental SES was related to diet, physical activity, and smoking, but not to alcohol or drug use. The use of parental SES as a proxy for adolescent SES may contribute to the inconsistent findings during this stage of transition from childhood to adulthood (Glendinning, Love, Hendry, & Shucksmith, 1992). Given that health behaviors that begin during adolescence lead to adult morbidity and mortality (Sawyer et al., 2012), understanding socioeconomic disparities in adolescent health behaviors and health outcomes is a critical area of research.

Most studies examining SES gradients in health have used objective indicators of an individual's status, such as income, education, and occupation. These indicators are only moderately correlated with one another (Braveman et al., 2005); however, they show similar associations with health outcomes. This suggests that a common underlying element of social stratification may influence health (Adler & Ostrove, 1999).

Relative SES and Adolescent Health

Relative position in the SES hierarchy may influence health over and above the material implications of position (Adler et al., 1994). Wilkinson (1997, 1999) has theorized that socioeconomic disparities in health result primarily from relative position, with absolute material standards having a less important role. Sapolsky (2005) has also suggested that psychosocial factors associated with relative standing in the social hierarchy affect health, based on experimental research findings in primates. Therefore, it is important to further our understanding of how relative SES is associated with health across the life span, including adolescence. The construct of relative SES may be conceptualized and measured in a number of different ways, including subjective ratings of SES, individual SES relative to community SES, and income inequality. In the following paragraphs, we provide a brief description of each of these as well as the existing literature linking them to adolescent health.

Subjective SES

Subjective SES is based on “an individual's perception of his or her place in the socioeconomic structure” (Singh-Manoux, Adler, & Marmot, 2003, p. 1322) and is thought to be a reflection of one's relative social position. Subjective SES may also be linked to health because it represents the cognitive average of several traditional socioeconomic indicators or due to reverse causation or a third variable that influences both ratings of status and health (Singh-Manoux, Marmot, & Adler, 2005). A meta-analysis of the studies that have examined the association between subjective SES and adolescent health demonstrated a significant overall association (Quon & McGrath, 2014). Results showed that the strength of

the association differed across health outcome types, with the strongest effects for self-rated health, mental health outcomes, and general physical symptoms, with smaller, inconsistent effects for health and substance use behaviors, obesity, and bio-markers of health. The strength of the association between subjective SES and health was not affected by statistical control of family objective SES; however, very few studies included two or more parent-reported measures of objective SES (e.g., Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007; Wilkinson, Shete, Spitz, & Swann, 2011). Many studies relied upon adolescent-reported objective SES (e.g., Hamilton, Noh, & Adlaf, 2009; Piko & Fitzpatrick, 2007) or did not control for objective SES (e.g., Cho & Khang, 2010; Zaborskis, Sumaskas, Maser, & Pudule, 2006), highlighting the need for further research that takes family, and even community, SES into consideration. In addition, the meta-analysis underlined the need for further investigation of associations between subjective SES and biomarkers of health in adolescence, as only a few studies have examined these outcomes, and this would also disentangle remaining questions about reporter bias as a third variable influencing both reported SES and reported health outcomes.

Community Socioeconomic Conditions

The idea that individual SES relative to others in the community may influence health can be examined using multilevel studies that measure SES at the individual and community levels. Community SES measures are aggregate measures of the group of individuals living in a defined community (e.g., neighborhood, school district). Wilson (1987) proposed that poorer individuals benefit from living in more affluent communities due to access to richer resources or learning effects. In contrast, according to Festinger's (1954) theory of social comparison (see also Wilkinson, 1999), less affluent individuals may experience more stress and relative deprivation when living with more affluent neighbors, which may lead to poorer health. In a review study, Leventhal and Brooks-Gunn (2000) found that lower neighborhood SES was related to worse adolescent mental health, particularly externalizing disorders, after controlling for individual SES. Chen and Paterson (2006) found that lower neighborhood SES was associated with higher obesity, but lower basal cortisol levels (and not related to blood pressure), after controlling for family SES. Lower school SES has been found to be negatively associated with adolescent delinquency (Wilcox & Clayton, 2001) and depression (Goodman, Goodman, Huang, Wade, & Kahn, 2003), and the latter authors noted a paucity of studies that have examined the effects of school SES context on health in adolescence.

Income Inequality

Finally, income inequality is a measure of distribution of income that highlights the gap between the rich and the poor. The income inequality hypothesis posits that individuals in more unequal societies (i.e., greater income inequality) have worse health, over and above average income of the society (Kawachi & Kennedy, 1997; Wilkinson, 1999). Income inequality may negatively affect health through low social capital, stressful social comparisons, and relative deprivation (cf. Wilkinson & Pickett, 2007). Alternatively, income inequality may be reciprocally linked to investment in social, educational, or health infrastructure, which influences health (Subramanian & Kawachi, 2004). Research has shown that developed countries with greater income inequality between the rich and the poor tend to have worse population health outcomes (e.g., life expectancy, infant mortality, child

well-being) compared to more equal developed countries (cf. Wagstaff & Van Doorslaer, 2000). However, multilevel studies that measure individual SES and individual health, as well as society income inequality, are required to disentangle the contextual effect of income inequality from the effects of the socioeconomic gradient alone (Subramanian & Kawachi, 2004). Results from multilevel studies in adolescents suggest that country-level income inequality has a contextual effect on self-rated health (Torsheim, Currie, Boyce, & Samdal, 2006) and U.S. state-level income inequality has a contextual effect on obesity prevalence (Singh, Kogan, & van Dyck, 2008). The effects of income inequality have not been examined across a number of domains of adolescent health and there is also a need for further investigation of the effects of income inequality on adolescent health at a more proximal geographic scale, such as neighborhood or community.

Objectives and Hypotheses

We have noted specific research gaps in the existing literature linking subjective SES, community SES, and income inequality to adolescent health. Taken together, a number of research questions remain regarding the broader construct of relative SES and adolescent health. First, measures of subjective SES, community SES, and income inequality are thought to reflect a similar underlying construct of relative SES; however, their relations with one another have largely not been explored. Therefore, the first objective of this study was to examine the extent to which these constructs (subjective SES, community SES, and income inequality) overlap in adolescents. We hypothesized that these variables would be moderately correlated with one another. Second, the effects of subjective SES, community SES, and income inequality have been previously examined in isolation; thus, their unique contributions to adolescent health are unknown. Therefore, the second objective of this study was to examine the independent contributions of subjective SES, community SES, and income inequality on adolescent health. We hypothesized that, when all measures of relative SES were considered, the effects of each measure would be attenuated somewhat due to a similar underlying construct of relative SES, but that independent associations would remain due to differences in these measures. Third, because associations between these measures may differ by health outcome, there is a need to measure multiple domains of adolescent health. In particular, there are relatively few studies that have examined associations with biomarkers of health, which are important during adolescence as these may identify early changes at the cellular level before the development of disease states (Barkin, Rao, Smith, & Po'e, 2012) and cardiovascular disease biomarkers have been shown to “track” from adolescence into adulthood (e.g., Berenson, Wittigney, Bao, Srinivasan, & Radhakrishnamurthy, 1995). Therefore, the third objective of this study was to examine the unique contributions of subjective SES, community SES, and income inequality on several domains of adolescent health, including mental health, health and substance use behaviors, reported physical health, and biomarkers of health. Based on the available previous research, we hypothesized that subjective SES would be closely associated with mental health, community SES would be closely associated with health and substance behaviors, and income inequality would be strongly related to physical health.

Method

Participants

The Quebec Child and Adolescent Health and Social Survey (QCAHS) was a school-based, population-representative sample survey of youth in Quebec, Canada. The design and methods of this survey have been described in detail elsewhere (Paradis et al., 2003). The current study included 13- ($n = 1,049$) and 16-year-olds ($n = 1,150$) from the original sample; 9-year-olds were excluded because subjective SES was not measured in this age group. After excluding participants ($n = 126$) who attended schools with fewer than 10 participating QCAHS students, our sample consisted of 2,199 adolescents ($M_{\text{age}} = 14.51$; $SD = 1.52$) from 109 schools ($M = 20.17$ students per school, range = 11–43) across the province of Quebec. Ninety schools were part of the Quebec Ministry of Education, within 49 different school districts ($M = 1.84$ schools per school district, range = 1–5).

Data Collection

Data were collected at schools by trained research teams. Upon arrival, a fasting blood sample was taken, after which a light breakfast was served. Blood was centrifuged on site and frozen until biochemical analyses were performed (Ste-Justine Hospital, Montreal, Quebec, Canada). Participants then completed age-appropriate questionnaires and had anthropometric and blood pressure measurements taken. Parent questionnaires were returned by mail. The study protocol received ethical approval (Paradis et al., 2003), and informed consent was obtained.

SES Measures

Subjective SES—Adolescents responded to the item, “Compared with your classmates, would you say that your family’s economic situation is *Worse, Same, or Better?*”

Family objective SES—(a) *Parent education* was measured by parent and spouse’s highest level of education as reported by parents. Education categories were transformed into corresponding years of education based on the Quebec education system (no formal schooling = 0 years, primary school = 6 years, high school incomplete = 9 years, high school graduate = 11 years, vocational school = 12 years, college = 13 years, university = 16 years. Note: students must complete 2 years of college before attending university within Quebec). Mean years of education for the two parents was calculated. (b) *Household income* was measured by total household income (before tax) in the previous year (<\$10k, \$10k–14.9k, \$15k–19.9k, \$20k–29.9k, \$30k–39.9k, \$40k–49.9k, \$50k–59.9k, \$60k–79.9k, >\$80k CAN), as reported by parents. Income categories were transformed into a continuous variable using the median value of each income category.

Community SES—These variables are based on indices provided by the Quebec Ministry of Education for each public school and public school district and are described in more detail elsewhere (Baillargeon, 2005; Ministère de l’Éducation du Québec, 2003). (a) *School education/employment index* was derived from maternal “undereducation” and parental economic inactivity at each school and is calculated as: $(2/3 \times \text{proportion of mothers with less than a high school education}) + (1/3 \times \text{proportion of unemployed parents})$, reverse-

coded. (b) *School poverty rate* was derived from the proportion of families who fall near or under the “low income cut off” (LICO; Statistics Canada, 2012) at each school, and is calculated as $(1/5 \times \text{proportion of families with an income between the LICO and the LICO} + 1/3) \times (\text{proportion of families below the LICO})$, reverse-coded. (c) *School district income* was derived from the median household income of each school district, which represents a larger geographical area.

Income inequality—This variable is based on information provided by the Quebec Ministry of Education for each public school district (Baillargeon, 2005). *Income inequality* was measured using the squared coefficient of variation, $(SD/N)^2$, of each school district (reverse-coded; cf. Hou & Myles, 2005). This index captures the amount of variability in household incomes in each school district.

Health Outcome Measures

Table 1 presents the health outcome measures used in the study. Health outcome measures are described in more detail, including original sources, in the survey user guide (Institut de la statistique Quebec, 2002). Outcomes were organized into eight categories: self-rated health, mental health, health behaviors, substance use behaviors, reported physical health, metabolic biomarkers, circulatory biomarkers, and inflammatory biomarkers. All reported health outcomes were coded so that higher scores indicate more health problems (i.e., worse health); biomarkers of physical health were retained as continuous variables.

Statistical Analyses

Missing data—To impute missing data at the individual level for parental SES ($n = 352-450$) and blood draw measures ($n = 604-748$), we included these variables along with demographic, subjective SES, reported health outcomes, and anthropometric measurements in a multiple imputation model (15 imputed data-sets; SPSS Version 20). Youth who provided blood samples did not differ from those for whom samples were not available or excluded. To impute missing SES data at the school level for schools outside the Quebec public system (information not available; $n = 19$), we included these variables along with school means and standard deviations for household income and parent education based on the QCAHS participants at that school in a multiple imputation model (15 datasets; SPSS Version 20). Although schools in the public school system had lower mean household income ($M_{\text{diff}} = \$15,875$; $p < .001$) and lower mean parent education ($M_{\text{diff}} = 1.5$ years; $p < .001$) than schools outside the public school system, there were moderate correlations between QCAHS school means and Ministry of Education indices ($r = .48-.62$). Thus, although data were not missing completely at random, we imputed missing information in order to examine associations across the full socioeconomic gradient (including private schools). Results were largely identical when analyses were run on the original versus imputed dataset. Only results based on the imputed dataset are presented.

Multilevel modeling—We used multilevel modeling techniques (Bryk & Raudenbush, 1987) to fit regression models to the data (HLM version 7; Scientific Software International, Lincolnwood, IL). A two-level model was specified in which participants (Level 1) were nested within school (Level 2). The Level 1 model describes the effect of individual

predictor variables (individual/ family level) and the Level 2 model describes the effect of school predictor variables (community level). Given the low number of participating schools per school district (and 19 schools outside defined school districts), both school and school district SES variables were handled as continuous, Level 2 variables. To facilitate comparison of results across analyses, all predictors and outcomes were standardized (Z -scores) and standardized beta coefficients are reported.

In order to examine the extent to which these constructs overlap in adolescence, we tested the correlations between subjective SES, community SES, and income inequality. To examine the independent contributions of subjective SES, community SES, and income inequality, we tested their univariate and multivariate effects across multiple domains of adolescent health. Specifically, to test the hypothesis that these measures of relative SES would be significantly associated with adolescent health, we examined the univariate effects of each SES predictor on each health outcome, while controlling for age and sex. To test the hypothesis that the unique contributions of subjective SES, community SES, and income inequality would vary by health outcome, we identified a best-fitting multivariate model for each health outcome category. To do this, we first determined a best-fitting model for each *health outcome* by entering all SES predictors that had significant univariate effects into a full model and then removing predictors until fit statistics indicated a best-fitting model, using chi-squared tests for differences in fit statistics (deviance scores). To determine a best-fitting model for each health outcome category, we entered all SES predictors that were included in any best-fitting models for health outcomes in that category, and then removed predictors until mean fit statistics (deviance scores) indicated a best-fitting model. Thus, the same SES predictors were entered for all health outcomes in the category. For parsimony, only univariate models by health outcome and final best-fitting models by health outcome category are presented.

Results

Descriptive statistics for the 2,199 adolescent participants and health outcomes are presented in Tables 1 and 2. Overall, the sample was evenly divided across age and sex categories. The majority of the sample (close to 80%) rated their family's SES as similar to that of their peers. Mean years of parent education corresponded to approximately 1 year of postsecondary education. Mean household income before taxes was about \$50,000 CAN. Rates of "not very good" health (4%) were slightly lower than rates (about 6%) of "not very healthy" on a similar scale of self-rated health in a large cross-country sample of adolescents (Torsheim et al., 2006). Means and rates for physiological outcomes in the QCAHS have been reported to be comparable to previous studies (e.g., Paradis et al., 2004; Lambert et al., 2004).

To examine the extent to which these constructs overlap in adolescence, we tested the correlations between subjective SES, community SES, and community income inequality. Table 3 presents a correlation matrix for all socioeconomic variables. Results showed that subjective SES was not related to community SES or to community income inequality. Higher income inequality was moderately related to higher school education/employment index and higher school district income and weakly associated with higher school poverty

rate. As a post-hoc analysis, we examined how family SES relative to community SES predicted adolescents' subjective SES. Regression results showed that parental education ($\beta = .14, p < .001$) and school education/employment ($\beta = -.06, p = .008$) explained 1.7% of the variance in subjective SES, while household income ($\beta = .26, p < .001$) and school district income ($\beta = -.08, p < .001$) explained 6.2% of the variance in subjective SES.

To test the hypothesis that these measures of relative SES would be significantly associated with adolescent health, we examined the univariate effects of each SES predictor on health outcomes (see Table 4). Results indicated that lower subjective SES was related to worse self-rated health, more mental health problems, worse dietary/exercise health behaviors, more general health symptoms, and increases in LDL cholesterol, diastolic blood pressure, and C-reactive protein. (Analyses based on comparisons across subjective SES categories yielded largely identical results; data not shown for parsimony.) Higher school poverty rate was associated with lower self-esteem, more physical inactivity, and more asthma, but fewer substance use behaviors and less obesity. Lower school education/employment index was associated with lower self-esteem, poorer dietary/exercise health behaviors, and higher systolic and diastolic blood pressure. Lower school district income was associated with poorer dietary/exercise health behaviors and higher systolic blood pressure, but less anger, less asthma, and lower insulin. Finally, greater community income inequality was associated with more anger and more asthma, but more consumption of fruits and vegetables, less drug use, and lower systolic blood pressure.

To test the hypothesis that the unique contributions of subjective SES, community SES, and income inequality would vary by health outcome, we examined the best-fitting multivariate effects of SES predictors on health outcomes (see Table 5, which is organized by health outcome categories). Table 6 presents an overview of the variables included in each of the best-fitting models. After controlling for family objective SES, measures of relative SES demonstrated differential effects across health outcome categories. Namely, for self-rated health, only subjective SES was retained in the best-fitting model. For mental health, subjective SES and community income inequality had the strongest effects on health outcomes. For dietary and exercise health behaviors, subjective SES and school education/employment had the strongest effects. For substance use behaviors, school SES variables showed the strongest associations. For reported physical health outcomes, there was no clear pattern across the category; however, subjective SES, community mean income, and community income inequality had significant effects on some health outcomes. For metabolic biomarkers, none of the measures of relative SES were significantly associated, except for school poverty, which was significantly related to BMI. For cardiovascular and inflammatory bio-markers, school SES variables were linked to blood pressure, while subjective SES was linked to C-reactive protein.

Discussion

The primary aim of this study was to examine how relative SES, as measured by subjective SES, community SES, and income inequality, is related to a number of adolescent health outcomes. This study is novel in its exploration of relative SES using several constructs and

measures at the individual and community levels. It is also among the first to examine the effects of school SES and community income inequality on adolescent health.

These findings contribute to the literature on subjective SES by examining its association with outcomes across multiple domains of health, with an emphasis on biomarkers of physical health, a previously understudied area. We expected that, after controlling for family objective SES and other measures of relative SES, subjective SES would be independently associated with self-rated health and mental health problems. The results partly supported this hypothesis, as lower subjective SES was linked to poorer self-rated health and more mental health problems (depression, anger, anxiety, low self-esteem). In addition, lower subjective SES was related to lower physical activity levels, less consumption of fruits and vegetables, more general health symptoms, and more asthma. Our results are highly consistent with a recent meta-analysis on the association between subjective SES and adolescent health outcomes (Quon & McGrath, 2014), which indicated that the strongest associations exist between subjective SES and self-rated health, mental health, and reported physical health outcomes, with weaker associations between substance use behaviors and biomarkers. Thus, associations between subjective SES and adolescent health seem to vary by health outcome. Finally, we examined correspondence of subjective SES with other SES indicators. Subjective SES was associated with parental education and household income, but not with community SES or income inequality, which is consistent with previous results (Chen & Paterson, 2006). Household income relative to community income explained more variance in subjective SES than parental education relative to school education/employment. Adolescents' subjective ratings of SES were positively related to their family's objective SES and negatively related to community SES. In other words, adolescents rated their SES highest when they had high family SES and lower community SES, which suggests that subjective SES reflects underlying status relative to community.

We examined how adolescents' SES relative to community SES influences their health by testing the effects of community SES while controlling for individual SES in a multilevel design. We expected that community SES would be most closely tied to health behaviors and substance use behaviors, based on prior research. We found that school SES was indeed independently associated with dietary/exercise behaviors and substance use behaviors, and also with mental health and blood pressure. However, school district income showed few independent effects, except for asthma, breakfast eating, and anger symptoms. We were also interested in the direction of the effects of community SES. In other words, we asked, when individual SES is held constant, is attending school or living in an area with higher SES individuals associated with a protective or detrimental effect on adolescent health? We found that the direction of these effects diverged depending on the type of socioeconomic indicator. Namely, after controlling for individual SES, lower school education/employment had an additional negative effect on several health outcomes, including physical inactivity, diet, alcohol use, and blood pressure. This suggests that attending school with classmates whose families have higher education levels and less unemployment has a protective effect on health, which is supportive of Wilson's (1987) theory. The findings for school education/employment are consistent with previous work examining the effects of community SES on adolescent health, which has primarily documented additional detrimental effects of low community SES (Chen & Paterson, 2006; Leventhal & Brooks-Gunn, 2000) and low school

income (Goodman et al., 2003), after accounting for individual SES. In contrast, after controlling for individual SES, income-based community indicators (school poverty, school district income) were associated with a protective effect for certain health outcomes, including anger, breakfast eating, and asthma; and, substance use, BMI, and blood pressure, respectively. These findings suggest a negative effect of social comparison, consistent with Festinger (1954) and Wilkinson (1999). Namely, less affluent youth may experience more stress and relative deprivation when attending a more affluent school or living in a more affluent area. Alternatively, lower community income may protect against substance use due to a lack of material resources and may increase consumption of breakfast due to greater availability of school-based breakfast programs in these areas. The divergent effects across specific SES measures observed in the current study are consistent with some previous studies that have also shown that community SES measures may have differential effects on health (Janssen, Boyce, Simpson, & Pickett, 2006), but inconsistent with other studies that have shown similar effects across SES measures (Chen & Paterson, 2006).

The current study is one of the first to examine the association between community income inequality and health in adolescents. We hypothesized that community income inequality would be associated with adolescent health outcomes, particularly self-rated health and physical health outcomes. Results showed that greater income inequality was more closely tied to mental health outcomes (lower self-esteem, more anger), and was not strongly linked to self-rated health or other physical health outcomes (other than asthma). This is the first study to examine associations with mental health outcomes in adolescents using a multilevel design that controls for individual SES. Previous research has demonstrated an effect of income inequality on adolescent self-rated health (Torsheim et al., 2006) and adolescent obesity rates (Singh et al., 2008). One potential explanation for this pattern of findings is that income inequality at the country- or state-level may be more strongly associated with physical health outcomes, due to policies related to health care, education, and welfare (Subramanian & Kawachi, 2004), while income inequality at the community-level may be linked to mental health outcomes through stressful social comparisons (Wilkinson & Pickett, 2007). Further exploration of these potential mechanisms is needed.

There are four limitations that merit discussion. First, our measures of income inequality and school education/employment index had some significant limitations. We employed community income variability as a proxy for income inequality, because available data precluded the calculation of more commonly used income inequality indices, such as the Gini coefficient. Variability measures of income inequality may be overly influenced by extreme income values (De Maio, 2007). Further, only maternal education level was considered in school education/employment index, which limits generalizability. Additional research using traditional measures of income inequality, such as the Gini coefficient, and more balanced indices of school parental education level, is required to understand the effects of community SES and income inequality on adolescent health. Second, given that this is a cross-sectional study, we are not able to determine directionality of the associations. In particular, questions remain regarding potential reverse causation or bidirectionality of the association between subjective SES and health (Garbarski, 2010; Singh-Manoux et al., 2005). Subjective SES seems to be closely tied to self-rated health and mental health outcomes; thus, longitudinal studies will help to facilitate understanding of the direction of

these associations and also whether these associations play a mediating role for eventual adult health outcomes. Third, we were not able to include adolescents who had dropped out of school in this school-based study. It is estimated that 5% of 16-year-olds in Quebec no longer attend school (Paradis et al., 2003), and school dropout is associated with lower SES (Cairns, Cairns, & Neckerman, 1989). However, associations were examined in a large, population-based survey of adolescents. In addition, the measurement of numerous health outcomes (using questionnaire, anthropometric, and blood draw methods) that are relevant to adolescent well-being and to future adult health is a major strength of this study. Finally, aspects of the community context, such as availability of healthful food, safety and crime, and infrastructure including community centers and parks, and social cohesion (Macintyre, Ellaway, & Cummins, 2002) that may not be sensitive to income-based SES indicators may be an important confounder of the associations between community SES and adolescent health. Moreover, it is important to note that adolescents may not attend the high school that is closest to their homes, thus one's neighborhood and school SES may differ. To address this issue, we included SES measures of the broader community (i.e., school district) because students are unlikely to travel outside of these boundaries for school. Our examination of SES across a number of levels, including individual/subjective, family, school, and community SES, was a strength of the current study and allowed for a thorough investigation of their effects on health. Future research in this area should include additional measures of the neighborhood socioeconomic context, such as education levels, unemployment rates, and built environment.

The current study provided an extensive investigation of the cross-sectional associations between subjective SES, community SES, and community income, and a number of adolescent health outcomes. As such, these findings provide an important base for further examination of relative status and health during adolescence, as many important research questions remain. Subjective status and associated psychological outcomes may be further explored as a potential mediator or pathway between family SES relative to community SES or community income inequality and adolescent health, particularly using longitudinal data that follows adolescents into adulthood. Further, cross-level interactions between income inequality and family SES or subjective SES is another line of research that may provide additional understanding about these associations.

In conclusion, we demonstrated that independent associations exist for subjective SES, community SES, and community income inequality for some health outcomes and that these associations differ across broad domains of adolescent health. These findings add to the literature on socioeconomic disparities in adolescent health, which has often revealed inconsistent results. This line of research may have policy implications, as prevention efforts to target subjective status and mental health, or health education interventions to reduce the detrimental effects of low school education levels may be warranted. By further evaluating the associations between relative SES and health, we may work toward healthy family, school, and community environments for adolescents across the socioeconomic gradient.

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Table 1

Health Outcome Measures

Outcome	Item/Scale	Mean (SD)	Range
<u>Self-rated health</u>			
Self-rated health	In general, would you say your health is <i>excellent, rather good, or not very good?</i>	1.60 (0.57)	1–3
<u>Mental health</u>			
Anxiety	3-item scale, with each item rated on a 4-point Likert scale (<i>never to very often</i>). Summed total score.	5.45 (2.17)	3–12
Depression	4-item scale, with each item rated on a 4-point Likert scale (<i>never to very often</i>). Summed total score.	8.16 (3.35)	4–16
Anger	4-item scale, with each item rated on a 4-point Likert scale (<i>never to very often</i>). Summed total score.	7.01 (2.76)	4–16
Self-esteem	10-item Rosenberg Self-Esteem Scale. Items 3, 5, 8, 9, 10 reverse-coded. Summed total score.	15.84 (4.91)	10–40
<u>Health behaviors</u>			
Physical activity	Frequency of engaging in physical activity (>20 min straight, with perspiration or increased breathing) in past week, rated on an 8-point scale (<i>every day to not 1 day</i>).	4.48 (2.17)	1–8
Physical inactivity	Usual number of daily hours spent watching television or videos. Mean calculated from weekday and weekend hours.	3.73 (2.16)	0–14.5
Diet: Fruits/vegetables	Three items on frequency of fruits and vegetables consumption in the past week, rated on a 7-point scale (<i>five or more times per day to not once</i>). Summed total score.	11.48 (3.42)	3–21
Diet: Breakfast	Frequency of breakfast eating (eating or drinking something in the morning before school other than coffee, tea, or water) in the past 5 school days, rated on a 4-point scale (<i>every day to never</i>).	1.68 (1.03)	1–4
<u>Substance use behaviors</u>			
Cigarette use	Lifetime smoking: Have you ever tried cigarette smoking, even just a few puffs? (<i>No/ Yes</i>)	0.64 (0.48)	0–1
Alcohol use	Alcohol use in the past year: During the past 12 months, did you drink alcohol, such as beer, wine, or liquor? (<i>No/ Yes</i>)	0.70 (0.46)	0–1
Drug use	Lifetime drug use: Have you ever used drugs? (<i>No/ Yes</i>)	0.38 (0.49)	0–1
<u>Reported physical health</u>			
General symptoms	Frequency of five general physical symptoms (headaches, stomach aches, sore back, insomnia, dizziness), rated on a 5-point scale (<i>rarely/never to almost every day</i>). Summed total score.	8.86 (3.43)	5–25
Chronic conditions	Presence of 13 chronic health conditions (food allergies, other allergies, respiratory problems, skin problems, psychological problems, bone/joint problems, cystic fibrosis, intestinal problems, other digestive problems, thyroid/liver/kidney problems, diabetes, cholesterol/lipid problems, other) (<i>No/ Yes</i>). Summed total score.	0.73 (1.02)	0–13
Limiting condition	Presence of a limiting condition: Are you limited in the type or number of activities that you can do because of a chronic physical disease, mental health problem, or any other health problem? (<i>No/ Yes</i>)	0.08 (0.27)	0–1
Injuries	Injuries in the past year: During the past 12 months, did you have any injuries that had to be treated by a doctor or nurse? (<i>No/ Yes</i>)	0.19 (0.39)	0–1
Asthma	Presence of asthma (parent-report): Has your adolescent ever had asthma? (<i>No/ Yes</i>)	0.41 (0.70)	0–1
<u>Metabolic biomarkers</u>			
BMI	Calculated as kg/m ² based on measured weight and height. Age- and sex-specific Z scores derived from CDC growth curves.	21.37 (4.08)	11.2–43.7

Outcome	Item/Scale	Mean (SD)	Range
HDL cholesterol	HDL cholesterol measured by enzymatic hydrolysis and measurement of free glycerol using Synchron CX-7; reverse-coded, measured in mmol/L.	1.26 (0.24)	0.5–2.2
LDL cholesterol	LDL cholesterol was calculated according to available guidelines; measured in mmol/L.	2.26 (0.63)	0.6–6.7
Glucose	Plasma concentration of glucose measured enzymatically using glucose oxidase on Beckman Coulter Synchron CX-7; measured in mmol/L.	5.20 (0.39)	3.5–6.9
Insulin	Plasma insulin concentration measured using an ultrasensitive insulin kit from Beckman Coulter; log transformed to reduce skewness, measured in pmol/L.	51.40 (34.31)	4.0–487.8
Triglycerides	Blood concentration of triglycerides measured by enzymatic hydrolysis and measurement of free glycerol using Synchron CX-7; log transformed to reduce skewness, measured in mmol/L.	0.91 (0.44)	0.2–5.9
<u>Cardiovascular and inflammatory biomarkers</u>			
Systolic BP	Resting blood pressure measured using an oscillimetric instrument (Dinamap XL). Mean of last two (of three) measures calculated. Age-, sex-, and height-specific Z scores were derived.	115.80 (13.02)	82.0–164.5
Diastolic BP	Resting blood pressure measured using an oscillimetric instrument (Dinamap XL). Mean of last two (of three) measures calculated. Age-, sex-, and height-specific Z scores were derived.	60.51 (7.22)	39.5–88.5
C-reactive protein	High-sensitivity plasma concentrations measured using IMMAGE® immunochemistry system (Beckman Coulter); measured in mg/L. Values above 10 mg/L indicate acute infection and were treated as missing data.	0.74 (1.32)	0.20–9.73

Note. BMI = Body Mass Index; HDL = high-density lipoprotein; LDL = low-density lipoprotein; BP = blood pressure. For biomarkers, age- and sex-specific Z scores were derived, unless otherwise specified.

Table 2

Participant Characteristics

	Mean (SD)	N (%)
Age	14.51 (1.52)	
Sex		
Male		1,065 (48.4)
Female		1,134 (51.6)
Subjective SES	2.10 (0.46)	
Worse		137 (6.2)
Same		1,716 (78.0)
Better		346 (15.7)
Parent education (years)	11.76 (2.21)	
Household income (\$CAD)	51,005.00 (23,545.41)	
School poverty index	22.60 (7.93)	
School edu/employ	21.98 (7.19)	
School district mean income (\$CAD)	56,151.71 (8,310.42)	

Note. SES = socioeconomic status; School edu/employ = school education/employment index.

Table 3**Bivariate Correlations Between Socioeconomic Status Variables**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Subjective SES	—						
(2) Parent education	.117 *	—					
(3) Household income	.232 *	.500 *	—				
(4) School poverty	-.011	.184 *	.292 *	—			
(5) School edu/employ	-.010	.360 *	.357 *	.619 *	—		
(6) School district income	.010	.298 *	.321 *	.360 *	.677 *	—	
(7) Income inequality	-.010	-.144 *	-.086	.182 *	-.314 *	-.500 *	—

Note. SES = socioeconomic status; School edu/employ = school education/employment index. All SES variables are coded such that a higher value indicates higher SES (and greater income equality). Spearman's rho zero-order correlation coefficients are presented.

* $p < .05$.

Table 4

Univariate Effects of Socioeconomic Status Variables on Health Outcomes

	ICC	Subjective SES	Parental education	Household income	School poverty	School edu/employ	School district income	Income inequality
Self-rated health	.981	-.14***	-.07***	-.10***	.01	-.02	.01	-.03
Self-esteem	.995	-.11***	-.07***	-.09***	-.07***	-.08***	-.04	-.04*
Anxiety	.969	-.07**	.01	-.04	-.01	.01	.00	-.01
Anger	.972	-.10***	-.01	-.05*	-.01	.02	.06**	-.06***
Depression	.981	-.10***	.00	-.05**	-.03	-.03	-.02	-.01
Physical activity	.970	-.10***	-.10***	-.08***	.00	-.02	-.02	.03
Physical inactivity	.945	-.04*	-.16***	-.18***	-.08**	-.14***	-.07*	-.03
Diet: Breakfast	.988	-.06**	-.11***	-.11***	-.01	-.01	.02	-.04
Diet: Fruits/vegetables	.973	-.08***	-.21***	-.14***	-.02	-.13***	-.08**	.06*
Cigarette	.944	.02	.07**	.00	.03	-.04	-.03	.04
Alcohol	.843	-.04	-.06**	-.08***	.09**	.02	.03	.03
Drug	.807	.01	.00	.00	.06*	.00	-.01	.07*
General symptoms	.999	-.08***	-.06**	-.03	.00	.00	.03	-.02
Chronic condition	.988	-.01	.02	-.01	.02	-.02	.01	.01
Limiting condition	.992	-.03	-.08***	-.07***	.00	-.04	.00	.03
Injuries	.990	.02	.06**	.06**	.00	.04	.05	-.03
Asthma	.953	.02	-.03	-.07***	-.07**	.02	.06*	-.08**
BMI	.989	.00	-.07***	-.04	.06*	.00	.01	.03
HDL cholesterol	.962	.00	-.03	-.02	.01	-.01	-.02	-.01
LDL cholesterol	.992	-.04*	-.04	-.02	.00	-.03	-.03	.01
Glucose	.949	-.01	-.01	-.04*	-.03	-.01	.03	-.01
Insulin	.980	-.01	-.01	-.06**	-.01	.03	.07**	-.02
Triglycerides	.995	-.01	-.03	-.03	.02	-.01	.00	.02
Systolic BP	.937	-.01	-.10***	-.10***	-.01	-.11***	-.10**	.08*
Diastolic BP	.922	-.04*	-.11***	-.09***	-.02	-.11***	-.07	.05

	ICC	Subjective SES	Parental education	Household income	School poverty	School edu/employ	School district income	Income inequality
C-reactive protein	.885	-.04 *	-.04	.06 *	.01	-.04	-.03	.03

Note. ICC = intraclass correlation, which denotes proportion of total variance explained by within-school variation; SES = socioeconomic status; School edu/employ = school education/employment index; BMI = Body Mass Index; HDL = high-density lipoprotein; LDL = low-density lipoprotein; BP = blood pressure. All SES variables are coded such that a higher value indicates higher SES (and greater income equality). All health outcomes are coded such that a higher value indicates more health problems. Age and sex are included as covariates for all models. Standardized beta coefficients are displayed.

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 5

Best-Fitting Multilevel Models by Health Outcome Category

	Self-rated health				
Subjective SES	−.12***				
Household income	−.07***				
R ² model	.060				
	Mental health				
	Self-esteem	Anxiety	Anger	Depression	
Subjective SES	−.10***	−.06**	−.09***	−.10***	
Household income	−.06**	−.02	−.04	−.03	
School district income	−.02	.01	.07**	−.01	
Income inequality	−.04**	−.01	−.06*	.01	
R ² model	.046	.056	.036	.059	
	Health behaviors				
	Physical activity	Physical inactivity	Diet: Breakfast	Diet: Fruits/vegetables	
Subjective SES	−.08***	−.01	−.03	−.06**	
Household income	−.03	−.12***	−.08**	−.03	
Parent education	−.08***	−.09**	−.08**	−.17***	
School edu/employ	.02	−.10**	.01	−.09**	
School district income	.00	.07	.06*	.04	
Income inequality	.02	−.02	−.04	.06*	
R ² model	.076	.033	.025	.042	
	Substance use behaviors				
	Cigarettes	Alcohol	Drugs		
Household income	.04	.05*	−.01		
Parent education	−.08***	.05	.01		
School poverty	.06*	.11***	.08**		
School edu/employ	−.05	−.07***	−.04		
R ² model	.023	.020	.018		
	Reported physical health				
	General symptoms	Chronic conditions	Limiting conditions	Injuries	Asthma
Subjective SES	−.08***	.02	−.01	.01	.04*

Household income	.00	-.03	-.05	.03	-.09***
Parent education	-.06*	.03	-.06*	.03	-.01
School district income	.04	.01	.03	.03	.08**
Income inequality	-.02	-.01	-.03	.02	-.08**
<i>R² model</i>	.058	.015	.010	.006	.008

	Metabolic biomarkers					
	BMI	HDL	LDL	Glucose	Insulin	Triglycerides
Household income	-.02	.01	.01	-.05	-.07**	-.02
Parent education	-.07**	.03	-.04	.02	.02	-.02
School poverty	.07*	-.02	.00	-.02	.00	-.03
<i>R² model</i>	.006	.008	.006	.007	.003	.007

	Cardiovascular and inflammatory biomarkers		
	C-reactive protein	Systolic BP	Diastolic BP
Subjective SES	-.04*	.02	-.02
Household income	.01	-.07***	-.05*
Parent education	-.04	-.05*	-.07*
School poverty	.05	.08*	.05
School edu/employ	-.05	-.10*	-.10*
<i>R² model</i>	.003	.006	.009

Note. SES = socioeconomic status; School edu/employ = school education/employment index; BMI = Body Mass Index; HDL = high-density lipoprotein cholesterol; LDL = low-density lipoprotein cholesterol; BP = blood pressure. All SES variables are coded such that a higher value indicates higher SES (and greater income inequality). All health outcomes are coded such that a higher value indicates more health problems. Age and sex are included as covariates for all models. Standardized beta coefficients are displayed.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 6

Variables Included in Best-Fitting Models by Health Outcome Category

	Self-rated health		Mental health	Health behaviors	Substance use behaviors	Reported physical health	Metabolic biomarkers	Cardiovascular and inflammatory biomarkers
Subjective SES	x		x	x	—	x	—	x
Household income	x		x	x	x	x	x	x
Parental education	—		—	x	x	x	x	x
School edu/employ	—		—	x	x	—	—	x
School poverty	—		—	—	x	—	x	x
Community income	—		x	x	—	x	—	—
Community inequality	—		x	x	—	x	—	—

Note. X i= inclusion in best-fitting model; SES = socioeconomic status; School edu/employ = school education/employment index.