Subjective and Relative Socioeconomic Status and Adolescent Health Outcomes

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A Thesis

In the Department

Of

Psychology

Presented in Partial Fulfillment of the Requirements

For the Degree of

Doctor of Philosophy (Psychology) at

Concordia University

Montreal, Quebec, Canada

June 2014

CONCORDIA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis prepared

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Entitled: **Subjective and Relative Socioeconomic Status and Adolescent Health Outcomes**

and submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY (Psychology)

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ABSTRACT

Subjective and relative socioeconomic status and adolescent health outcomes

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Social and psychological variables associated with relative position in the socioeconomic hierarchy may influence health over and above the material implications of that position. Subjective socioeconomic status, the perception of one's position in the socioeconomic structure, may reflect relative status better than traditional measures of socioeconomic status. Income inequality, the scale of income distribution in a society, is linked to the degree of social status differentiation in a society. Although relative status and social comparison may be particularly relevant during adolescence, and adolescence may be a period of relevance for later health outcomes, less research has been conducted on socioeconomic disparities in health during this developmental period. The objective of the current research program is to examine how relative position in the socioeconomic hierarchy is related to adolescent health, across multiple domains of health: self-rated health, mental health, physical health, and health behaviours.

Study 1**,** a systematic review and quantitative meta-analysis of the studies that have examined the association between subjective socioeconomic status and adolescent health, demonstrated a significant overall effect of subjective socioeconomic status on adolescent health, and examined the influence of a variety of moderating factors. Using data from the population-based National Longitudinal Survey of Children and Youth, Study 2 found a main effect of province-level income inequality on select individual

physical health outcomes and a moderating effect of income inequality on the associations between family socioeconomic status and mental health outcomes in adolescents. Using the Quebec Child and Adolescent Health and Social Survey, Study 3 demonstrated the independent effects of subjective socioeconomic status, individual socioeconomic status relative to community, and income inequality on a range of adolescent health outcomes.

Overall, this research program provided a comprehensive understanding of the influence of subjective socioeconomic status and income inequality, and the broader construct of relative status, on several domains of health during adolescence. It is recommended that future studies use longitudinal data to examine pathways between relative socioeconomic status and health during adolescence and into adulthood. Further examination of cross-level interactions is also warranted. This line of research has implications for health and social policy.

ACKNOWLEDGEMENTS

Foremost, I would like to express my sincere gratitude to my supervisor, Dr. Jennifer McGrath for her continuous support of my dissertation research, as well as guidance and mentorship during my clinical training. I am fortunate to have such a dedicated and motivated advisor!

I would like to thank the members of my internal committee, Dr. Lisa Serbin and Dr. Erin Barker, for their ongoing support and guidance during my dissertation research. I would also like to thank members of my external committee, Dr. Tracie Barnett and Dr. Edith Chen, for taking the time to share their expertise and serve on my dissertation committee.

I am grateful for the funding agencies that made this research possible: the Canadian Institutes of Health Research, Concordia University, and the Quebec Inter-University Centre for Social Statistics. Thank you to my fellow graduate students, Cynthia Dolezsar and Danielle Kingdon, for their guidance and help in the completion of the meta-analysis presented in Study 1. I also thank the Quebec Inter-University Centre for Social Statistics and Statistics Canada for granting access to the National Longitudinal Survey of Children and Youth and for providing statistical support throughout my graduate training. Study 2 was based on Statistics Canada master files; however, the responsibility for the use and interpretation of these data is solely that of the authors, and the opinions expressed in this paper do not represent the view of Statistics Canada. I would like to thank Dr. Gilles Paradis and colleagues for the opportunity to draw data from the Quebec Child and Adolescent Health and Social Survey for the completion of Study 3. Finally, I am grateful for the opportunity to join the International Network for

Research on Inequalities in Child Health, and gain knowledge and inspiration from its members that stimulated my dissertation research.

Thank you to my graduate school colleagues, with whom I have shared invigorating discussions, and the ups and downs of graduate studies. I am especially grateful to my colleagues-turned-lifelong-friends, Gillian, Hilary, Sivan, Allison, and Jana, whose wisdom, humour, and support made the completion of this dissertation not only possible, but also fun. I would also like to thank my colleagues in the Pediatric Public Health Psychology Lab for their ongoing support and exchange of knowledge that enriched my graduate experience.

I would like to thank my parents and family for their unconditional love and support throughout this process. Finally, to my husband Dan, for your patience over the past six years, for your unwavering belief in me, and for your constant love and support, thank you.

CONTRIBUTION OF AUTHORS

For Studies 1-3, Elizabeth Quon developed the research question, conducted the literature review, undertook the statistical analyses, interpreted the results, and wrote and revised the manuscript. As Elizabeth Quon's research supervisor, Dr. Jennifer J. McGrath co-developed the research question, supervised the statistical analyses, and revised the manuscript.

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LIST OF ABBREVIATIONS

ANOVA……...Analysis of Variance

BMI……...…….Body Mass Index

GDP……Gross Domestic Product

HDL……..High Density Lipoprotein

ICC……..Intraclass Correlation

LDL……...…Low Density Lipoprotein

LICO…….....Low-Income Cut-Off

NLSCY……National Longitudinal Survey of Children and Youth

QCAHS…….. .Quebec Child and Adolescent Health and Social Survey

SD……...Standard Deviation

SES…….....Socioeconomic Status

GENERAL INTRODUCTION

Social Determinants of Health

Determinants of individual and population health extend beyond the boundaries of medicine and health care. Health is determined by a range of personal, social, economic, and environmental factors. Social determinants of health are the conditions in the environment in which people are born, live, learn, play, work, and age. They are shaped by the distribution of money, power, goods, and services at local, national, and global levels (Commission on Social Determinants of Health, 2008). Health disparities are differences in health that are closely linked with social or economic disadvantage (Centers for Disease Control, 2008). Thus, socioeconomic status (or class, position) is a key factor underlying health disparities. Indeed, the role of income and social status is listed as one of the key determinants of the health of Canadians (Public Health Agency of Canada, 2013). Socioeconomic status (SES) is a concept that takes into account both material resources/assets and prestige-related rank in a social hierarchy associated with social class (Krieger, Williams, & Moss, 1997). SES is typically measured by traditional indicators of income, educational level, and occupation, but may also be measured by perception of standing in the social hierarchy.

Summary of Research on Health Disparities: Five Eras

Interest in health disparities has grown dramatically within the past 25 years and different eras of research on health disparities associated with SES have emerged (Adler & Ostrove, 2009; Adler & Stewart, 2010). In the first era of research, a threshold framework was applied and poverty was seen as a categorical determinant of health. Thus, prior to the mid-1980s, the majority of research studies compared the health of individuals above and below the poverty line. The underlying assumption of this

threshold framework was that differences in morbidity and mortality were due to material deprivation associated with poverty, and that further increases in income above the threshold of poverty would have little effect on health (Adler & Ostrove, 1999). The Whitehall study (Marmot, Shipley, & Rose, 1984) challenged the notion of the poverty threshold effect on health by demonstrating, in a sample of British civil servants, that health improved and mortality decreased with each increase in occupational grade. Notably, all participants were employed and had access to health care, and the graded effect of occupational grade existed even in those who were clearly above the poverty line.

Thus, the second era established the inverse graded relation between SES and health that occurs at all levels of SES (Adler et al., 1994). Although they do not exist for *all* diseases, SES gradients have been demonstrated across many diseases that carry a substantial burden of morbidity and premature mortality, including cardiovascular disease (Kaplan & Keil, 1993; Matthews, Kelsey, Meilahn, Kuller, & Wing, 1989), diabetes (Paeratakul, Lovejoy, Ryan, Bray, 2002), and arthritis (Bengtsson, Nordmark, Klarskog, Lundberg, Alfredsson, & EIRA Study Group, 2005). Moreover, pervasive incremental SES gradients have been established for health outcomes in infants (Kramer, Seguin, Lydon, & Goulet, 2001; O'Campo, Xue, Wang, & Caughy, 1997; Parker, Schoendorf, & Kiely, 1994), children (Chen, Matthews, & Boyce, 2002), and adults (Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010); findings in adolescents are less consistent (Goodman, 1999). The finding that higher SES is associated with better health at every increment of social status suggests that the association between SES and health is derived not just from inadequate material resources to fulfil basic health needs, but also from

social and psychological phenomena associated with one's standing in a social hierarchy (Adler et al., 1994). In other words, one's relative position in the SES hierarchy may influence health over and above the material implications of that position. These assumptions about the importance of relative position in the social hierarchy led to an increased emphasis on subjective socioeconomic status, or one's perception of one's place in the socioeconomic structure (Singh-Manoux, Adler, & Marmot, 2003). Subjective SES is thought to more accurately reflect a person's relative position within the social hierarchy, rather than his or her absolute socioeconomic position. In adults, subjective SES has been found to be more strongly related to health outcomes than objective SES, as measured by education, income (Operario, Adler, & Williams, 2004), or employment grade (Singh-Manoux, Marmot, & Adler, 2005), or by a composite measure of education, income, and occupation (Adler, Epel, Castellazzo, & Ickovics, 2000).

The third era of research included the identification of the mechanisms that underlie the link between SES and health in order to understand how SES "gets under the skin" to affect health. There is research evidence for a number of pathways, including access to health care, environmental exposure to toxins, health behaviours like smoking, diet, and exercise, and psychological, social, and biological processes associated with stress (Adler & Stewart, 2010). Some research has emphasized the importance of material resources (e.g., Lynch, Davey Smith, Kaplan, & House, 2000), while other work has emphasized the importance of psychological and social factors (e.g., Wilkinson, 1997a; 1999). Wilkinson has theorized that socioeconomic disparities in health result primarily from the psychosocial circumstances associated with relative social position, and that

absolute material standards have a less important role. Specifically, Wilkinson has pointed to lack of social cohesion, relative deprivation, and stress as pathways between social class differentiation and poor health. Sapolsky (2005), based on experimental research findings on social hierarchies and health in primates, has also suggested that psychosocial factors associated with relative standing in the social hierarchy affect health in humans.

During the fourth era of research, a greater emphasis was placed on the contextual factors that operate at multiple levels of influence, including the contextual and compositional effects of neighbourhoods (Diez-Roux, 2001), cities, and countries. Among these contextual factors is income inequality, or the scale of income distribution in a society. Societies with a high level of income inequality have a very unequal distribution of income, with the bulk of the income share held by the wealthiest members of society. In societies with a lower level of income inequality, the income is shared more equally across income groups. The level of income inequality is intrinsically linked to the degree of hierarchical class structure and the amount of social status differentiation in a society (Wilkinson & Pickett, 2007). Findings suggest that countries with greater income inequality (more unequal distribution of income, greater gap between rich and poor) have worse population health (Wilkinson & Pickett, 2006), over and above average income of the country. Income inequality may negatively affect health through low social capital, stressful social comparisons, and relative deprivation (Wilkinson, 1997a, 1997b, Wilkinson & Pickett, 2007). Income inequality may also be reciprocally linked to social and health policy, including investment in welfare spending, child care policies, taxation,

and unemployment compensation, which influences health (Subramanian & Kawachi, 2004).

Finally, research in the fifth era has begun to examine interactions (i.e., individual-level and neighbourhood-level, SES and race/ethnicity) and attempted to establish causality in the associations between SES and health. Research continues across all five eras, as many questions remain in the field of socioeconomic health disparities, including understanding the associations between SES and health across the lifespan.

Health Disparities across the Lifespan

The lifespan developmental perspective (Alwin & Wray, 2005) emphasizes that SES may

have an impact on health at multiple points across the life span, that these exposures may accumulate over time, and that there may be periods of relevance during which socioeconomic inequalities have the greatest impact on health, including early childhood and adolescence. Chen et al. (2002) examined whether SES may have stronger effects during certain periods of development than others. They proposed three developmental models to describe temporal patterns across childhood and adolescence. The childhood-adolescent persistent model posits that SES differences in health are established early in life and remain fairly constant throughout development. The childhood-limited model suggests that SES effects are initially large, but decrease over time and are weaker during adolescence due to school and peer influences (see also West, 1997). The adolescent-emergent model posits that SES effects increase over time due to the accumulation of SES influences that contribute to health and are more apparent during adolescence. Chen et al. found that injuries, asthma, and blood pressure followed a childhood-limited model,

such that there were limited effects of SES on these health outcomes during adolescence, while smoking and physical inactivity followed an adolescent-emergent model, such that effects of SES on these health behaviours emerged during adolescence. These results suggest that associations between SES and health may be unique during adolescence.

Focus on Adolescence

The current program of research focused on health disparities during the period of adolescence for a number of interrelated reasons. First, adolescence is a unique time of transition toward a state of greater social and economic independence. The experience of socioeconomic status during this time shifts from being primarily determined by parents in childhood to being primarily self-determined in adulthood. Second, related to this transition, measurement of SES may be an issue during adolescence. Adolescent SES is usually derived from parental education, parental occupation, family income, or family wealth. This information is sometimes collected from one or more parents, and sometimes from the adolescents themselves, which may influence results, especially as adolescents may inaccurately report their parents' education (Lien, Friestad, & Klepp, 2001). Furthermore, using parental or family SES as a proxy for adolescent SES may be problematic (Glendinning, Love, Hendry, & Strucksmith, 1992), since adolescents develop a sense of their own social status during this time, as they obtain their first job and begin to generate income, and plan for future education. Third, social comparison and relative status may be particularly relevant to health during adolescence, due to the importance of position in the school hierarchy and peer relations during this time (West, 1997). Fourth, adolescence may be a period of relevance for later morbidity and mortality. Health outcomes experienced during adolescence, such as obesity, mental

disorders, and injuries, as well as health behaviours beginning in adolescence, such as cigarette use, alcohol use, and physical inactivity, are sustained into adulthood and may have profound effects on adult health (Sawyer et al., 2012; World Health Organization, 2009). Finally, despite the importance of the adolescent period, less research has been conducted on disparities in health during adolescence, compared to childhood or adulthood (Currie et al., 2008). Altogether, there is a need for further research on health disparities during adolescence, particularly on the link between relative position and health, and using adolescent-specific measures of socioeconomic status.

Brief Summary of Previous Research in Adolescence

The existing research on health disparities during adolescence has indicated that SES gradients in health may be present inconsistently in this age group. Based on longitudinal datasets from the United Kingdom, West (1997) found little evidence of parental SES gradients in self-rated health, acute illness, non-fatal injuries, and mental health; although, there were inverse gradients in certain conditions that may result from childhood low SES. Similarly, Goodman (1999) found that parental SES was associated with some health outcomes (self-rated health, depression, obesity), but not with others (asthma, suicide attempts, sexually transmitted diseases) in American adolescents. In contrast, Chen, Martin, and Matthews (2006) found inverse gradients between parental SES and global health measures (parent ratings of health, activity limitations, school limitations) and acute conditions (injuries, respiratory conditions) in adolescents in the United States. Moreover, Lowry, Kann, Collins, and Kolbe (1996) found an inverse relationship between parental SES and a number of unhealthy risk behaviours, particularly cigarette smoking and sedentary lifestyle, for adolescents in the United

States. Therefore, the existing research in adolescents suggests that associations between SES and health are inconsistently present and may depend on health outcome.

A number of studies have examined the association between subjective or perceived SES and a variety of health outcomes in adolescents. Subjective SES has been measured using 10-point ladder scales and 4- or 5-point Likert scales. In Hungarian adolescents, subjective SES was positively associated with self-rated health and psychological well-being, and negatively associated with general physical health complaints (Piko & Fitzpatrick, 2001). Subjective SES was inversely associated with obesity and depression in American adolescents (Goodman et al., 2001). In another study of American adolescents, subjective SES was not associated with physiological health outcomes, like blood pressure, cortisol, or body mass index, but was associated with positive psychological characteristics of optimism, self-esteem, and perceived control (Chen & Paterson, 2006). In Canadian adolescents, subjective SES was inversely associated with poor self-rated health and psychological distress, but was not associated with harmful drinking or drug use (Hamilton, Adlaf, & Noh, 2009). The existing research suggests that subjective SES is associated with some adolescent health outcomes, but comparison across studies is difficult due to the measurement of different domains of health.

The contextual effects of income inequality, while controlling for individual/family SES, have been examined in a few adolescent studies. Country-level income inequality was shown to be related to self-rated health in adolescents across 27 countries (Torsheim, Currie, Boyce, & Samdal, 2006); however, results did not adjust for country GDP or mean income. In other cross-country comparisons, income inequality

was linked to alcohol drinking in younger but not older adolescents (Elgar, Roberts, Parry-Langdon, & Boyce, 2005), and showed no main effect on adolescent life satisfaction, although a steeper within-country gradient was observed in more unequal countries (Levin et al., 2011). Within-country effects of income inequality have been primarily investigated in the United States. State-level income inequality was positively related to obesity prevalence (Singh, Kogan, & van Dyck, 2008) and negatively related to physical activity (Singh, Kogan, Siahpush, & van Dyck, 2009) in adolescents; however, these studies did not control for state mean income. There have been few evaluations of within-country effects of income inequality on adolescent health outside of the United States. Moreover, most existing studies have focused on a single adolescent health outcome.

Gaps in the Current Literature

Altogether, there is a relative lack of research on socioeconononomic inequalities in adolescent health. The research examining associations between objective parent SES and health has yielded inconsistent findings. Using measures of SES that are specific to adolescents' experience of SES may reduce some of the measurement error associated with using parent SES as a proxy for adolescent SES. In addition, tapping into relative position in the social hierarchy and social comparison may be particularly relevant to the adolescence developmental period. Thus, measuring adolescents' subjective ratings of SES is a promising addition to understanding health disparities during adolescence. A number of studies have investigated the link between adolescent subjective SES and health outcomes; however, it is difficult to make comparisons across studies and to draw conclusions since different measures of subjective SES were employed and associations

were examined across different health outcomes and numerous countries. There is a need for a quantitative summary of these findings, and a more cohesive approach to studying these associations in the future.

Investigating the link between income inequality and health is an emerging field of research and only a handful of studies have examined this association using a multi-level approach in adolescents. To date, studies have primarily examined country-level income inequality and state-level income inequality in the United States. Results in adults (Kondo et al., 2009; Ross et al., 2005) suggest that within-country effects of income inequality may emerge in highly unequal societies only (e.g., United States). However, within-country effects of income inequality on adolescent health have not been examined in a more equal society than the United States. Moreover, there is a lack of previous research on associations between income inequality and adolescent mental health, although mental health problems constitute close to half of the burden of disease during adolescence (Gore et al., 2011). There is a need for more research on these associations across a multiple domains of adolescent health, particularly since research on health disparities in adolescence suggests that associations differ based on the health outcome of interest.

In addition to specific gaps in the research on subjective SES and income inequality during adolescence, a number of research questions remain related to the broader construct of relative position in the social hierarchy. Although subjective SES, income inequality, and SES relative to community SES are thought to reflect a similar underlying construct of relative status, to date, studies have examined each of these constructs in isolation. Thus, their relations with one another are largely unknown.

Moreover, since they have not been examined simultaneously, their respective independent influences on adolescent health are also unknown. There is a need for integration of these research literatures for a deeper understanding of SES disparities in adolescent health.

Aim of the Current Program of Research

The aim of the current research program was to address some of the gaps in the existing literature on health disparities during adolescence. Broadly, the current research aimed to examine how relative position in the socioeconomic hierarchy was related to adolescent health. Because previous research has indicated that health disparities differ across health outcomes, the current research program examined associations across multiple domains of adolescent health in an effort to draw more specific conclusions. The research objectives were addressed in three inter-related studies, all of which organized adolescent health outcomes into broad domains of adolescent health: self-rated health, mental health, physical health, and health behaviours.

Study 1 provided a systematic review and quantitative meta-analysis of the studies that have examined the association between subjective SES and adolescent health. Study 1 demonstrated the overall effect of subjective SES on adolescent health, and examined the influence of a variety of moderating factors, including subjective SES measure, health outcomes, study quality, objective parent SES, and country of study. The results of this study have both measurement and theoretical implications for the influence of subjective SES on adolescent health.

Study 2 examined the effects of province-level income inequality on individual health outcomes in Canadian adolescents. This study drew data from the population-

based National Longitudinal Survey of Children and Youth. Using multi-level analysis, Study 2 tested for a contextual main effect of income inequality (while controlling for compositional effects of family SES) and for a moderating effect of income inequality on the associations between family SES and health. This study was the first to examine within-country effects of income inequality in Canadian adolescents. It was timely and policy-relevant, as income inequality in Canada is rising and Canada now ranks among the most unequal developed nations in the world (Conference Board of Canada, 2013). It also contributed to the growing literature on the effects of income inequality during adolescence.

Study 3 examined the construct of relative socioeconomic status, which was conceptualized and measured by subjective SES, individual SES relative to community SES, and income inequality. This study drew data from the population-based Quebec Child and Adolescent Health and Social Survey. Results from Study 3 demonstrated the independent contributions of subjective SES, individual SES relative to community SES, and income inequality on a wide range of adolescent health outcomes. Results also showed the degree of statistical overlap between these conceptualizations of relative SES. This study has measurement and theoretical implications for the construct of relative SES across the lifespan.

Together, these three studies provided a comprehensive understanding of the influence of subjective SES and income inequality, and the broader construct of relative status, on several domains of health during adolescence.

TRANSITION TO STUDY 1

One of the most direct ways to tap into adolescents' relative position in the social hierarchy is by asking them to subjectively rate their socioeconomic status relative to others. Indeed, over the past 10 to 15 years, researchers around the world have examined associations between subjective SES and various health outcomes in adolescents. In adults, subjective SES has been found to be a better predictor of health status and decline in health status over time than objective SES (Singh-Manoux et al., 2005). Initially, we were interested in comparing the overall effects of subjective and objective SES on adolescent health.

Turning to the research literature uncovered a number of issues. First, subjective SES showed different associations with adolescent health outcomes across studies. However, measurement issues made it difficult to predict when significant associations between subjective SES and health would exist in adolescents. Although a standard measure of subjective SES, the 10-rung ladder, had been introduced for adults (Adler et al., 2000) and for adolescents (Goodman et al., 2001), subjective SES continued to be measured using a number of different scales in adolescents. Moreover, although a number of studies had examined common health outcomes (especially self-rated health), examination of associations between subjective SES and adolescent health had been completed across multiple outcomes. Second, many of the studies had not measured objective SES or had not examined the effects of subjective SES and objective SES simultaneously. Thus, it seemed premature to compare effects of subjective versus objective SES in adolescents when the overall association between subjective SES and adolescent health remained murky and unclear.

Instead, a quantitative summary of the literature examining the association between subjective SES and adolescent health was needed. Using meta-analytic techniques, the effects of variables such as type of subjective SES scale, health outcome of interest, and influence of family objective SES on the effect between subjective SES and adolescent health could be examined. Thus, the objectives of Study 1 were a) to examine the overall effect of subjective SES on adolescent health, and b) to examine the influence of a variety of moderating factors on this effect.

STUDY 1:

Subjective Socioeconomic Status and Adolescent Health: A Meta-Analysis

Abstract

Objective: To comprehensively and quantitatively examine the association between subjective socioeconomic status (SES) and health outcomes during adolescence. **Methods:** Forty-four studies met criteria for inclusion in the meta-analysis. Information on study quality, demographics, subjective SES, health outcomes, and covariates were extracted from each study. Fisher's *Z* was selected as the common effect size metric across studies. Random-effect meta-analytic models were employed and fail-safe numbers were generated to address publication bias. **Results:** Overall, subjective SES was associated with health during adolescence (Fisher's $Z = .10$). The magnitude of the effect varied by type of health outcome, with larger effects observed for mental health outcomes, self-rated health, and general health symptoms; and non-significant effects observed for biomarkers of health and substance use-related health behaviours. Of the measures of subjective SES employed in the reviewed studies, perception of financial constraints was most strongly associated with adolescent health outcomes. Analysis of covariates indicated that inclusion of objective SES covariates did not affect the association between subjective SES and health. **Conclusions:** This meta-analysis has implications for the measurement of subjective SES in adolescents, for the conceptualization of subjective and objective SES, and for the pathways between SES and health in adolescents.

Keywords: subjective socioeconomic status; health outcomes; adolescence; meta-analysis

Subjective socioeconomic status and adolescent health: A meta-analysis

Considerable research has linked low socioeconomic status (SES) to poor health outcomes. Prior to the mid-1980s, SES was assumed to be related to health simply below a threshold of poverty, and it was used most often as a control variable (Adler & Ostrove, 1999). The threshold model was challenged most notably by the Whitehall study of mortality (Marmot et al., 1984), which demonstrated an increase in risk of mortality as employment grade decreased in British civil servants. Since then, the graded relation between SES and health that occurs at all levels of SES has been well established (Adler et al., 1994) and inverse gradients have been found for many health outcomes, including cardiovascular disease (Kaplan & Keil, 1993), diabetes (Paeratakul et al., 2002), arthritis (Bengtsson et al., 2005) and adverse birth outcomes (Kramer et al., 2000). The finding that higher SES is associated with better health at every increment of social status suggests that the association between SES and health is derived not just from basic health needs, but also from social and psychological variables associated with one's standing in a social hierarchy. In fact, relative standing in the hierarchy may be more important than absolute levels of SES (Wilkinson, 1999). Most studies examining SES gradients in health have used objective indicators, such as income, education, and occupation. These indicators are often used interchangeably even though they are only moderately correlated with one another (Winkleby, Jatulis, Frank, & Fortmann, 1992). Similar associations with health have been found with each SES indicator, suggesting that a common underlying element of social stratification may influence health (Adler & Ostrove, 1999).

Subjective status has been defined as "a person's belief about his location in a status order" (Davis, 1956, p. 154). Subjective SES, also called "subjective social status" (Adler et al., 2000) and "perceived social position" (Garbarski, 2010), may be defined as "an individual's perception of his or her place in the socioeconomic structure" (Singh-Manoux et al., 2003, p. 1322). In adults, subjective SES has been found to be more strongly related to health outcomes than objective SES, as measured by a composite of education, income, occupation (Adler et al., 2000), education or income (Operario et al., 2004), or employment grade (Singh-Manoux et al., 2005). Subjective SES may be strongly linked to health outcomes through a number of mechanisms (Singh-Manoux et al., 2005). First, subjective SES may reflect a person's relative social position within the social hierarchy, rather than his or her absolute position. Wilkinson (1999) has suggested that perception of relative position mediates the association between income inequality and population health. Experimental research in animals also points to the link between position in the social hierarchy and health outcomes (Sapolsky, 2005). Second, subjective SES may be a more precise measure of social position, as it represents the cognitive average of various markers of SES (Singh-Manoux et al., 2003), takes into account past and future prospects, and offers a more nuanced judgement of objective indicators. Third, the association between subjective SES and health may be reciprocal, such that subjective rating of SES is affected by health status or that both subjective status and health ratings are affected by a third, underlying variable. Garbarksi (2010) found evidence for reciprocal associations between subjective SES and health; however, these associations differed across health outcomes and subjective SES measures. In contrast, negative affect was found not to uniquely confound the relation between subjective SES and health

(Operario et al., 2004) and associations between subjective SES and health did not change with an experimental mood induction (Kraus, Adler, & Chen, 2013). Finally, longitudinal associations have been observed between subjective SES and change in self-rated health over time (Singh-Manoux et al., 2005), which provides preliminary support for the direction of this association.

The inverse, graded relation between SES and health has been well established in infants (e.g., Kramer et al., 2001), children (e.g., Chen et al., 2002), and adults (e.g., Adler & Ostrove, 1999). However, inequalities in adolescent health are understudied (Currie et al., 2008) and studies have shown that the SES gradient in health may be present inconsistently during adolescence. For instance, some studies have demonstrated inverse gradients between SES and global health measures (parent ratings of health, activity limitations, school limitations), acute conditions (injuries, respiratory conditions; Chen et al., 2006), and health behaviours (cigarette smoking, sedentary lifestyle; Lowry et al., 1996), while other studies found little evidence of SES gradients in self-rated health, acute illness, non-fatal injuries, and mental health (West, 1997). Some studies have shown associations with some health outcomes (self-rated health, depression, obesity), but not with others (asthma, suicide attempts, sexually transmitted diseases; Goodman, 1999). Studying adolescent health is important because health-related behaviours (e.g., tobacco and alcohol use, physical inactivity) and health outcomes (e.g., obesity, mental disorders, injuries) during adolescence track over time and can have a sustained effect on future health (Sawyer et al., 2012).

There are multiple explanations for differing relations between SES and health in childhood, adolescence, and adulthood, including a non-constant, dynamic relation

between SES and physical health across the lifespan or different patterns across age according to health outcomes. In adolescence, the association between SES and health may be weaker due to equalization from school and peer influences (West, 1997) or stronger due to the accumulation of SES influences that contribute to health (Chen et al., 2002). The SES-health association may also differ across age depending on the health outcome of interest (Chen et al., 2006). However, inconsistencies in SES gradients in some adolescent health outcomes may also be partly explained by measurement issues. Adolescent SES is usually derived from parental education, parental occupation, family income, or family wealth, with information collected from parents or from adolescents themselves. Using parental or family SES as a proxy for adolescent SES may be problematic (Glendinning et al., 1992), since adolescents may develop a sense of their own social status during this time of transition between childhood (status primarily determined by family) and adulthood (status primarily self-determined).

Having adolescents report their subjective SES, in addition to using objective measures of SES, may help to address some of the issues associated with the measurement of SES in adolescents. Subjective ratings of social status provide insight into how perceptions of relative rank within social hierarchies affect health in this age group. A number of studies have examined the association between subjective socioeconomic status and a variety of health outcomes in adolescents, including smoking, obesity, depression, and self-rated health. A systematic, narrative review of nine studies that examined this association was completed previously (Ritterman, 2007). Since then, there has been expansion in the number of studies completed in this area. Due to the broad range of health outcomes measured and variety of measures of subjective

socioeconomic status employed, it is difficult to qualitatively describe the overall results from these studies. To our knowledge, no systematic, quantitative review of this literature has been completed. Therefore, a meta-analytic review of the studies examining the association between subjective SES and health in adolescents is valuable in terms of synthesizing the research in this area, and makes both theoretical and methodological contributions.

The purpose of this paper is to comprehensively and quantitatively examine the association between subjective SES and health outcomes during adolescence. This meta-analysis examines the overall magnitude of the association, as well potential moderators of the association.

Method

Literature Search Strategy

A literature search was conducted in PsycInfo and MedLine electronic databases from 1970 to May 2012. Searches included the words *subjective* or *perceived*, variations on the words *social status*, *socioeconomic position,* and *adolescence* and related terms. Next, ascendancy and descendency approaches were used to identify additional articles. Finally, letters of solicitation were sent to authors who had published two or more articles on the topic requesting available data from unpublished manuscripts, including non-significant findings. Researchers' suggestions did not pertain to any non-redundant data. A total of 154 potentially relevant studies were identified for full review, and were located and retrieved (see Figure 1 for full description of literature search strategy).

Study Inclusion Criteria and Selection

Each study selected for inclusion examined the association between subjective

SES and a health outcome or health behaviour in the adolescent age range (12-19 years). Additional inclusion criteria were: study results published in English, and results were not previously published in another included study. Thus, 44 studies were included in the meta-analysis.

Data Extraction

Data were extracted by a single rater (EQ), who coded all studies in consultation with another rater (JM). Discrepancies were resolved to reach consensus. Ten percent of studies were blindly re-coded after a period of four months, with excellent intra-rater agreement (ICC = .997). Sample size, demographic information (e.g., % female, age, country), and participation rate were extracted from each study. Information on extraction of subjective SES measures, health outcome measures, and main covariates is provided in the subsequent sections.

Measures

Subjective SES. Subjective SES was operationally defined as the adolescents' perception of their or their family's socioeconomic, financial, or social status. Four types of subjective SES measures were coded depending on the type of measure used and content of comparison: society ladder, school ladder, Likert scale, and financial constraints. *Society ladder* assesses familial placement in society, while *school ladder* assesses personal placement in the school community, by asking participants to indicate their ranking on a 10-point ladder (see Goodman et al., 2001 for full description of the original scales). Variations of these ladders were accepted, including using a 7-point society ladder (Aslund, Leppert, Starrin, & Nilsson, 2009), examining placement within community (Ritterman, Fernald, Ozer, Adler, Gutierrez, & Syme, 2009; Ritterman,

2010), and examining several types of school status (West, Sweeting, Young, & Kelly, 2010). *Likert scale* assesses perception of family's socioeconomic status based on questions such as, "How well off do you think your family is? How would you rate your family's socioeconomic status? How would you describe your family's financial situation?" Responses were rated on 3-, 4-, or 5-point ordinal scales, such as "low, middle-low, middle, middle-high, high; short of money, in the middle, well off, very well off." *Financial constraint* assesses adolescents' perception of economic constraints in the family using several methods, including a single item ("financial difficulties in the family") and multi-item scales that assessed perception of inadequate money for various needs and wants.

Health outcomes. Outcome variables were defined as: self-rated health, mental health, physical health, and health behaviours. *Self-rated health* included adolescents' ratings of their general or overall health on a single item using a 3-, 4- or 5-point Likert scales, such as "poor, fair, good, very good, excellent" or "not healthy, healthy, very healthy." *Mental health* outcomes included the following sub-categories: psychological well-being (e.g., life satisfaction, quality of life, psychological well-being, and psychological distress), psychological variables (e.g., self-esteem, optimism, aggression, hostility, mastery), depression, and stress. *Physical health* outcomes included the following sub-categories: obesity (e.g., body mass index, overweight, obesity), biomarkers (e.g., cortisol, blood pressure, cardiovascular indicators), general symptoms (e.g., headaches, back pain, stomachaches), and injuries. *Health behaviours* included the following sub-categories: substance use (e.g., alcohol, cigarettes, illicit drugs, marijuana), other health behaviours (e.g., diet, exercise), and sexual health.

Covariates. We coded whether each of these variables of interest were included as covariates for each subjective SES-health association: *age*, *sex*, *race*, *family structure* (e.g., two-parent vs. single-parent home) and *school achievement* (e.g., type of academic program, marks). We also coded whether the following *objective SES* covariates were controlled for: household income, parent education, parent occupation, parent employment status, family wealth (Family Affluence Scale; Currie et al., 2008), an objective SES index score, receipt of government aid/welfare, and family savings.

Study quality. The quality of the study was determined on the basis of eight study characteristics: (i) population-representative, (ii) *N* greater than 1,000, (iii) participation rate greater than 80%, (iv) statistical control for confounders, (v) statistical control for objective SES, (vi) objective SES measured by two or more indicators and parent-reported, (vii) majority of outcomes used validated measures (standardized questionnaires or objectively measured variables), (viii) appropriate statistics used. Intra-rater reliability by the first coder (EQ) after a 4 month delay and inter-rater reliability by an independent coder (DK) for study quality were both excellent (ICC = .990 and .964, respectively).

Statistical Analysis

Effect size calculation. Effect size calculations were guided by previously reported procedures (Cooper & Hedges, 1994). Fisher's *Z* was selected as the common effect size metric across studies, as results were predominantly reported as correlations between subjective SES and a health outcome. Fisher's *Z* ranges from $-\infty$ to $+\infty$ and is interpreted similar to that of a correlation. It is advantageous as data may be converted from almost any form and summary data are not required; however, it is slightly biased

by low sample sizes (Rosenthal, 1991). Bivariate correlations (*r)* were converted using Fisher's variance stabilizing transformation. Test statistics, including unstandardized beta coefficients, *t*-test and *F*-statistic, were converted into *r* and then into Fisher's *Z* (Cooper & Hedges, 1994; Rosenberg, Adams, & Gurevitch, 2000). Dichotomized outcomes (e.g., odds ratio) were transformed into Cohen's *d*, and then converted to Fisher's *Z* (Chinn, 2000). Means and standard deviations, and χ^2 were transformed into Hedges' *g*, and then converted to Fisher's *Z* (Durlak, 2009). When no test statistic data were reported, effect sizes were derived from reported *p* values (Rosenberg et al., 2000), and results described as "nonsignificant" were assigned an effect size of zero. The direction of the Fisher *Z* was coded uniformly, to ensure that positive values reflected better health outcomes (e.g., less obesity, higher self-rated health, lower depression scores) as a function of higher subjective SES.

Selection of effect sizes. Effect sizes were coded for all available and relevant data reported within each article, thus yielding multiple effect sizes per study. There were several reasons why multiple effect sizes were reported and we selected effect sizes accordingly. 1) When multiple results were reported for the same effect size due to employment of several analytic strategies in the original article, we followed a hierarchy to determine which statistic to use and only included one effect size. 2) When different subjective SES measures were employed, different health outcomes were measured, or different group of participants were included, we treated each effect size as non-redundant because a separate subjective SES-health relation was examined. 3) When identical participants were incorporated in more than one subjective SES-health relation due to inclusion of different covariates, we employed two approaches to deal with

redundancy (aggregation to create a mean effect size vs. retention of redundant effect sizes); thus, results were analysed in two ways, depending on the selection of effect sizes. A conservative approach included aggregated effect sizes, so that each subjective SES-health relation was examined only once in each sample (134 non-redundant effect sizes; $M = 3.04$ effects per study). A less conservative approach included redundant effect sizes to maximize power and to examine the effect of inclusion of covariates (262 redundant effect sizes; $M = 5.95$ effects per study).

Analytic strategy. Random-effect meta-analytic models were used to evaluate the association between subjective SES and health during adolescence. Random-effects models assume that the samples are drawn from populations with different effect sizes and allows for both random variance and variance due to true differences between the populations. Random-effects models are preferred to fixed-effects models, which typically yield overly narrow confidence intervals (Schmidt, Oh, & Hayes, 2009).

An analysis of the heterogeneity statistic (Q_T), which measures the variation for the included effect sizes, was conducted for each meta-analytic model. A non-significant Q_T statistic indicates a homogeneous distribution, such that the variability of the effect sizes is less than would be expected from sampling error. A significant Q_T statistic indicates heterogeneous distribution, and may warrant additional moderator analyses. Separate analyses were conducted for all *a priori* specified moderator variables, including type of health outcome, geographical region, type of subjective SES measure, study quality, and inclusion of age, sex, race, family type, school achievement, household income, parent education, parent occupation, and family health as covariates. We conducted categorical summary analyses for moderators. As with variance in ANOVA,

the total heterogeneity (Q_T) can be partitioned into the variation explained by the model (Q_M) and the residual error variance (Q_M). For all moderator analyses, we tested for differences between groups. We also used continuous summary analyses (regression) to test for an association between sample characteristics (mean age, female proportion) and effect size. Bootstrap methods (1000 samples) were used to produce robust non-parametric estimates of confidence intervals about each effect size (Rosenberg et al., 2000).

To address concerns about possible publication bias and the file-drawer problem, Orwin's (1983) fail-safe numbers were calculated to determine the number of non-significant, unpublished, or missing comparisons that would be needed to make the overall effect negligible or not different from zero. Analyses were performed using MetaWin 2 (Sinauer Associates, 2000).

Results

Study and Participant Characteristics

Study and sample characteristics are presented in Table 1. The mean number of participants per study was 7,293 (*SD*=16,568), which permits adequately powerful tests of a small effect size.

Overall Effects

The average cumulative effect size indicated a positive relation such that higher subjective SES was associated with better health outcomes (Fisher's $Z = .095$, non-redundant effect sizes; $Z = .113$, redundant effect sizes). Results suggest that the effect sizes were homogeneous for non-redundant effect sizes and heterogeneous for redundant

effect sizes. Effect sizes and confidence intervals are provided for each non-redundant effect size by type of health outcome (see Figures 2-5).

Moderator Analyses

Sufficient data and variability existed for the examination of moderators, including health outcome, subjective SES measure, study quality, and geographical region within non-redundant effects (see Table 2), and inclusion of covariates: age, sex, race, family type, school achievement, parent education, parent occupation, household income, family wealth within redundant effects (see Table 3).

Health outcome. Categorical summary analyses indicated significant between-group differences for the type of health outcome. The association between subjective SES and self-reported health was reported in 12 studies (15 non-redundant effect sizes). The average cumulative effect size was homogeneous and indicated a positive relation such that higher subjective SES was associated with better self-reported health (Fisher's Z = .178). The association between subjective SES and mental health was reported in 19 studies (43 non-redundant effect sizes). The average cumulative effect size was homogeneous and indicated a positive relation, such that high subjective SES was associated with better mental health (Fisher's Z = .189). Further examination of mental health outcomes showed that this association was present for depression, psychological well-being, and psychological variables (e.g., self-esteem). The association between subjective SES and physical health was reported in 15 studies (31 non-redundant effect sizes). The average cumulative effect size was heterogeneous and indicated a positive relation, such that high subjective SES was associated with better physical health (Fisher's Z = .064). Further examination of physical health outcomes showed that this

association was present for general physical symptoms (e.g., headaches), but not for biomarkers (e.g., cortisol). The association between subjective SES and health behaviours was reported in 20 studies (44 non-redundant effect sizes). The average cumulative effect size was homogeneous and indicated a lack of association between subjective SES and health behaviours (Fisher's $Z = .010$). Further examination showed that this association was not present for substance-related health behaviours; however, a small, but significant effect was present for other health behaviours (e.g., diet, physical activity).

Subjective SES measure. Categorical summary analyses indicated significant between-group differences for type of subjective SES measure employed. Specifically, although all types of measures were associated with a significant positive association with health, financial constraints was associated with the largest effect (Fisher's $Z = .240$), while Likert scale, Society ladder, and School ladder were associated with smaller mean effect sizes (Fisher's $Z = .062, .093, .058$, respectively). As a post-hoc analysis, we ran all analyses without the financial constraints measure and patterns of results remained largely identical. Results are not presented for parsimony.

Objective SES. Categorical summary analyses indicated no significant difference between effects that controlled for objective SES compared to those that did not control for objective SES (Fisher's $Z = .114$ vs $.112$). Therefore, the inclusion of objective SES covariates did not influence the magnitude of the association between subjective SES and health. Likewise, Q_M was non-significant for the inclusion of parent education, parent occupation, household income, and family wealth as covariates.

Covariates. Categorical summary analyses indicated that inclusion of one or more covariates was associated with a significantly smaller effect size compared to

examining the subjective SES-health relation alone (Fisher's Z = .097 vs. .145). Effects that included age or sex covariates had significantly smaller mean effect size compared to effects that did not control for these covariates. Continuous summary analyses showed that mean age of the sample (B = -0.009, SE = 0.011, p = .26), age range of the sample (minimum age B = -0.002, SE = 0.007, p = .46; maximum age B = 0.001, SE = 0.005, p =.51), and female proportion of the sample (B = 0.001; SE = 0.002; p = .60) were not significantly associated with effect size. The inclusion of race or family structure as covariates did not appear to alter the association between subjective SES and health. Controlling for school achievement was associated with a larger mean effect size than not controlling for school achievement.

Study quality. There was no difference between studies that were coded to be of high compared to low quality (Fisher's Z = .093 and .098 respectively) in categorical summary analyses. In addition, when study quality was retained as a continuous variable, the slope of the regression line between study quality and effect size was non-significant (B = -0.002, SE = 0.008, p = .36).

Geographical region. Categorical summary analyses indicated significant between-group differences for geographical region of the study. Specifically, studies conducted in Western Europe, Asia, North America, and Australia had significant positive mean effect sizes (Fisher's Z = .185, .181, .071, .056, respectively) while studies conducted in Eastern Europe did not (Fisher's Z = .042). Because of heterogeneity between studies from North America, each country was examined separately. These analyses indicated significant associations in Canada and the United States, but not in Mexico.

Discussion

The present meta-analysis examined the association between subjective SES and health outcomes during adolescence across 44 studies. Overall, results demonstrated a positive association such that higher subjective SES was associated with better health outcomes. The magnitude of the associations were similar to those observed in studies that have examined the subjective SES-health association in adults (e.g., Singh-Manoux et al., 2005) and in studies that have examined the objective SES-health association in youth (e.g., Chen et al., 2006). Several moderating variables were examined to further explain this association.

We examined four different types of subjective SES measures: society ladder, school ladder, Likert scale, and financial constraints. Results indicated that measuring subjective SES using the society ladder, school ladder, or Likert scale yielded similar effect sizes. These findings suggest that the association between subjective SES and health in adolescents is robust, and is not altered significantly by measuring slightly different constructs. Namely, the society ladder references income, education, and jobs compared to others in society and clearly reflects "socioeconomic status," as do some of the Likert scales employed in the included studies. Other Likert scales are worded in such a way that the ratings are more closely tied to income, financial status, or wealth. School ladder may be theoretically more consistent with "sociometric status," a form of social status that represents the respect and admiration individuals have in their face-to-face groups (Anderson, John, Keltner, & Kring, 2001). Despite these conceptual differences, as well as a variety of measurement (own status vs. family's status; school vs. society vs. neighbourhood comparison groups; Likert scale vs. 10-point ladder) and analytical

differences (categorical vs. continuous), overall associations were largely similar between these three measures of subjective SES. One measure of subjective SES yielded stronger associations with health outcomes than the others: perception of financial constraints. It is possible that perception of financial constraints reflects a different construct than the other measures of subjective SES. Adolescents who perceive financial constraints or difficulties in their households may be those at the very bottom of the socioeconomic gradient. This measure may detect adolescents living in poverty, who experience material deprivation in addition to low social status, which may put them at greater risk for experiencing stress and other negative health outcomes.

In terms of health outcomes, subjective SES showed the largest effect sizes for mental health outcomes, followed by self-rated health, and physical health outcomes, all of which were positively associated with subjective SES. Within mental health outcomes, depression was most strongly linked to subjective SES, followed by general psychological well-being and other psychological variables. Perception of socioeconomic rank is thought to influence health outcomes through psychological processes (Operario et al., 2004; Wilkinson, 1999), and associated biological processes and harmful coping behaviours. The present results corroborate the idea that subjective SES is closely tied to psychological processes and outcomes. The finding that subjective SES is robustly associated with global self-rated health is important because self-rated health is considered to be a strong indicator of physical health status and predictor of future mortality (Idler & Benyamini, 1997; Singh-Manoux et al., 2006). In addition, these results mirror those in the adult literature (e.g., Singh-Manoux et al., 2005), which indicates that the relation between subjective SES and health may be similar in

adolescents and adults. Results varied depending on the type of physical health outcome measured. For instance, subjective SES was strongly associated with general physical health symptoms, while the effect size of the association between SES and obesity was much smaller, and biomarkers of physical health were not associated with subjective SES. It is possible that general symptoms, such as headaches and stomachaches may be psychosomatic, and thus, are more strongly and immediately associated with psychological processes. In contrast, changes in biomarkers of health may take longer to emerge, which may explain why few associations were observed in these "healthy" community samples of adolescents. It will be important to examine associations between subjective SES and biomarkers of physical health in population-representative samples that would include unhealthy and at-risk youth.

The current pattern of results across health outcomes may also be linked to the measurements of these outcomes: subjective SES was more strongly associated with self-reported measures of health (e.g., self-rated health, general symptoms, psychological well-being) than measured health outcomes (e.g., height/weight, blood pressure). This could be due to shared variance across self-reports (i.e., mono-informant bias), reverse causation, or a confounding third variable. Garbarksi (2010) examined whether subjective SES and health are reciprocally associated with one another in a sample of adults. Results indicated that subjective SES had an effect on self-rated health that was stronger than the reverse association; however, relations between subjective SES and health status were reciprocal, and depressive symptoms affected subjective ratings of SES. In contrast, other studies have demonstrated that chronic negative affect (Operario et al., 2004) and other psychosocial variables (e.g., self-esteem, mastery, trust; Lundberg & Kristenson, 2008)

do not uniquely confound the association between subjective SES and self-rated health. Moreover, experimentally-induced shifts in negative mood did not affect subjective SES ratings or the association between subjective SES and self-rated health (Kraus et al., 2013). To date, there has been little examination of third variables or reciprocal relations between subjective SES and health in adolescents. Longitudinal associations between low subjective SES and subsequent poor self-rated health (Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007) suggest that this relation is not merely a measurement artefact in this age group. However, more research is needed to measure and test potential confounds of the association between subjective SES and self-reported health outcomes in adolescence.

Present results showed a lack of association between subjective SES and substance use-related health behaviours. The cost of purchasing alcohol, cigarettes, or illicit drugs may be protective against initiation or maintenance of these behaviours in adolescents. Other health behaviours, including diet and physical activity, showed a significant positive association. Finally, sexual health behaviours were inversely related to subjective SES, such that high status was associated with more risky sexual health behaviours in the one study that measured this outcome. Health behaviours are thought to be established in youth and extend into adulthood and contribute greatly to morbidity and mortality from cardiovascular disease, cancer, and other conditions (Kolbe, Kann, & Collins, 1993). However, this review suggests a lack of association between subjective SES and substance-related and sexual health behaviours during adolescence.

Geographic region of the study was examined as a potential moderator. Results showed the largest effects of subjective SES and adolescent health in Western Europe

(UK, Finland, Sweden) and Asia (China, South Korea). Slightly smaller effect sizes were observed in the United States, Canada, and Australia, with no association observed in Eastern Europe (Hungary, Serbia) and Mexico. Cross-country differences may be related to economic variables (e.g., gross domestic product, societal income inequality), socio-cultural variables (e.g., collectivism vs. individualism, capitalism vs. socialism vs. communism), or study methodology (e.g., subjective SES measure, health outcomes). Income inequality is of particular interest, since more unequal distribution of income in society is thought to accentuate relative SES differences (Wilkinson, 1999). Examination of the hypothesis that subjective SES-health association was stronger in more unequal countries could not be examined due to the potential confound of study variables. For instance, no associations were observed in the studies conducted in Mexico (a highly unequal society); however, it is unclear whether these findings were associated with income inequality or socio-cultural variables, or the fact that these studies examined substance-related health behaviours. Future studies that use more similar subjective SES measures and examine similar health outcomes may help to elucidate the specific moderating role of economic, cultural, and political influences on the subjective SES-health association.

We examined the influence of inclusion of a variety of covariates on the association between subjective SES and health. Results indicated that larger effect sizes were found in studies that did not control for covariates, which is an expected finding. Specifically, studies that controlled for age and sex had lower mean effect sizes than studies that did not. However, the association between subjective SES and health did not differ as age of the sample increased or in studies with a greater proportion of female

adolescents. Inclusion of race as a covariate did not moderate the association. A lack of reporting of race outside of the United States precluded further examination of this variable. Future research in this area should report racial breakdown to examine how race may affect the subjective SES-health association, especially since racial differences have been observed in this area (Goodman, Adler, et al., 2003). Interestingly, larger effect sizes were observed when school achievement (e.g., marks at school, future academic goals) was entered as a covariate. School achievement may be conceptualized as an adolescent-specific objective indicator of SES, as it is indicative of future educational attainment. Future objective SES may have a suppressive effect on subjective SES, since controlling for this measure strengthened the relation between subjective SES and health. Thus, it may be important to control for adolescent-specific objective SES indicators, including school achievement, current employment, and pocket money, when examining the association between subjective SES and health.

We found no difference in the magnitude of the association between effects that controlled for objective SES and effects did not control for objective SES. These results suggest that the influence of subjective SES on health is independent of objective SES, which is supportive of the idea that subjective SES reflects a person's relative social position, while objective SES is reflective of absolute position. Less than half of the effect sizes controlled for objective SES, with most of these using parental education as the objective SES indicator. More studies that measure both objective and subjective SES are required to tease apart these associations across health outcomes.

The graded association between SES and health is well-established (Adler et al., 1994); however, precise mechanisms of how SES "gets under the skin" to affect health

remain unclear. Several mechanisms have been proposed and examined (see Adler & Stewart, 2010 for a review), including material conditions (differential access to health care, environmental exposure to hazards; Lynch et al., 2000), psycho-social factors (stress, social support), and health behaviours. The importance of relative rank and social comparison has also been emphasized (Wilkinson, 1999). Rank is thought to be a fundamental process of social life, both in humans and in animals. Humans place themselves into hierarchies based on numerous dimensions. Research in non-human primates has demonstrated the importance of subordinate rank on physical and psychological stress (Sapolsky, 2005). The importance of measuring subjective SES emerged from these lines of research.

Socioeconomic status is posited to be shaped by two related, but relatively independent processes: material resources (education, wealth, occupation) and subjective perception of social rank (Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012). Material resources help to determine access to goods and services, while rank shapes perception of one's standing. Based on this conceptualization, objective and subjective SES may be differentially associated with different health outcomes. Indeed, in the present study, we found that subjective SES was most strongly linked to health outcomes that are closely tied to psychological processes, including self-rated health, depression, psychological well-being, and general physical health symptoms. Over time, low subjective SES and associated psychological processes may predict worsened physical health outcomes. However, further evidence is necessary to support this hypothesis.

In addition to these theoretical implications, the findings from the current study also have implications for ongoing research in this field. Previously, Braveman et al. (2005) recommended that researchers take an outcome-specific and socioeconomic group-specific approach to measuring SES. Based on current findings, we suggest that future research measure as much relevant socioeconomic information as possible, including subjective SES, traditional measures of objective SES, and area or neighbourhood SES, when investigating the role of SES on adolescent health. It is also critical to clearly specify the precise SES factors measured and why these were chosen, and to provide adequate analytical information to understand the unique influence of each indicator. It is also recommended that researchers designing surveys of child and adolescent health begin to include measures of subjective SES in addition to measures of objective and area SES. These ratings are quick and easy to complete, and we have shown that subjective SES may be an independent construct from objective SES in adolescents. Results appear largely similar when the society ladders, school ladders, and Likert scales measuring perceived family SES are employed. However, it is recommended that the Subjective Social Status Scale – Youth Version be employed across studies and across countries for increased consistency and comparability of results. This scale offers ability to explain social status using examples to be modified as appropriate across different cultural contexts.

Future research in this area should build on the results of this review to understand how subjective and objective SES affect specific health outcomes, especially biomarkers of health and health behaviours. In addition, research is required to better understand the relations between subjective and objective measures of SES, as well as to

uncover mediating and moderating factors between these measures of SES and health outcomes. Finally, additional research is needed to understand how subjective and objective SES affect health across countries, with different health policies, income inequality, and sociocultural influences.

This review and meta-analysis provides an important contribution to the growing literature on subjective SES and health. There is evidence of an association between subjective SES and adolescent health outcomes. Future research should incorporate both subjective and objective measures of SES to help understand pathways to health disparities. This knowledge, together with social policy action, may help to reduce disparities in health across the lifespan. As this field continues to expand, it is important for researchers to consider the measurement of subjective SES on the observed results and to streamline the number of subjective SES measures used by researchers. Theoretically, examining the overall association between subjective SES and health in adolescents contributes to the limited literature on the SES gradient in health in this age group. Moreover, it provides insight into the role of subjective status in the pathway from social inequalities to disparities in health outcomes.

Table 1

Descriptive Characteristics and Frequencies of 45 Studies Included

Characteristic	*K*	*N*	*M (SD)*
Sample size	44	320,872	7,292.55 (16,567.61)
Age (range)	36	303,435	12.52 (2.10) - 17.32 (2.79)
Age (mean)	27	135,517	15.32 (1.62)
Sex (% female)	42	318,906	52.97 (9.10)
Objective SES			
Parental Education – Low	16	164,982	18.90% (15.14)
Parental Education – High	18	171,428	25.15% (13.56)
Unemployment	8	20,907	13.56% (9.89)
Subjective SES			
Society ladder	12	31,467	6.51 (0.76)
School ladder	9	28,853	6.80 (1.12)
Likert scale – Low	22	277,135	11.41% (9.87)
Likert scale - High	17	257,939	15.15% (11.80)
Financial constraints	6	11,448	
Region			
North America	19	48,739	
Western Europe	6	34,794	
Eastern Europe	12	26,324	
Asia	5	208,590	
Australia	1	97	
Study Quality	44	320,872	4.46 (1.38)
Population-representative	10	74,698	
N > 1,000	33	306,405	
Participation rate > 80%	25	265,473	
Control for potential confounders	37	303,204	
Control for objective SES	29	209,604	
Objective SES = two measures, parent-reported	6	19,352	
Validated measures for >50% outcomes	19	34,739	
Appropriate statistics, presented adequately	39	308,893	

Note. *K*= number of studies reporting this information; *N* = total number of participants; *M* = Mean; *SD* = standard deviation.

Table 2

Effect Sizes by Health Outcome, Subjective SES Measure, Study Quality, and Region

Comparison	Effect sizes[1]	*N*	*Fisher Z*	Bootstrap *95% CI*	Q_T	Fail-safe N[2]
All studies	133	5105,372	**.095**	**(.071, .117)**	138.04	12,462
Health Outcome			Q_M =56.56 (3, 129) p<.001*			
Self-rated health	15	98,837	**.178**	**(.118, .246)**	10.50	2,649
Mental Health	43	72,182	**.189**	**(.154, .227)**	53.54	8,086
Depression	9	38,122	**.249**	**(.193, .324)**	14.07	2,232
Psychological well-being	16	24,407	**.192**	**(.140, .240)**	9.20	3,047
Psychological variables	17	8,444	**.154**	**(.086, .230)**	22.68	2,612
Physical Health	31	137,726	**.064**	**(.029, .102)**	44.58*	1,957
BMI/Obesity	10	118,442	**.052**	**(.021, .085)**	9.45	508
Biomarkers	13	10,486	.006	(-.025, .033)	10.66	66
General Symptoms	7	8,238	**.162**	**(.067, .259)**	76.26	1,125
Health Behaviours	44	196,627	.010	(-.025, .040)	45.10	380
Substance Use	33	91,363	.011	(-.016, .039)	32.95	321
Other	9	101,700	**.068**	**(.028, .122)**	4.49	604
Subjective SES Measure			Q_M =28.95 (3, 128) p=.001*			
Likert scale	48	306,816	**.062**	**(.023, .100)**	50.07	2,945
Society ladder	44	85,011	**.093**	**(.047, .142)**	40.41	4,032
School ladder	21	83,657	**.058**	**(.024, .103)**	10.03	1,202
Financial constraints	20	29,888	**.240**	**(.182, .293)**	18.88	4,770
Study Quality			Q_M =0.08 (1, 131) p=.78			
Low (0-4)	64	133,012	**.093**	**(.055, .125)**	40.51	5,717
High (5-7)	69	372,360	**.098**	**(.066, .130)**	83.27	6,676
Region			Q_M =29.76 (4, 132) p=.001*			
North America	56	172,540	**.071**	**(.044, .104)**	68.48	3,919
United States	41	91,342	**.088**	**(.052, .133)**	42.35	3,569
Canada	7	36,364	**.063**	**(.038, .088)**	6.05	433
Mexico	8	44,834	.003	(-.010, .016)	6.94	16
Western Europe	21	69,126	**.185**	**(.129, .244)**	16.78	3,857
Eastern Europe	31	45,503	.042	(-.016, .095)	26.72	1,270
Asia	15	217,233	**.181**	**(.146, .213)**	8.21	2,700
Australia	10	970	**.056**	**(.000, .136)**	9.00	551

Note. [1]Number of non-redundant effect sizes, [2]Fail-safe *n* using Orwin's method; N = total number of participants; Q_T = heterogeneity test statistic; Q_M = test of between-group differences; *p < .05.

Table 3

Effect Sizes by Type of Covariates Included in Original Analysis

Comparison	Effect sizes[1]	*N*	*Fisher Z*	Bootstrap *95% CI*	Q_T	Fail-safe N[2]
All studies	262	1,672,597	**.113**	**(.095, .131)**	364.10*	29,436
Any Covariates			Q_M=8.55 (1, 260) p=.02*			
No covariates	89	188,463	**.145**	**(.115, .178)**	83.08	12,824
One or more covariates	173	1,484,134	**.097**	**(.077, .119)**	237.78*	16,655
Age			Q_M=8.69 (1, 260) p=.01*			
Did not include as covariate	134	303,149	**.135**	**(.109, .164)**	123.85	18,013
Included as covariate	128	1,339,448	**.090**	**(.069, .116)**	153.30	11,414
Sex			Q_M =6.89 (1, 260) p=.03*			
Did not include as covariate	153	709,387	**.131**	**(.106, .153)**	191.31	19,892
Included as covariate	109	963,210	**.089**	**(.062, .115)**	142.55	9,588
Race			Q_M=0.19 (1, 260) p=.71			
Did not include as covariate	224	1,457,806	**.113**	**(.094, .132)**	367.56	24,987
Included as covariate	38	214,791	**.119**	**(.075, .177)**	24.22	4,501
Family Type			Q_M=0.53 (1, 260) p=.53			
Did not include as covariate	201	749,688	**.110**	**(.090, .129)**	229.93	21,907
Included as covariate	61	922,909	**.123**	**(.082, .162)**	112.84	7,461
School Achievement			Q_M=15.93 (1, 260) p=.006*			
Did not include as covariate	220	765,767	**.099**	**(.080, .118)**	173.00	21,565
Included as covariate	42	906,830	**.183**	**(.141, .227)**	115.68	7,651
Objective SES Covariates			Q_M=0.02 (1, 260) p=.89			
No objective SES covariates	142	846,659	**.114**	**(.090, .138)**	205.78*	16,112
One or more objective SES covariates	120	825,938	**.112**	**(.086, .138)**	145.45*	13,313
Education			Q_M=1.67 (1, 260) p=.28			
Did not include as covariate	175	1,352,057	**.106**	**(.084, .128)**	307.84*	18,408
Included as covariate	87	320,540	**.127**	**(.097, .159)**	57.63	10,941
Occupation			Q_M=3.09 (1, 260) p=.13			
Did not include as covariate	243	1,631,999	**.117**	**(.098, .135)**	328.83*	28,229
Included as covariate	19	40,598	.060	(-.023, .139)	12.09	1,121
Income			Q_M=2.07 (1, 260) p=.22			
Did not include as covariate	253	1,649,759	**.116**	**(.096, .134)**	350.01	28,972
Included as covariate	9	22,838	**.055**	**(.029, .088)**	4.62	482
Family Wealth			Q_M=0.04 (1, 260) p=.62			
Did not include as covariate	251	1,230,679	**.114**	**(.096, .133)**	280.13	28,400
Included as covariate	11	441,918	**.093**	**(.050, .138)**	13.44	1,107

Note. [1]Number of redundant effect sizes, [2]Fail-safe *n* using Orwin's method; N = total number of participants; Q_T = heterogeneity test statistic; Q_M = test of between-group differences; *$p < .05$.

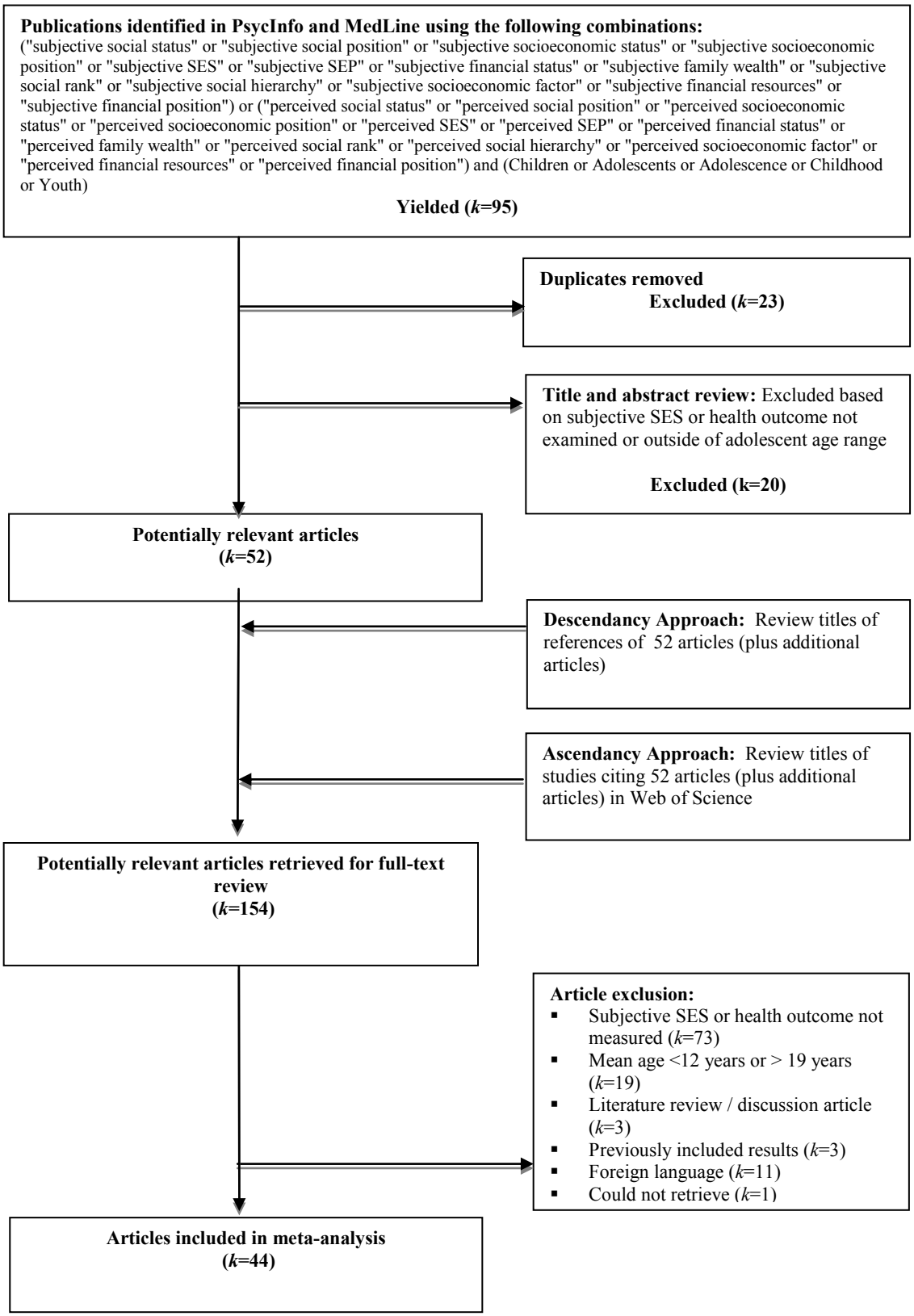

Figure 1. Flow chart for article identification and inclusion in meta-analysis.

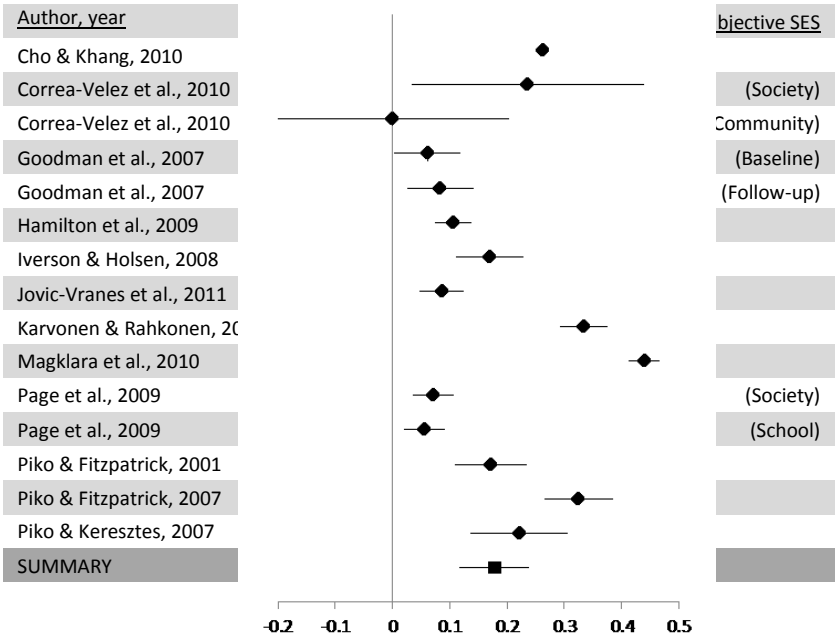

Figure 2. Forest plot for self-rated health.

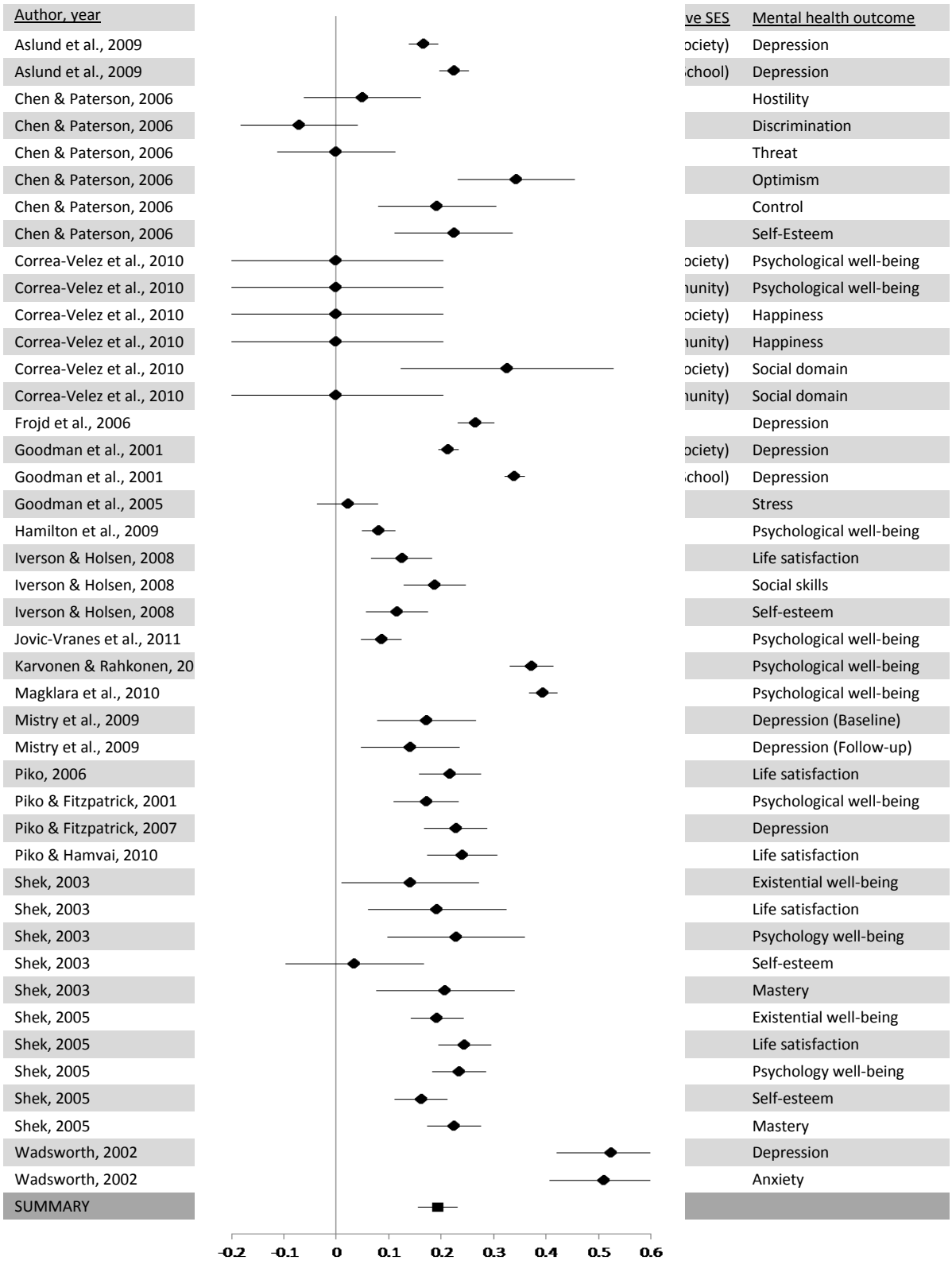

Figure 3. Forest plot for mental health outcomes.

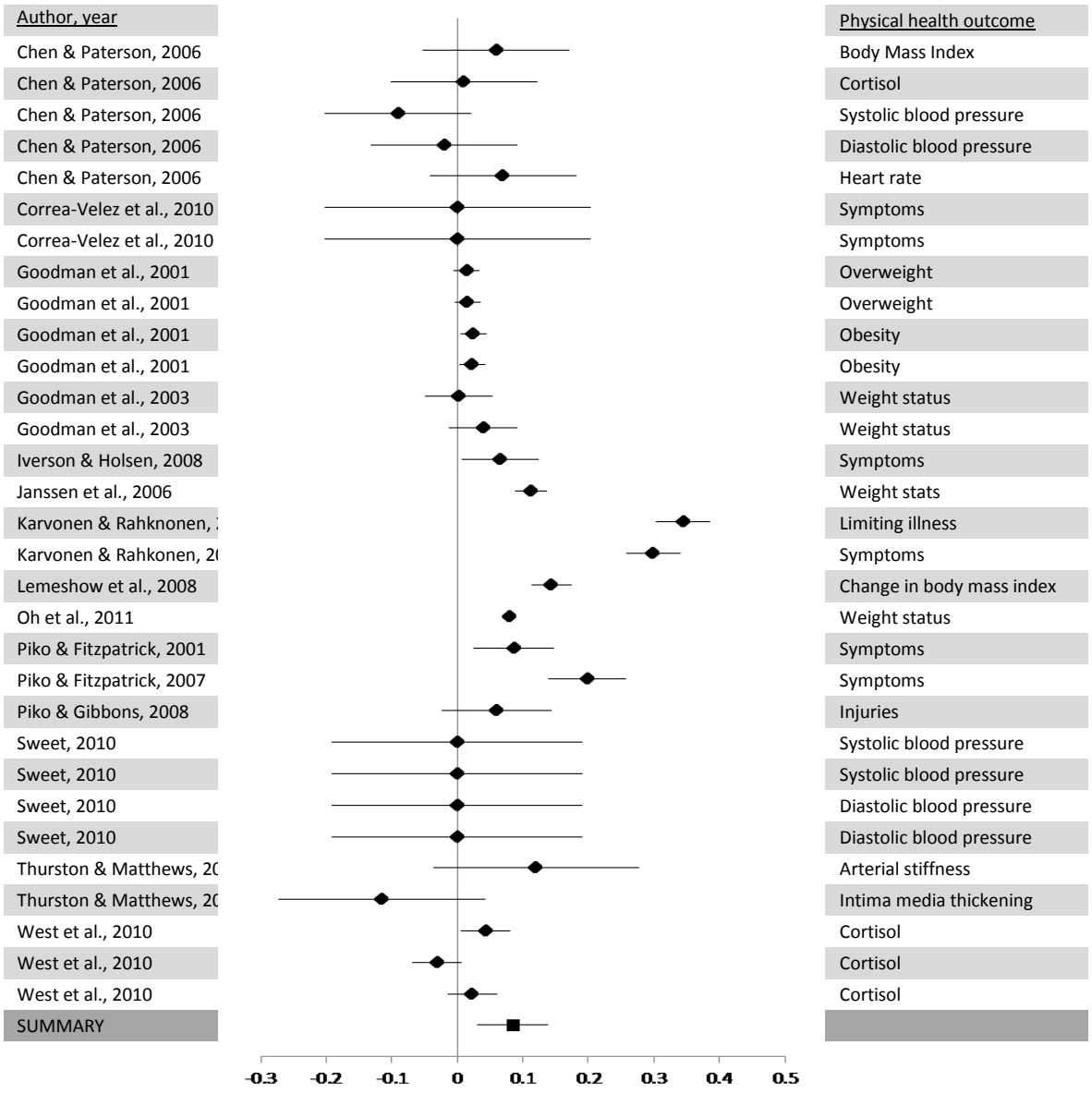

Figure 4. Forest plot for physical health outcomes.

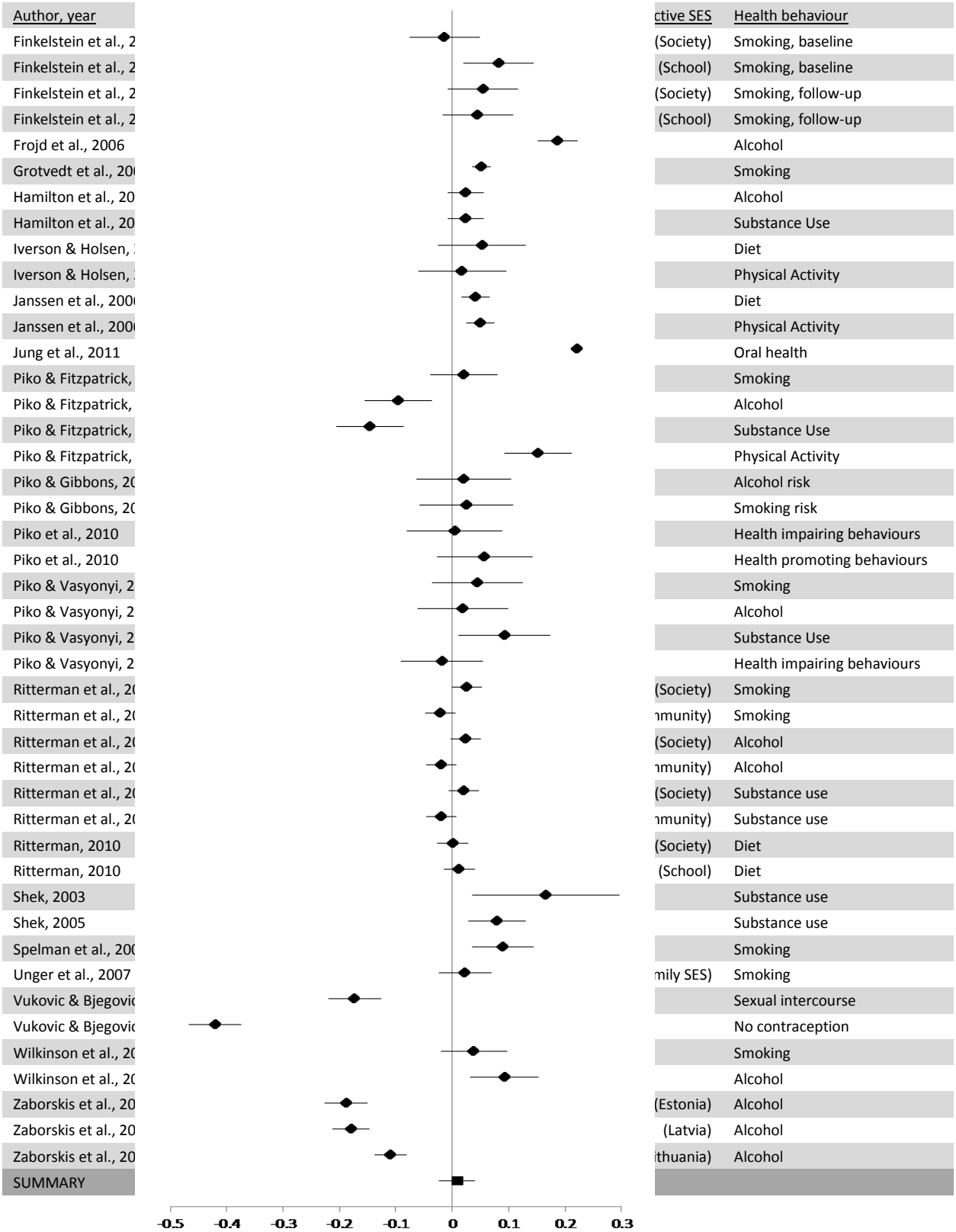

Figure 5. Forest plot for health behaviours.

TRANSITION TO STUDY 2

The purpose of Study 1 was to provide a quantitative summary of the studies that have reported associations between subjective SES and health outcomes or health behaviours during adolescence. Meta-analytic techniques were used to examine the overall effect of subjective SES and investigate the influence of variety of moderating factors on this effect. A small, but significant overall association between subjective SES and adolescent health emerged.

One of the most striking findings of the meta-analysis was the difference in magnitude of the associations across health outcomes. Specifically, subjective SES was strongly related to self-related health, mental health outcomes, and general physical health outcomes, but showed weak or non-significant associations with other physical health outcomes and health behaviours. Given previous studies have also shown inconsistent effects of family objective SES and health outcomes in adolescents (e.g., Goodman, 1999), future studies should continue to measure adolescent health across a number of domains and outcomes. In the meta-analysis, we grouped health outcomes based on face validity and availability of data into four categories: self-rated health, mental health, physical health, and health behaviours. Results suggested divergence of associations across physical health outcomes, particularly when comparing self-reported general physical health outcomes to physiological measures of health. In addition, results for health behaviours also diverged between substance use behaviours and other health behaviours, such as diet and exercise behaviours. In Study 2, we aimed to continue to measure health across these domains of health. Because the dataset did not include measured health data, we included adolescent outcomes across five domains of health:

self-rated health, mental health, physical health, substance use behaviours, and diet/exercise health behaviours.

Study 1 also indicated that controlling for family objective SES did not affect the association between subjective SES and adolescent health, suggesting that material resources and perception of social rank may represent relatively independent processes (Kraus et al., 2012). As such, material standards and relative social position may affect health through different mechanisms and pathways. Wilkinson (1997b; 1999) has emphasized the importance of social cohesion and relative deprivation as pathways between relative social position and poor health. Relative position is linked to the amount of social status differentiation in a society, which may be measured by the scale of income distribution – or income inequality – in that society (Wilkinson & Pickett, 2007). Thus, subjective SES and income inequality have similar conceptual underpinnings, so we wondered if these measures would also show similar associations with adolescent health.

There is less research investigating associations between income inequality and adolescent health compared to the research on subjective SES and adolescent health. A few studies investigated cross-country associations with single adolescent health outcomes (e.g., self-rated health, alcohol use, life satisfaction; Elgar et al., 2005; Levin et al., 2011; Torsheim et al., 2006) and within-country associations with single adolescent health outcomes (e.g., obesity, physical activity; Singh et al., 2008; 2009). Findings were mixed across these studies, perhaps due to the measurement of different health outcomes. Lack of study across multiple health domains, together with our findings regarding differences across health outcomes in Study 1, indicated the need for a comprehensive

examination of the associations between income inequality and a number of adolescent health outcomes.

Further, results in adults suggested that within-country effects of income inequality may emerge in countries with a high level of inequality (Kondo et al., 2009; Ross et al., 2005). To date, within-country associations in adolescents had only been examined in highly unequal countries (e.g., United States, Brazil), and no studies had examined the within-country effects of income inequality on adolescent health in Canada.

By linking individual SES and health data from a population-based survey of youth in Canada with provincial income data, the within-country effects of income inequality on multiple domains of adolescent health could be examined. Thus, the objectives of Study 2 were a) to examine the overall effect provincial income inequality on adolescent health, and b) to examine the influence of provincial income inequality on the association between family SES and adolescent health.

STUDY 2:

Province-Level Income Inequality and Health Outcomes in Canadian Adolescents

Quon, E. C., & McGrath, J. J. (Under Review).

Abstract

Objective: To examine the effects of provincial income inequality on multiple adolescent health outcomes. **Methods:** Participants (aged 12-17 years; N=11,899) from Cycles 4 and 7 of the Canadian National Longitudinal Survey of Children and Youth were included. Parental education, household income, province income inequality, and province mean income were measured. Health outcomes were measured across a number of domains, including self-rated health, mental health, health behaviours, substance use behaviours, and physical health. **Results:** Income inequality had a significant main effect for injuries (β=.05, p=.03), general physical symptoms (β=.05, p=.05), and limiting conditions (β=.05, p=.03), after controlling for other socioeconomic variables, and a moderating effect on family socioeconomic status for limiting conditions (β=-.04, p=.01), hyperactivity/inattention (β=-.02, p=.04), and conduct problems (β=-.02, p=.05). **Conclusions:** Province-level income inequality may influence select individual physical and mental health outcomes in adolescents, which has implications for research and policy in this age group.

Keywords: adolescents; disparities; public health; mental health; health behaviour

Province-Level Income Inequality and Health Outcomes in Canadian Adolescents

Countries with greater disparity between the rich and the poor – or greater income inequality – have been shown to have worse population health (see Wilkinson & Pickett, 2006 for a summary). These findings have formed the basis of the income inequality hypothesis: a more unequal distribution of income in society, over and above societal average income, has an adverse effect on the health of the individuals in that society (Wilkinson & Pickett, 2007). To test the hypothesis that income inequality has a contextual effect on health, Subramanian and Kawachi (2004) have argued that multi-level consideration of individual income and societal/community income inequality, and their effects on individual health is essential. In a meta-analysis of 28 multi-level studies, Kondo et al. (2009) found that income inequality had a "modest" adverse effect on adult self-rated health and mortality.

As the period of transition from childhood to adulthood, adolescence is also a time when socioeconomic status shifts from parent- or family-determined status as a child to self-determined adult status. Existing evidence suggests that graded associations between socioeconomic status and health, which are well-established in adulthood and childhood (e.g., Braveman et al., 2010), may be present inconsistently during adolescence (Chen et al., 2006; Goodman, 1999; West, 1997). Similarly, associations between income inequality and health may be different in adolescence compared to adulthood. Two main mechanisms have been proposed to explain the link between income inequality and health, both of which may differentially affect adolescent vs. adult health. The *social cohesion* pathway suggests that income inequality leads to low social capital and stressful social comparison, which affect health through psychological processes and associated

physiological changes (Wilkinson, 1997a; 1997b; Wilkinson & Pickett, 2009). Social comparison and social cohesion may be particularly relevant to health during adolescence, due to the importance of peer relations during this time (West, 1997). Psychosocial processes are also critical during this developmental period, and mental disorders are the most common health problems (Gore et al., 2011). The *policy* pathway suggests that the adverse influence of income inequality may operate through social and health policies, such as health care, welfare spending, child care, tax policy, and unemployment compensation (Subramanian & Kawachi, 2004). Policies and spending related to education and mental health care may be particularly important during adolescence.

To date, only a handful of studies have examined associations between income inequality and adolescent health outcomes. Using data from the Health Behaviour in School-aged Children study, greater income inequality at the country level has been shown to be related to poorer adolescent self-related health (although results did not control for country mean income; Torsheim et al., 2006), drinking alcohol in young adolescents (with no effect in older adolescents; Elgar et al., 2005), and a steeper within-country gradient in adolescent life satisfaction (but no main effect; Levin et al., 2011). In the United States, greater state-level income inequality was linked to higher adolescent obesity prevalence (Singh et al., 2008) and lower physical activity levels (Singh et al., 2009), although these findings did not control for state mean income. State-level income inequality was inversely correlated with birth-control usage, but was not significant in multivariate analyses (Crosby, Holtgrave, DiClemente, Wingood, & Gayle, 2003).

Finally, higher municipal-level income inequality was associated with worse oral health in Brazilian adolescents (Celeste, Nadanovsky, Ponce de Leon, & Fritzell, 2009).

Results from these studies suggest that associations between income inequality and adolescent health may vary by health outcomes, such that income inequality may have a stronger effect on certain health outcomes. To date, no studies have examined associations between income inequality and mental health outcomes, a critical domain of adolescent health. Moreover, lack of control for potential confounders limits some of the previous findings. There is a need for the examination of multiple health outcomes, including mental health, within a single sample to further understand how income inequality may be differentially linked to health outcomes.

It also remains unclear whether the geographical scale (i.e., country, state, city) of income inequality comparison matters for adolescent health. Existing evidence in adults, as reported in the meta-analysis by Kondo et al. (2009), suggests that stronger associations between income inequality and self-rated health exist for between-country vs. within-country comparisons. Moreover, meta-analytic findings suggested that within-country associations may emerge in highly unequal societies only. Ross et al. (2005) found that within-country city-level income inequality was linked to mortality in highly unequal countries (United States, United Kingdom), but not in more equal countries (Canada, Sweden, Australia). To date, within-country adolescent comparisons are limited to US states (Crosby et al, 2003; Singh et al., 2008; 2009) and Brazilian municipalities (Celeste et al., 2008). There is a need for more within-country comparisons outside of the United States, particularly in more equal countries, like Canada. In terms of income inequality, Canada is more equal than the United States,

United Kingdom, Italy, Australia, and Japan, and less equal than Switzerland, Ireland, France, Sweden, Denmark, and other peer countries (Conference Board of Canada, 2013). To our knowledge, no previous studies have tested for of the effects of income inequality on adolescent health within Canada. Further understanding of how geographical scale and the inequality level of the country affects within-country effects may help to elucidate the mechanisms by which income inequality may influence health.

The aim of the current study was to test the effects of provincial income inequality across a number of health outcomes in Canadian adolescents. We chose to examine income inequality at the province level, since Canadian provinces have different taxation, health, social, and education policies and represent distinct geographical regions. Therefore, using a within-country design, we examined for a contextual main effect of province-level income inequality on individual health outcomes in adolescents, while controlling for province mean income, household income, and parental education. We expected that greater provincial income inequality would be associated with worse adolescent health outcomes. We also examined for an interaction between province-level income inequality and family socioeconomic gradients in health. We expected stronger inverse associations between family socioeconomic status and adolescent health in more unequal provinces.

Method

Sample

Participants were from the National Longitudinal Survey of Children and Youth (NLSCY), a population-based longitudinal survey of Canadian children and adolescents conducted by Statistics Canada and Human Resources Development Canada. The

NLSCY sample is representative of children aged 0 to 11 years who were living in any Canadian province in 1994/1995, when survey weights are applied. A full description of the NLSCY and its sampling design is available elsewhere (Human Resources Development Canada & Statistics Canada, 1995). Data were accessed with permission from the Social Sciences and Humanities Research Council of Canada.

The current study used data from the original longitudinal cohort of the NLSCY, a sample that was 0-11 years old at initial recruitment in 1994-1995. Data collection occurred every two years, with a total of eight collection cycles. Using a cross-sectional design, data were included from Cycle 4 (2000-2001) and Cycle 7 (2006-2007) in order to measure all participants from the original cohort during adolescence (between 12 and 17 years old). In Cycle 4, we included 5,580 adolescents who were 6 to 11 years old at initial recruitment in 1994. In Cycle 7, we included 6,319 adolescents who were 0 to 5 years old at initial recruitment in 1994.

Data collection for the NLSCY was completed via computer-assisted telephone interviews with the "person most knowledgeable" about the youth (parent) and their spouse, paper-and-pencil questionnaires for adolescents aged 10-17 years, and computer-assisted telephone interviews with youth aged 16 and older. The "person most knowledgeable" was the youth's biological mother (90%) or biological father (8%) and will hereafter be referred to as "parent."

Individual/Family SES Characteristics

Household income (before taxes and transfers) from all sources of income for all family members during the previous 12 months was derived from open-ended questions answered by the parent and their spouse. *Parental education* (years) was derived from

questions about the highest level of education attained for parent and spouse. Mean years of education between the two parents was calculated (except in cases where there was no spouse).

Province Income and Income Inequality

Income measures for each Canadian province were drawn from the Canadian Socio-economic Information Management System database, from the Income Statistics Division of Statistics Canada. *Income inequality* was measured using the Gini index, a measure of inequality that ranges from 0 (perfect equality) to 1 (perfect inequality), based on household income after taxes and transfers, adjusted for household size (Statistics Canada, 2013a). *Mean income* was measured as the average household income after taxes and transfers, adjusted for household size (Statistics Canada, 2013b). Data from 2000 and 2006 were extracted to match the years of NLSCY data collection. Thus, we included information from the 10 Canadian provinces from two different time points. Gini indices by province and year are presented in Table 1.

Health Outcomes

Health outcomes were broadly categorized into five categories: self-rated health, mental health, health behaviours, substance use behaviours, and physical health. All health outcomes were coded such that higher scores indicate worse health.

Self-rated health. Adolescents rated their health status from "Excellent, Very good, Good, Fair, Poor."

Mental health. Adolescents responded to a number of questions about their mental health, which were aggregated to form indices. *Self-esteem* was measured by four items taken from the General Self Scale of the Marsh Self-Description Questionnaire

(Cronbach's alpha = 0.73). Adolescents completed the "Behaviour Checklist," which was factor analyzed by Statistics Canada to identify six factors: *Indirect aggression* (5 items; Cronbach's alpha = 0.73), *Physical aggression* (6 items; Cronbach's alpha = 0.74), *Emotional disorder* (7 items; Cronbach's alpha = 0.76), *Hyperactivity/Inattention* (7 items; Cronbach's alpha = 0.75), *Prosocial behaviour* (10 items; Cronbach's alpha = 0.77), and *Property offences* (6 items).

Health behaviours. *Television watching* was derived from adolescent report of average number of hours spent watching TV or videos or playing video games per day. Response categories were recoded to create a continuous variable using the median value, where applicable. *Physical activity* was derived from adolescents' responses to two questions about frequency of playing sports or doing physical activities during the week, with or without a coach or instructor. Responses were summed to create a total score. *Breakfast eating* was derived from adolescent report of frequency of eating breakfast from Monday to Friday.

Substance use behaviours. *Alcohol use* was measured by adolescent report of their experience with alcohol, ranging from "I have never had a drink of alcohol" to "About 6-7 days a week." *Cigarette use* was measured by adolescent report of their experience with smoking cigarettes from "I have never smoked" to "About 6-7 days a week."

Physical health. *Limiting condition* was measured by parent report (for 12-15 years) and adolescent report (for 16-17 years) of whether a physical or mental condition or health problem reduces the amount of kind of activity the adolescent can do ("Yes" or "No"). Responses were summed across three domains: home, school, and leisure

activities. *Injuries* were measured by parent report (for 12-15 years) and adolescent report (for 16-17 years) of whether the adolescent was injured seriously enough to require medical attention in the past 12 months ("Yes" or "No"). *Chronic conditions* were measured by parent report (for 12-15 years) and adolescent report (for 16-17 years) of a health professional diagnosis of the following long-term conditions: asthma, bronchitis, food allergies, respiratory allergies, other allergies, heart condition, kidney condition, epilepsy, cerebral palsy, mental handicap, learning disability, ADHD, psychological disorder, or other ("Yes" or "No"). Responses were summed to create a total score. *Body mass index* was calculated as weight (kg)/height $(m)^2$ based on adolescent-reported height and weight. *General symptoms* were derived from adolescent report of frequency of occurrence of headaches, stomachaches, and backaches in the past 6 months from "Seldom or never" to "Most days." Responses were summed to create a total score. *Sleep difficulties* were measured by adolescent report of how often they had difficulties in getting to sleep in the past 6 months from "Seldom or never" to "Most days."

Missing Data

Longitudinal response rate for the NLSCY was 68% in Cycle 4 and 57% in Cycle 7. We were unable to include data for adolescents who did not participate in these cycles. Multiple imputation (5 datasets) was performed using SAS (Version 9.2) to impute missing information for partial nonresponse data. To impute health outcomes, we included all other health outcomes along with age, sex, cycle, and province in the imputation model. To impute household income and parental education, we included these variables along with parental employment status, family size, single parent status, number of bedrooms in the home, and type of dwelling. Results were largely identical

when analyses were run on the original versus imputed data set; therefore, only results based on the imputed dataset are presented. The characteristics of the current study sample are provided in Table 2.

Analytical Strategy

Multi-level modeling techniques (Bryk & Raudenbush, 1987) were used to fit regression models to the nested data. A two-level model was specified in which participants (level-1) were nested within province-year (level-2). The level-1 model describes the effect of individual socioeconomic variables and the level-2 model describes the effect of province socioeconomic variables. Multi-level models were specified using HLM 6.2 software.

To test the effect of income inequality, we entered province income inequality as a level-2 predictor, while controlling for level-2 province mean income and level-1 household income and level-1 parental education. To examine whether provincial income inequality moderated the effect of family socioeconomic status on health, we tested cross-level interactions of Gini index and household income, and Gini index and parental education, while controlling for provincial mean income. As a post-hoc analysis, we grouped provinces into low, medium, or high tertiles based on income inequality and examined associations between individual socioeconomic status and health.

Results

Descriptive sample characteristics for the 11,899 adolescents included in the study are presented in Table 2. Overall, the sample was evenly divided across age and sex categories. Mean parental education was about 13 years, which corresponds to completion of secondary education or one year of post-secondary education, depending

on the Canadian province. Mean pre-tax household income before taxes was about $77,000. Descriptive statistics for health outcomes are presented in Table 3.

We hypothesized that greater provincial income inequality would be associated with worse health outcomes. Results (presented in Table 4) indicated that greater income inequality (higher Gini index) was associated with more injuries requiring medical attention, more general physical symptoms, and more life domains affected by limiting conditions, after controlling for provincial mean income, household income, and parental education.

We also hypothesized that family socioeconomic gradients in health would be stronger in provinces with greater income inequality. Cross-level interactions of income inequality with household income and parental education are presented in Table 5. Results indicated that greater income inequality was associated with stronger associations for household income with limiting conditions, and for parental education with limiting conditions, physical aggression, hyperactivity/inattention, and property offences. In contrast, greater income inequality was associated with weaker gradients for household income and parental education with cigarette use.

To further investigate these findings, we stratified provinces by Gini index into low, medium, and high income inequality tertiles, and examined effects of household income and parental education on health across each level of inequality. Results for the effects of household income and parental education on health stratified by low, medium, and high income inequality are presented in Table 5. Household income and parental education showed stronger associations with limiting conditions in high Gini index provinces, compared to low and medium Gini index provinces. In contrast, household

income showed a weaker association with cigarette use in high Gini index provinces and parental education showed weaker associations with cigarette use in medium and high Gini index provinces. Finally, parental education showed the strongest associations with physical aggression, hyperactivity/inattention, and property offences in high Gini index provinces.

Discussion

Using a within-country design in Canadian adolescents, the aim of the current study was to examine the effects of income inequality on multiple domains of adolescent health. We tested for a main effect of provincial income inequality on adolescent health and for a moderating effect of provincial income inequality on associations between family socioeconomic status and adolescent health.

The first hypothesis was that greater provincial income inequality would be associated with worse health outcomes in adolescents. A significant association between income inequality and poor health was observed for certain health outcomes, which provides partial support for this hypothesis. Greater income inequality was related to more injuries requiring medical attention, more frequent physical symptoms like headaches, stomachaches, and backaches, and more limitations at home, school, and leisure due to a physical or emotional condition, after controlling for family socioeconomic status and mean province income. Thus, income inequality was most consistently associated with general physical health issues, although it was not associated with self-rated health. In addition, there were no significant effects of income inequality on health behaviours, like diet, physical activity, or substance use, or on mental health problems, such as hyperactivity/inattention, emotional problems, or aggression.

Previous research on the effects of income inequality on health in adolescents has shown mixed results across studies and outcomes. Greater country income inequality was associated to poorer self-rated health in adolescents (Torsheim et al., 2006), and greater state income inequality was associated with higher obesity prevalence and lower physical activity levels (Singh et al., 2008; 2009). In contrast, the current study did not observe significant associations between province income inequality and self-rated health, body mass index, or physical activity. Of note, the previous studies did not adequately control for average income levels, which may be an important confound of the effects of income inequality, while we included mean province income as a covariate, along with household income and parental education. Other factors that may contribute to the differences in findings are the scale of the study (between-country vs. within-country) and overall level of income inequality in the country (high inequality in the United States vs. medium inequality in Canada). Based on current and previous findings, independent effects of income inequality on adolescent health are not consistently observed. However, when significant associations are observed, they consistently indicate that greater income inequality is associated with poorer health in adolescents.

The second hypothesis was that greater provincial income inequality would be associated with steeper socioeconomic gradients in health. A significant cross-level interaction between income inequality and family socioeconomic status was observed for limiting conditions, physical aggression, hyperactivity/inattention, and property offences in the expected direction, which provides partial support for this hypothesis. Levin et al. (2011) also observed a significant interaction between Gini index and individual socioeconomic status (as measured by the Family Affluence Scale), which indicated that

as country income inequality increases, the socioeconomic gradient in life satisfaction increased. In the present study, income inequality displayed a main effect on limiting conditions, as well as a moderating effect on the family socioeconomic gradients for this outcome. Moreover, steeper gradients were observed in more unequal provinces for several "externalizing" mental health issues, including physical aggression, hyperactivity, and property offences. In other words, low family socioeconomic status was most strongly linked to externalizing problems in more unequal provinces. Previous research has linked income inequality to juvenile homicide and bullying (Pickett & Wilkinson, 2007). Violence is thought to be linked to income inequality through social trust, increased importance on status, and increased sensitivity of shame and humiliation (Wilkinson & Pickett, 2009). This is consistent with the idea that higher inequality leads to lower social cohesion (Wilkinson, 1997a, 1997b), and findings that higher inequality is linked to lower social capital (civic engagement and social trust; Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997). For cigarette use, we observed that individual socioeconomic gradients decreased as income inequality increased. This finding may be linked to regional variations in youth cigarette use across Canada (Health Canada, 2012), which may confound the associations. For instance, youth smoking rates are much higher in Quebec compared to other provinces, thus a socioeconomic gradient may be less apparent in this province.

This paper adds to the literature that has employed a multi-level design to examine associations between income inequality and health during adolescence. One of the strengths of the current study was our ability to examine the independent effects of income inequality, while statistically controlling for mean income, household income,

and parental education. Previous studies in this area have often not adequately controlled for mean income, or have employed adolescent-reported "family affluence" instead of parent-reported income and education to measure individual socioeconomic status. This study is also one of the first to examine within-country associations between income inequality and adolescent health outside of the United States. Given the evidence that within-country effects of income inequality may exist only in highly unequal societies, it was important to test for within-country effects in a more equal country, like Canada. Finally, we were able to examine the effects of income inequality in a broad range of health outcomes and health behaviours, which allows for a more thorough investigation of these associations in adolescence.

There are several methodological limitations of the current study. First, although we employed after-tax income to derive the Gini coefficient, in line with previous studies (e.g., Torsheim et al., 2006), the NLSCY dataset included before-tax household income only. Second, although we examined associations in both 2000 and 2006 to increase our statistical power, we employed a cross-sectional design and are not able to determine the direction of the observed associations. Third, the NLSCY relies on adolescent- and parent-reports of health behaviours and health outcomes, which are subject to differences in response styles and is a potential source of bias. Finally, although the original sample was representative of the Canadian population at initial recruitment, significant attrition occurred over time in the NLSCY. In order to maximize available data, we utilized multiple imputation in order to examine associations in all remaining participants.

In conclusion, this study provided some evidence of a main effect of income inequality on adolescent physical health, and a moderating effect on associations between

parental education and adolescent mental health. Using a multi-level, within-country design in Canada, we demonstrated these effects in some, but not all health behaviours and health outcomes. Future research in this area should also examine within-country effects in more equal societies and across multiple countries. In addition, longitudinal studies documenting change in income inequality levels over time and subsequent health outcomes are required to determine the directionality of the relation between income inequality and health. Further understanding of the effects of income inequality on health in childhood and adolescence, as well as adulthood, will help to promote interventions to reduce inequality or its impact on health and well-being.

Table 1

Gini Index by Province and Year

	Gini index	
Province	2000	2006
Alberta	.312	.314
British Columbia	.312	.319
Manitoba	.290	.304
New Brunswick	.291	.293
Newfoundland	.302	.299
Nova Scotia	.295	.295
Ontario	.325	.320
Prince Edward Island	.285	.265
Quebec	.294	.291
Saskatchewan	.295	.323

Table 2

Sample Characteristics

Characteristic	Mean *(SD)*	N *(%)*
Age	14.33 *(1.71)*	
12		2,229 *(18.7)*
13		2,321 *(19.5)*
14		1,927 *(16.5)*
15		1,857 *(15.6)*
16		1,855 *(15.6)*
17		1,710 *(14.4)*
Sex		
Male		5,983 *(50.3)*
Female		5,916 *(49.7)*
Parental education (years)	13.10 *(2.14)*	
Household income (CAD)	77,024 *(55,433)*	
Cycle		
4 (2000/01)		5,580 *(46.9)*
7 (2006/07)		6,319 *(53.1)*
Province		
Alberta		1,253 *(10.5)*
British Columbia		988 *(8.3)*
Manitoba		912 *(7.7)*
New Brunswick		699 *(5.8)*
Newfoundland and Labrador		646 *(5.5)*
Nova Scotia		843 *(7.1)*
Ontario		2,993 *(25.1)*
Quebec		2,267 *(19.1)*
Prince Edward Island		349 *(3.0)*
Saskatchewan		949 *(8.0)*

Table 3

Descriptive Statistics

Health Outcome	Mean *(SD)*	N *(%)*
Self-rated health (1-5)	1.93 *(0.80)*	
Excellent (1)		3,717 *(31.2)*
Very Good (2)		5,798 *(48.7)*
Good (3)		1,970 *(16.6)*
Fair (4)		361 *(3.0)*
Poor (5)		53 *(0.4)*
Injury (past 12 months; 0-1)	0.19 *(0.39)*	
No (0)		9,675 *(81.3)*
Yes (1)		2,224 *(18.7)*
Chronic conditions (number; 0-14)	0.63 *(0.97)*	
Sleep difficulties (1-5)	2.19 *(1.22)*	
Never (1)		4,426 *(37.2)*
Once per month (2)		3,474 *(29.2)*
Once per week (3)		2,152 *(18.1)*
Two or more time per week (4)		1,010 *(8.5)*
Most days (5)		837 *(7.0)*
General symptoms score (3-15)	5.79 *(2.32)*	
Body mass index	21.51 *(3.62)*	
Limiting condition (# of domains; 0-3)	0.18 *(0.62)*	
0		10,751 *(90.4)*
1		507 *(4.3)*
2		271 *(2.3)*
3		370 *(3.1)*
Physical activity score (2-8)	4.76 *(1.64)*	
Television watching (hours/day)	2.49 *(1.66)*	
Breakfast eating (1-4)	1.88 *(1.04)*	
Every day (1)		5,950 *(50.0)*
3-4 days per week (2)		2,839 *(23.9)*
1-2 days per week (3)		1,739 *(14.6)*
Never (4)		1,371 *(11.5)*
Cigarette use score (1-8)	2.09 *(1.90)*	
Alcohol use score (1-9)	3.28 *(2.06)*	
Self-esteem score (0-16)	4.17 *(2.50)*	
Indirect aggression score (0-10)	1.35 *(1.55)*	
Emotional problems score (0-16)	3.45 *(2.70)*	
Physical aggression score (0-12)	1.10 *(1.64)*	
Hyperactivity/inattention score(0-16)	4.00 *(2.68)*	
Prosocial behaviour score (0-20)	8.76 *(3.76)*	
Property offences score (0-12)	1.02 *(1.36)*	

Note: For all health behaviours and conditions, a lower score indicates better health.

Table 4

Main Effects of Province and Family SES on Health Outcomes

	Province				Family/Individual			
Health outcome	Gini index		Mean income		Household income		Parental education	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Self-rated health	.007	.76	.018	.39	**-.062**	**<.001**	**-.062**	**<.001**
Injuries	**.049**	**.03**	-.024	.25	.002	.87	**.027**	**.008**
Chronic conditions	.013	.72	-.008	.81	**-.036**	**.001**	.001	.92
Sleep difficulties	-.042	.11	**.095**	**.001**	**-.026**	**.007**	**.037**	**.001**
General symptoms	**.048**	**.05**	-.017	.43	-.015	.15	-.012	.23
Body mass index	-.035	.17	.005	.85	**-.028**	**.004**	**-.071**	**<.001**
Limiting conditions	**.047**	**.03**	.024	.22	**-.033**	**.002**	**-.042**	**<.001**
Low physical activity	-.015	.56	.002	.94	**-.074**	**<.001**	**-.100**	**<.001**
Television hours	.042	.15	**-.096**	**.003**	**-.034**	**.001**	**-.112**	**<.001**
Low breakfast eating	.012	.78	.001	.97	**-.053**	**<.001**	**-.098**	**<.001**
Cigarette use	.048	.27	**-.102**	**.03**	**-.038**	**<.001**	**-.085**	**<.001**
Alcohol use	.038	.25	-.025	.44	**.022**	**.01**	**-.028**	**.001**
Low self-esteem	-.020	.30	**.040**	**.04**	**-.058**	**<.001**	**-.031**	**.003**
Indirect aggression	.022	.34	-.012	.57	-.002	.82	**-.029**	**.005**
Emotional problems	.028	.22	.013	.55	**-.041**	**<.001**	-.001	.93
Physical aggression	.001	.98	.046	.14	**-.032**	**.002**	**-.081**	**<.001**
Hyperactivity/inattention	-.005	.87	.043	.10	**-.028**	**.03**	**-.051**	**<.001**
Prosocial behaviour	-.021	.37	.018	.44	**-.037**	**<.001**	**-.038**	**<.001**
Property offences	-.013	.61	.040	.11	**-.031**	**.003**	**-.031**	**.003**
Expected direction	positive		negative		negative		negative	

Note: Standardized beta coefficients and exact *p*-values are presented. All models include age, sex, parental education, household income, Gini index, and mean income.

Table 5

Cross-Level Interaction of Gini Index with Household Income and Parental Education

Health outcome	Gini x Household income		Household income			Gini x Parental education		Parental education		
			Low Gini	Med Gini	High Gini			Low Gini	Med Gini	High Gini
	β	*p*	*β*	*β*	*β*	*β*	*p*	*β*	*β*	*β*
Self-rated health	.010	.54	**-.049***	**-.079****	**-.060*****	-.011	.31	**-.073*****	-.018	**-.076*****
Injuries	-.005	.64	.001	.012	.000	.001	.95	.012	**.050***	.025
Chronic conditions	.006	.59	**-.043***	-.031	**-.036****	.009	.51	-.014	.001	.014
Sleep difficulties	-.005	.65	**-.050***	-.004	-.021	-.008	.52	**.045***	**.042***	.026
General symptoms	-.006	.70	-.022	-.018	-.017	-.006	.58	-.026	.026	-.026
Body mass index	.011	.39	**-.043***	.000	**-.031****	.011	.39	**-.062****	**-.112*****	**-.053*****
Limiting conditions	**-.022**	**.08**	-.023	-.029	**-.034***	**-.037**	**.01**	-.006	-.021	**-.083*****
Low physical activity	.020	.24	**-.092*****	**-.099*****	**-.063*****	.000	.98	**-.089*****	**-.119*****	**-.096*****
Television hours	.005	.77	-.039	**-.052***	**-.029***	.003	.78	**-.104*****	**-.112*****	**-.113*****
Low breakfast eating	.012	.31	**-.088*****	**-.069***	**-.039****	-.001	.89	**-.067*****	**-.107*****	**-.109*****
Cigarette use	**.029**	**.03**	**-.061****	**-.066****	**-.025***	**.019**	**.06**	**-.103*****	**-.069****	**-.075*****
Alcohol use	.002	.83	.011	.013	**.027****	-.002	.83	**-.033***	-.002	**-.038****
Low self-esteem	.002	.86	**-.055***	**-.067***	**-.056*****	-.006	.56	**-.041***	-.014	**-.038***
Indirect aggression	-.008	.46	.014	-.005	-.006	-.013	.27	-.016	-.024	**-.047****
Emotional problems	-.004	.67	-.037	-.036	**-.041****	-.017	.11	-.007	**.051***	-.026
Physical aggression	.003	.84	.007	**-.087****	**-.031***	**-.023**	**.07**	**-.078*****	-.033	**-.111*****
Hyperactivity/inattention	-.003	.79	-.013	-.040	-.020	**-.024**	**.04**	**-.056****	.008	**-.079*****
Prosocial behaviour	-.013	.32	**-.032**	-.032	-.040	-.009	.41	**-.053****	-.015	**-.044*****
Property offences	-.003	.82	-.011	**-.084****	-.023	**-.023**	**.05**	**-.041***	**.045***	**-.062*****
Expected direction	negative		negative			negative		negative		

Note: For interaction terms, standardized beta coefficients and exact *p*-values are presented. Gini x Income models control for age, sex, mean province income, Gini index, and household income. Gini x Education models control for age, sex, mean income, Gini index, and parental education. For interpretation purposes, Gini index tertiles were created. For effects of household income and parental education, standardized beta coefficients are presented and * denotes p <.05, ** denotes p<.01, *** denotes p<.001.

TRANSITION TO STUDY 3

The purpose of Study 2 was to examine within-country effects of income inequality on health outcomes in Canadian adolescents. Multi-level modelling was used to examine the overall effects of provincial income inequality and its influence on family SES gradients across multiple adolescent health outcomes.

Compared to the effects of subjective SES in Study 1, we observed few direct effects of income inequality on adolescent health. Indeed, across 19 health outcomes, significant effects of income inequality were observed for only three outcomes: injuries, limiting conditions, and general symptoms. Moreover, significant associations were observed for physical health outcomes, rather than for self-rated health or mental health outcomes. These findings suggested that subjective SES and income inequality may reflect different underlying constructs; however, direct comparison in this sample was not feasible as the NLSCY did not assess subjective ratings of SES.

We also considered other ways of assessing relative position within the socioeconomic hierarchy. Perhaps the most direct way to assess relative position is to examine individual/family SES relative to the average community SES – in other words, is one's SES higher, lower, or similar to the community average? Previous research suggests that lower neighbourhood SES is associated with worse adolescent health, after controlling for family/individual SES (Leventhal & Brooks-Gunn, 2000; Sellström & Bremberg, 2006). Considering the potential importance of social comparison and relative deprivation, school SES may be a more appropriate comparison than neighbourhood SES, particularly for adolescents attending high school. Goodman, Huang, Wade, & Kahn (2003) found that lower school SES was related to more depression, even after

accounting for school income inequality and individual SES; however, additional studies that examine other health outcomes are required. Moreover, to our knowledge, effects of subjective SES, income inequality, and school or community SES have not been previously examined in a single study.

Given the findings for provincial income inequality in Study 1, we elected to examine income inequality at a more proximal geographical area. We reasoned that provincial income inequality may not influence the daily social comparisons made by adolescents. The level of income variability at the community level may be more closely linked to concepts of relative deprivation in adolescence.

Following the findings of Studies 1 and 2, we felt it was important to continue to measure health outcomes across a number of domains of adolescent health. In addition, as measuring physiological health outcomes was identified as an area requiring additional investigation in Study 1, and as we were not able to assess measured outcomes in Study 2, we chose to draw data from a survey that had examined a number of physiological health outcomes.

Therefore, although subjective SES, income inequality, and SES relative to community SES are thought to reflect a similar underlying construct of relative status, to date, studies have examined each of these constructs in isolation. There is a need for integration of these research literatures for a deeper understanding of SES disparities in adolescent health.

Drawing from a population-based survey of adolescents across over 100 schools in Quebec allowed for the examination of the effects of subjective SES, school/community SES, and community income inequality on multiple domains of

adolescent health. Thus, the objectives of Study 3 were a) to examine the extent to which subjective SES, community SES, and income inequality overlap in adolescents, and b) to examine the unique contributions of subjective SES, community SES, and income inequality on adolescent health outcomes.

STUDY 3:

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 yr; *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 behaviours, substance-related health behaviours, reported physical health, and biomarkers of health. Best-fitting multi-level 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

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

The graded relation between socioeconomic status 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 et al., 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 et al., 2006; West, 1997) and may depend on the health outcome or behaviours in question (Goodman, 1999; Hanson & Chen, 2007). The use of parental SES as a proxy for adolescent SES may contribute to the inconsistent findings in this age of transition from childhood to adulthood (Glendinning et al., 1992). Given that health behaviours that begin during adolescence lead to adult morbidity and mortality (Sawyer et al., 2012), understanding socioeconomic disparities in adolescent health behaviours 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 (1997a; 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 socioeconomic status is associated with health across the lifespan, 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 socioeconomic status. Subjective SES is based on "an individual's perception of his or her place in the socioeconomic structure" (Singh-Manoux et al., 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 et al., 2005). A meta-analysis of the studies that have examined the association between subjective SES and adolescent health demonstrated a significant overall association, although the strength of the association differed across health outcome types (Quon & McGrath, 2013). 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 et al., 2007; Wilkinson, Shete, Spitz, & Swann, 2011). Many studies relied upon adolescent-

reported objective SES (e.g., Hamilton et al., 2009; Piko & Fitzpatrick, 2007) or did not control for objective SES (e.g., Cho & Khang, 2010; Zaborskis, Sumskas, 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, which 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 multi-level 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., neighbourhood, 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 neighbours, which may lead to poorer health. Review studies have shown that neighbourhood SES negatively relates to adolescent health, after controlling for individual SES (Leventhal & Brooks-Gunn, 2000; Sellström & Bremberg, 2006). School SES has also been negatively linked to adolescent mental health (Goodman, Huang, et al., 2003), and these 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 (c.f. 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 (c.f. Wagstaff & Doorslaer, 2000). However, multi-level 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 multi-level studies in adolescents suggest that country-level income inequality has a contextual effect on self-rated health (Torsheim et al., 2006) and US state-level income inequality has a contextual effect on obesity prevalence (Singh et al., 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 neighbourhood 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 socioeconomic status; 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, since 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, Wattigney, 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 behaviours, reported physical health, 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 behaviours, 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 completed in 1999. 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_{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, QC). 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.

Socioeconomic Status Measures

All SES measures were coded such that higher values indicate higher SES and greater income equality.

Subjective SES. Adolescents' response to the item: "Compared with your classmates, would you say that your family's economic situation is (*Worse*, *Same*, *Better*)?"

Family objective SES. 1) *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 yr, Primary school = 6 yr, High school incomplete = 9 yr, High school graduate = 11 yr, Vocational school = 12 yr, College = 13 yr, University = 16 yr; Note students must complete two years of college before attending university within Quebec). Mean years of education for the two parents was calculated. 2) *Household income* was measured by total household income (before tax) in the previous year (<$10k, $10-14.9k, $15-19.9k, $20-29.9k, $30-39.9k, $40-49.9k, $50-59.9k, $60-79.9k, >$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; Ministere de l'Education du Quebec, 2003). 1) *School education/employment index* was derived from maternal "under-education" and parental economic inactivity at each school, and is calculated as: (2/3 x proportion of mothers with less than a high school education) + (1/3 x proportion of unemployed parents) (reverse coded). 2) *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 x proportion of families with an income between the LICO and the LICO plus one-third) + (proportion of families below the LICO) (reverse coded). 3) *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 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 behaviours, substance use behaviours, 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 demographics, subjective SES, reported health outcomes, and anthropometric measurements in a multiple imputation model (15 imputed datasets; 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_{diff}=$15,875; p<.001) and lower mean parent education (M_{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.

Multi-level modeling. We used multi-level modeling techniques (Bryk & Raudenbush, 1987) to fit regression models to the data (HLM 7). 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 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 one year of post-secondary education. Mean household income before taxes was about $50,000. 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.

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 behaviours, 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 behaviours and less obesity. Lower school education/employment index was associated with lower self-esteem, poorer dietary/exercise health behaviours, and higher systolic and diastolic blood pressure. Lower school district income was associated with poorer dietary/exercise health behaviours and higher systolic blood pressure, but less anger, less asthma, and lower insulin. Finally, greater community income inequality was associated with lower self-esteem, 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 behaviours, subjective SES and school education/employment had the strongest effects. For substance use behaviours, 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 biomarkers, 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, 2013), 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 behaviours 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). This suggests that adolescents' subjective ratings of SES are primarily influenced by their family's objective status in society and are less influenced by their school or community socioeconomic context.

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 multi-level design. We expected that community SES would be most closely tied to health behaviours and substance use behaviours, based on prior research. We found that school SES was indeed independently associated with dietary/exercise behaviours and

substance use behaviours, 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, Huang, 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 one of the first studies to examine associations with mental health outcomes in adolescents using a multi-level 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, since 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 centres 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 neighbourhood and school SES may differ. To address this issue, we included SES measures of the broader community (i.e., school district) since 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 neighbourhood 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.

Table 1

Health Outcome Measures

Outcome	Item/Scale	Mean (SD)	Range
	Self-rated health		
Self-rated health	In general, would you say your health is (Excellent, Rather good, Not very good)?	1.60 (0.57)	1-3
	Mental health		
Anxiety	3-item scale, with each item rated on a 4-point Likert scale (Never to Very often). Summed total score.	5.45 (2.17)	3-12
Depression	4- item scale, with each item rated on a 4-point Likert scale (Never to Very often). Summed total score.	8.16 (3.35)	4-16
Anger	4- item scale, with each item rated on a 4-point Likert scale (Never to Very often). 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
	Health behaviours		
Physical activity	Frequency of engaging in physical activity (>20 minutes straight, with perspiration or increased breathing) in past week, rated on an 8-point scale (Every day to Not one day).	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 and vegetables	3 items on frequency of fruits and vegetables consumption in the past week, rated on a 7-point scale (Five or more times per day to Not Once). Summed total score.	11.48 (3.42)	3-21
Diet – eating breakfast	Frequency of breakfast eating (eating or drinking something in the morning before school other than coffee, tea, or water) in the past five school days, rated on a 4-point scale (Every day to Never).	1.68 (1.03)	1-4
	Substance use behaviours		
Cigarette use	Lifetime smoking : Have you ever tried cigarette smoking, even just a few puffs? (No/Yes).	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? (No/Yes).	0.70 (0.46)	0-1
Drug use	Lifetime drug use: Have you ever used drugs? (No/Yes).	0.38 (0.49)	0-1

	Reported physical health		
General symptoms	Frequency of 5 general physical symptoms (headaches, stomach aches, sore back, insomnia, dizziness), rated on a 5-point scale (Rarely/never to Almost every day). 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) (No/Yes). 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? (No/Yes).	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? (No/Yes).	0.19 (0.39)	0-1
Asthma	Presence of asthma (parent-report): Has your adolescent ever had asthma? (No/Yes).	0.41 (0.70)	0-1
	Metabolic biomarkers		
Body mass index	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
HDL Cholesterol	High-density lipoprotein (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	Low-density lipoprotein (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
Triglycer-ides	Blood concentration of triglycerides measured by enzymatic hydrolysis and measurement of free glycerol using Synchron CX-7; log transformed to reduce skewness, measured in	0.91 (0.44)	0.2-5.9

	mmol/L.		
	Cardiovascular and inflammatory biomarkers		
Systolic blood pressure	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 blood pressure	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: 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 ($CAD)	51,005.00 (23,545.41)	
School poverty index	22.60 (7.93)	
School education/employment index	21.98 (7.19)	
School district mean income ($CAD)	56,151.71 (8,310.42)	

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*	-

Notes: 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. * denotes $p<.05$.

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 – fruit/veg	.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*
Gen. symptoms	.999	-.08***	-.06**	-.03	.00	.00	.03	-.02
Chronic condition	.988	-.01	.02	-.01	.02	-.02	.01	.01
Limit. 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
C-reactive protein	.885	-.04*	-.04	.06*	.01	-.04	-.03	.03

Notes: 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. ICC refers to intraclass correlation, which denotes proportion of total variance explained by within-school variation. Age and sex are included as covariates for all models. Standardized beta coefficients are displayed. *** denotes p<.001, **denotes p<.01, * denotes p<.05.

Table 5

Best-Fitting Multi-Level 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 behaviours			
	Phys. activity	Phys. inactivity	Diet - breakfast	Diet - fruits/veg
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 behaviours			
	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				
	Gen. sympt.	Chronic cond.	Limiting cond.	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**
R^2 model	*.058*	*.015*	*.010*	*.006*	*.008*
	Metabolic Biomarkers					
	BMI	HDL Chol.	LDL Chol.	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
R^2 model	*.006*	*.008*	*.006*	*.007*	*.003*	*.007*
	Cardiovascular and Inflammatory Biomarkers		
	C-reactive protein	Systolic blood pressure	Diastolic blood pressure

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*
R^2 model	*.003*	*.006*	*.009*

Notes: 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. R^2 values are displayed in italics. *** denotes p<.001, ** denotes p<.01, * denotes p<.05.

Table 6

Variables Included in Best-Fitting Models by Health Outcome Category

	Self-rated health	Mental health	Health behaviours	Substance use behaviours	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	-	-

TRANSITION TO GENERAL DISCUSSION

The purpose of Study 3 was to examine the unique contributions of three measures, which are purported to reflect a similar underlying construct of relative SES, on health outcomes in Quebec adolescents. Multivariate multi-level modelling was used to examine the independent effects of subjective SES, school and community SES, and community income inequality across multiple adolescent health outcomes.

We found that associations between subjective SES and adolescent health followed a very similar pattern to findings of the meta-analysis in Study 1, with the strongest associations between subjective SES and self-rated health, mental health, and general physical health symptoms. Of note, subjective SES was not correlated with community SES measures or community income inequality, although it was moderately correlated with family objective SES. Moreover, accounting for family and community SES did not greatly affect associations between subjective SES and health, further supporing the idea that perception of one's relative position is an independent construct.

Similar to Study 2, there were only a few significant associations for income inequality. However, whereas provincial income inequality was linked to select physical health outcomes in Study 2, community income inequality was related to self-esteem and anger in Study 3. Thus, income inequality measured at a more proximal level may be more strongly linked to mental health outcomes in adolescents, potentially through social comparison and relative deprivation. Findings for community and school SES suggested that attending school with more affluent peers or living in a more affluent neighbourhood was associated with worse health outcomes, perhaps due to relative deprivation (Festinger, 1954). Meanwhile, attending school with peers from more highly educated

families was associated with better health outcomes, perhaps due to modelling or community resources (Wilson, 1987).

Examination of physiological health outcomes in this study demonstrated few consistent socioeconomic gradients in these outcomes during adolescence. These findings have implications for understanding health disparities in adolescence and across the lifespan.

Overall, Study 3 demonstrated that subjective SES, community SES, and income inequality are relatively unique constructs and show independent associations with adolescent health outcomes. The extensive investigation of these associations provided an important base for further examination of relative status and health during adolescence.

GENERAL DISCUSSION

Summary of Results

This research program aimed to address some of the general and specific gaps in the existing research literature on health disparities during adolescence. Broadly, there was a relative lack of research on socioeconomic inequalities in adolescent health and the research to date had yielded inconsistent findings. There was also a need to tap into the unique experience of socioeconomic status during adolescence. Social comparison and relative status may be particularly relevant to health during the adolescent period. The broad aim of this research program was to examine how relative position in the socioeconomic hierarchy is related to multiple domains of adolescent health. Given that previous research has shown differences across health outcomes, it was important to measure adolescent health across a number of relevant domains, including self-rated health, mental health, physical health, and health behaviours.

Study 1. Although a number of studies had examined subjective SES in relation to health outcomes during adolescence, the literature was difficult to qualitatively summarize due to different measures employed and different outcomes examined, and had not been quantitatively summarized. Thus, Study 1 provided a timely meta-analytic summary of the current literature that has examined the association between subjective SES and health outcomes during adolescence. Overall, results demonstrated a positive association such that higher subjective SES was associated with better adolescent health outcomes. It was important for this field to also examine whether type of measurement of subjective SES had an impact on findings. Results showed that, out of the four types of measures employed across studies, associations were largely similar across three types

(school ladder, society ladder, Likert scales). This suggests that the association between SES and health is robust regardless of the type of measurement (e.g., ladder vs. Likert scale), the reference group (e.g., peers vs. society), the wording of the question (e.g., income, wealth, financial status, socioeconomic status), or analytical differences (e.g., categorical vs. continuous). However, the fourth measure of subjective SES, perception of financial constraints, showed stronger associations with health, suggesting that it may reflect a construct indicative of poverty and material deprivation in addition to low social status. Across four categories of health outcomes, subjective SES was significantly related to self-rated health, mental health, and physical health, but not health behaviours. The strongest effects were observed for health outcomes that are closely tied to psychological processes, including self-rated health, depression, psychological well-being, and general physical health symptoms. Low subjective SES and associated psychological processes may be a pathway by which SES gets under the skin to predict health; however, longitudinal research is needed to empirically test this hypothesis. Results suggested the influence of subjective SES on health is independent of family objective SES (e.g., household income, parental education, parental occupation/employment status). However, since less than half of the effect sizes controlled for objective SES, there was a need for additional research that examines the effects of both subjective and objective SES on adolescent health. The findings from the meta-analysis also highlighted other gaps in the current literature, including few studies that have examined the association between subjective SES and measured health outcomes, especially biomarkers.

Study 2. A number of specific gaps remained in the literature investigating the link between income inequality and adolescent health. Namely, there was a need for the examination of within-country effects of income inequality on adolescent health outside of the United States, since the level of income inequality of the country may affect within-country effects. Some of the previous research studies had not adequately controlled for average income. Finally, there was a need for the examination of additional domains of adolescent health, as no previous studies had looked at the association between income inequality and adolescent mental health. Thus, Study 2, a multi-level, population-based study of Canadian adolescents, examined the effects of province-level income inequality, while controlling for household income, parental education, and mean province income, on multiple domains of health, including self-rated health, mental health, physical health, substance-use behaviours, and health behaviours. Results showed that provincial income inequality was linked to some general physical health issues. Specifically, provinces with higher income inequality showed higher levels of injuries, more physical symptoms like headaches and stomachaches, as well as more physical or emotional limitations. Provincial income inequality did not have an effect on health or substance use behaviours, self-rated health, or mental health problems. Results also showed that provincial income inequality affected the way family SES influenced adolescent health for certain outcomes. In particular, in more unequal provinces, steeper SES gradients were observed for several "externalizing" mental health issues, including physical aggression, hyperactivity, and property offences. These findings suggest that independent within-country effects of income inequality on adolescent health are not consistently observed in Canadian adolescents.

Study 3. In addition to specific gaps in the research, there were also remaining questions about the broader construct of relative position and its influence on adolescent health. Relative position in the social hierarchy is purportedly measured by subjective SES, individual SES relative to the community, and income inequality; however, these constructs had not been examined simultaneously. Thus, Study 3 aimed to examine the associations between these three constructs and their independent contributions to adolescent health. In addition, this study addressed one of the gaps identified in the meta-analysis by examining a number of biomarkers of health, including metabolic, cardiovascular, and inflammatory biomarkers, in addition to self-rated health, mental health, reported physical health, substance use behaviours, and health behaviours. Results indicated that lower subjective SES was linked to poorer self-rated health and more mental health problems, as well as to some health behaviours and general physical health symptoms, similar to findings from the meta-analysis. While holding family SES constant, higher community education/employment had a protective effect on several health outcomes (physical inactivity, diet, alcohol use, and blood pressure), while higher income indicators were associated with a detrimental effect for certain health outcomes (anger, breakfast eating, asthma, substance use, BMI, and blood pressure). Finally, community income inequality was found to be associated with some health outcomes: greater inequality was associated with lower self-esteem, more anger, and more asthma, but better diet health behaviours. Overall, although subjective SES, individual SES relative to community SES, and income inequality are conceptually similar and moderately correlated with each other, they showed different and independent associations with adolescent health outcomes.

Theoretical Contributions

Material/objective vs. relative/subjective SES. The establishment of socioeconomic gradients in health during the second era of research on health disparities suggested that the association between SES and health is derived from one's relative position in a social hierarchy and from material implications of one's position (Adler et al., 1994). More recently, the social cognitive theory of social class posited that socioeconomic status is shaped by two related, but relatively independent processes: material resources (education, wealth, occupation) and subjective perception of social rank (Kraus et al., 2012). Material resources are thought to help determine access to goods and services, while rank is thought to shape perception of one's standing. Study 1 found that controlling for objective SES did not affect the magnitude of the overall association between subjective SES and health, which supports the idea that material, objective SES and perceived, subjective SES are relatively independent processes. Study 3 also demonstrated independent contributions of objective family SES and subjective SES on adolescent health, although these contributions varied by health outcome.

The idea that objective SES and subjective SES are relatively independent processes suggests that they may show dissimilar associations with different domains of health. Moreover, pathways from objective and subjective SES to health may differ. Study 3 allowed for the examination of independent associations of objective family SES and subjective SES across several domains of adolescent health. Household income was found to be a strong, independent predictor of self-rated health, self-esteem (but not other mental health outcomes), health behaviours, substance use, and a few physical health outcomes (asthma, insulin, blood pressure). Parental education was found to be a strong

independent predictor of health behaviours, cigarette use, and some physical health outcomes (general physical symptoms, limiting conditions, body mass index, blood pressure). Subjective SES emerged as a strong independent predictor of self-rated health, mental health, health behaviours, and a few physical health outcomes (general physical symptoms, asthma, inflammation). Thus, objective SES was more clearly linked with health and substance use behaviours, while subjective SES was more clearly related to self-rated health and mental health outcomes. Neither objective nor subjective SES showed clear gradients across physical health outcomes during adolescence. These findings are consistent with previous research that showed that there were limited effects of SES on physical health outcomes (injuries, asthma, blood pressure) during adolescence, although the effects of SES on health behaviours (smoking, physical inactivity) emerged during adolescence (Chen et al., 2002).

Contextual influences. Apart from the effects of family objective SES and subjective ratings of SES on adolescent health, the contextual and compositional effects of communities, provinces, and countries may also influence health during adolescence. Community SES, or the socioeconomic status of our peers and neighbours, may have a positive influence on health through better resources in the environment or through modelling of health behaviours (Wilson 1987), or may have a negative influence on health through negative social comparison and relative deprivation (Festinger, 1954). In Study 3, higher community income-based measures were predictive of worse health across several outcomes (anger, breakfast eating, substance use behaviours, asthma, body mass index, and blood pressure), while higher community education/employment-based measures were predictive of better health across health behaviours and substance use

behaviours. These findings suggest that higher parental education and less unemployment in the school community are protective for health behaviours during adolescence, potentially through modelling or better material resources. In contrast, higher income and less poverty in the school or community have a detrimental effect on select health outcomes, potentially through negative social comparison, which may be particularly relevant for mental health outcomes, like self-esteem and anger. However, it is also possible that lower incomes may be protective against substance use because adolescents have less pocket money and access to substances, and higher poverty rates may improve breakfast eating habits through targeted prevention programs in low income communities, such as school breakfast programs.

Higher income inequality is thought to negatively affect health through negative social comparison and lower social cohesion(Wilkinson & Pickett, 2007) or through social and health policies (Subramanian & Kawachi, 2004), including access to health care and taxation rates. Study 2 found that low family SES was most strongly linked to several "externalizing" mental health issues, including physical aggression, hyperactivity, and property offences, in more unequal provinces. This is consistent with the idea that higher inequality leads to lower social cohesion and social trust (Kawachi et al., 1997; Wilkinson, 1997a, 1997b), which may in turn be linked to increases in violent behaviours (Wilkinson & Pickett, 2007). More proximal measures of income inequality (i.e., at the community level) may be more indicative of effects of social comparison, while measures of income inequality that reflect larger regions (i.e., at the country or province level) may be more indicative of effects of social and health policies. Comparing the effects of income inequality on adolescent health in Study 2 and Study 3 shed some light

on these pathways. We found that province-level income inequality was associated with injuries, general physical symptoms, and limiting conditions, while community-level income inequality was associated with self-esteem, anger, asthma, and diet behaviours. Significant associations between community income inequality and mental health outcomes suggest that effects of relative deprivation may be more easily captured by community-level measures of inequality. Provincial policies related to safety (e.g., wearing a helmet while cycling) may influence injury outcomes, while access to special health and education services may affect the level of limitation of physical or emotional conditions across provinces. Clearly, more research evaluating pathways between income inequality and health is needed to draw conclusions.

Relative status and health during adolescence. This research program focused on adolescence, the unique time of transition between childhood and adulthood that may be a period of relevance for adult health. Previous research on health disparities during adolescence indicated that associations between family objective SES and adolescent health may vary depending on the health outcome measured (e.g., Goodman, 1999). Moreover, research that compared the effects of SES in across childhood and adolescence found limited effects of SES on physical health outcomes (blood pressure, injuries, asthma), but stronger effects for health behaviours (smoking, physical inactivity) in adolescence compared to childhood (Chen et al., 2002). With a focus on relative status during adolescence, the current studies aimed to extend earlier findings. The results from the current research program indicated that clear socioeconomic gradients in self-rated health, mental health, and health behaviours exist during adolescence, but that socioeconomic gradients in physical health outcomes are present inconsistently during

this period. Socioeconomic inequalities in physical health during early childhood may be linked to prenatal and genetic factors, as well as access to quality child and health care. These factors may be less influential during adolescence, as social comparison, peer relations, and school and neighbourhood environment gain importance. Moreover, changes in physical health related to SES may take time to accumulate, thus measurable differences may not emerge during adolescence. In contrast, observable changes in mental health and health behaviours may take less time to emerge. In addition, adolescence is a period of relatively good physical health, with the lowest rates of mortality of any age group; while mental disorders are common and many health behaviours are established during adolescence (World Health Organization, 1998). Therefore, in addition to a potential direct association between SES and physical health over time, mental health and health behaviours may be potential pathways between adolescent SES and adult physical health outcomes.

Strengths and Limitations

The current research program demonstrated a number of strengths that increase its contribution to the research literature on health disparities in adolescence. Across all three studies, we examined multiple domains of adolescent health, including self-rated health, mental health, reported and measured physical health, and substance use and health behaviours. Given previous mixed findings, it was important to examine associations across many adolescent health outcomes, and to provide improved clarity about the nature of socioeconomic inequalities in adolescent health. The two original research studies were strengthened by drawing information from large, population-based samples, and by the use of multi-level modelling to examine both contextual and

individual effects of SES on health. Finally, this research program used a combination of theory and data-driven approaches to test hypotheses, and push the boundaries of current understanding.

There are a number of limitations of the current research that warrant discussion. Many of these limitations present areas for further investigation and ongoing study. First, these studies are cross-sectional and correlational; thus, the direction of these effects is not known, and mediation and time-course effects could not be examined. More longitudinal research across the adolescent period is needed to understand potential changes in associations from early to late adolescence, and to explore the trajectories of SES gradients in physical health from adolescence to adulthood. Second, some of the measures included in these studies were not "gold standard" measures, including the 3-point Likert scale used to measure subjective SES and the coefficient of variation used to measure income inequality in Study 3. However, the effects of subjective SES in Study 3 closely mirrored effects from the Study 1 meta-analysis, suggesting that a 3-point Likert scale is a valid measure of subjective SES. Routine inclusion of validated measures of subjective SES is encouraged for future population-based studies in order to continue to examine these effects. Third, the current research program was largely focused on the health effects of relative SES for adolescents living in Canada. Evaluation of these associations across countries and cultures will provide further insight into adolescent health disparities in countries with vastly different social policies, mean incomes, levels of income inequality, and socio-cultural norms.

Conclusions and Implications

These three inter-related research studies provide a comprehensive understanding

of the influence of subjective SES, income inequality, and relative status on multiple domains of adolescent health. We found consistent evidence of a graded relation between subjective SES and self-rated health, mental health, and non-substance-related health behaviours during adolescence, which exists over and above the influence of family objective SES. The effects of income inequality on health were found to be less consistent across adolescent outcomes, although there was some evidence that community-level income inequality was more closely linked to mental health while province-level income inequality was more closely related to physical health. The effects of community SES, over and above the effects of family SES, may depend on the type of socioeconomic measure. Higher community education and employment were linked to better adolescent health behaviours, while higher income was linked to some worse health behaviours and outcomes.

By examining the effects across numerous health outcomes, the results from this program of research helped to clarify the existence of socioeconomic gradients in self-rated health, mental health, and health behaviours during adolescence. However, gradients in physical health outcomes were not consistently observed across these studies. Overall, subjective SES, family SES, income inequality, and community SES show independent effects on adolescent health that may differ by health outcome.

These findings have implications for the understanding of health disparities during adolescence and across the lifespan. Specifically, although associations between SES and physical health are inconsistent in this age group, health disparities in mental health outcomes and health/substance use behaviours have long-term implications for health and well-being. Therefore, prevention and intervention efforts in this age group

should be targeted toward mental health care and improvement of health behaviours. One avenue to address these issues may be specialized primary health care for adolescents that includes access to mental health services. Moreover, targeted prevention efforts in low SES communities may be warranted. Social programs and teen drop-in centres may help to boost self-esteem, mitigate initial symptoms of anxiety and depression, and even reduce substance use. Health promotion efforts may include additional teaching about health behaviours in school, as well as initiatives to reduce negative social comparisons in adolescents.

Further, reducing socioeconomic inequalities is another important opportunity to reduce health disparities during adolescence and across the lifespan. Economic rules and regulations may help to shape market forces that drive the growing gap between the rich and the poor. Moreover, more progressive taxation systems may reduce income inequality and provide revenue for investment in social programs (e.g., employment insurance, education) and health care. Thus, economic and social policy has the potential to reduce health disparities both directly and indirectly. Altogether, investment in the health and well-being of adolescents, through economic and social policy to reduce socioeconomic inequalities, and health promotion and prevention programs, has the potential to pay dividends in terms of improved health and productivity across the lifespan.

REFERENCES

References marked with an asterisk indicate studies included in the meta-analysis.

Adler, N. E., Boyce, T., Chesney, M. A., Cohen, S., Folkman, S., Kahn, R., & Syme, S. L. (1994). Socioeconomic status and health: The challenge of the gradient. *American Psychologist*, *49*, 15–24. doi:10.1037/0003-066X.49.1.15

Adler, N. E., Epel, E. S., Castellazzo, G., & Ickovics, J. R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: preliminary data in healthy white women. *Health Psychology*, *19*, 586–592. doi:10.1037//0278-6133.19.6.586

Adler, N. E., & Ostrove, J. M. (1999). Socioeconomic status and health: What we know and what we don't. *Annals of the New York Academy of Sciences*, *896*, 3–15. doi:10.1111/j.1749-6632.1999.tb08101.x

Adler, N. E., & Stewart, J. (2010). Health disparities across the lifespan: Meaning, methods, and mechanisms. *Annals of the New York Academy of Sciences, 1186*, 5-23. doi:10.1111/j.1749-6632.2009.05337.x

Alwin, D. F., & Wray, L. A. (2005). A Life-span developmental perspective on social status and health. *Journal of Gerontology: Series B, 60* (Suppl. 2), S7-S14. doi:10.1093/geronb/60.Special_Issue_2.S7

Anderson, C., John, O. P., Keltner, D., & Kring, A. M. (2001). Who attains social status? Effects of personality and physical attractiveness in social groups. *Journal of Personality and Social Psychology, 81*, 116-132. doi: 10.1037//0022-3514.81.1.116

* Aslund, C., Leppert, J., Starrin, B., & Nilsson, K. W. (2009). Subjective social status and shaming experiences in relation to adolescent depression. *Archives of Pediatrics & Adolescent Medicine*, *163*, 55–60. doi:10.1001/archpedi.163.1.55

Baillargeon, G. (2005). *La carte des unités de peuplement de 2003: Les principales donness socio-economiques et demographiques du recensement de 2001 selon les territoires des commissions scolaires*. Ministère de l'Éducation, du Loisir et du Sport, Québec, QC.

Barkin, S., Rao, Y., Smith, P., & Po'e, E. (2012). A novel approach to the study of pediatric obesity: A biomarker model. *Pediatric Annals, 41*, 250-256. doi: 10.3928/00904481-20120525-13

Bengtsson, C., Nordmark, B., Klareskog, L., Lundberg, I., Alfredsson, L., & the EIRA study group (2005). Socioeconomic status and the risk of developing rheumatoid arthritis: results from the Swedish EIRA study. *Annals of the rheumatic diseases*, *64*, 1588–94. doi:10.1136/ard.2004.031666

Berenson, G. S., Wittigney, W. A., Bao, W., Srinivasan, S. R., & Radhakrishnamurthy, B. (1995). Rationale to study the early natural history of heart disease: The Bogalusa Heart Study. *American Journal of Medican Science, 310*(Suppl. 1), S22-28.

Braveman, P. A., Cubbin, C., Egerter, S., Marchi, K. S., Metzler, M., & Posner, S. (2005). Socioeconomic status in health research: One size does not fit all. *Journal of the American Medical Association*, *294*, 2879–2888. doi:10.1001/jama.294.22.2879

Braveman, P. A, Cubbin, C., Egerter, S., Williams, D. R., & Pamuk, E. (2010). Socioeconomic disparities in health in the United States: what the patterns tell us.

American Journal of Public Health, *100*(Suppl. 1), S186–196. doi:10.2105/AJPH.2009.166082

Bryk, A. S., & Raudenbush, S. W. (1987). Application of hierarchical linear models to assessing change. *Psychological Bulletin*, *101*, 147–158. doi:10.1037//0033-2909.101.1.147

Cairns, R., Cairns, B., & Neckerman, H. (1989). Early school dropout: Configurations and determinants. *Child Development, 60*, 1437-1452. doi:10.2307/1130933

Chen, E., Martin, A. D., & Matthews, K. A. (2006). Socioeconomic status and health: do gradients differ within childhood and adolescence? *Social Science & Medicine*, *62*, 2161–70. doi:10.1016/j.socscimed.2005.08.054

Chen, E., Matthews, K. A., & Boyce, W. T. (2002). Socioeconomic differences in children's health: How and why do these relationships change with age? *Psychological Bulletin*, *128*(2), 295–329. doi:10.1037//0033-2909.128.2.295

* Chen, E., & Paterson, L. Q. (2006). Neighborhood, family, and subjective socioeconomic status: How do they relate to adolescent health? *Health Psychology, 25*, 704–14. doi:10.1037/0278-6133.25.6.704

Celeste, R. K., Nadanovsky, P., Ponce de Leon, A., & Fritzell, J. (2009). The individual and contextual pathways between oral health and income inequality in Brazilian adolescents and adults. *Social Science & Medicine*, *69*, 1468–1475. doi:10.1016/j.socscimed.2009.08.005

Centers for Disease Contol. (2008). *Community health and program services: Health disparities among racial/ethnic populations.* Atlanta: U.S. Department of Health and Human Services.

Chinn, S. (2000). A simple method for converting an odds ratio to effect size for use in meta-analysis. *Statistics in Medicine*, *19*(22), 3127–3131. Retrieved from *www.ncbi.nlm.nih.gov/pubmed/11113947*

* Cho, H.-J., & Khang, Y.-H. (2009). Family Affluence Scale, other socioeconomic position indicators, and self-rated health among South Korean adolescents: findings from the Korea Youth Risk Behavior Web-based Survey (KYRBWS). *Journal of Public Health*, *18*, 169–178. doi:10.1007/s10389-009-0299-9

Commission on Social Determinant of Health. (2008). *Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.* Geneva: World Health Organization.

Conference Board of Canada. (2013). *How Canada performs: Income inequality*. Retrieved from http://www.conferenceboard.ca/hcp/details/society/income-inequality.aspx

Cooper, H., & Hedges, L. V. (1994). *The handbook of research synthesis.* New York: Robert Sage Foundation.

* Correa-Velez, I., Gifford, S. M., & Barnett, A. G. (2010). Longing to belong: social inclusion and wellbeing among youth with refugee backgrounds in the first three years in Melbourne, Australia. *Social Science & Medicine*, *71*, 1399–408. doi:10.1016/j.socscimed.2010.07.018

Crosby, R. A, Holtgrave, D. R., DiClemente, R. J., Wingood, G. M., & Gayle, J. A. (2003). Social capital as a predictor of adolescents' sexual risk behavior: a state-

level exploratory study. *AIDS and behavior*, *7*(3), 245–52. doi:10.1023/A:1025439618581

Currie, C., Molcho, M., Boyce, W., Holstein, B., Torsheim, T., & Richter, M. (2008). Researching health inequalities in adolescents: the development of the Health Behaviour in School-Aged Children (HBSC) family affluence scale. *Social Science & Medicine*, *66*, 1429–36. doi:10.1016/j.socscimed.2007.11.024

Davis, J. A. (1956). Status symbols and the measurement of status perception. *Sociometry, 19I, 154-165*. Retrieved from www.jstor.org/stable/2785629

De Maio, F. G. (2007). Income inequality measures. *Journal of Epidemiology and Community Health, 61*, 849-852. doi:10.1136/jech.2006.052969

Diez-Roux, A. V. (2001). Investigating neighborhood and area effects on health. *American Journal of Public Health, 91,* 1783–1789. doi:10.2105/AJPH.91.11.1783

Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes. *Journal of Pediatric Psychology*, *34*, 917–28. doi:10.1093/jpepsy/jsp004

Elgar, F. J., Roberts, C., Parry-Langdon, N., & Boyce, W. (2005). Income inequality and alcohol use: a multilevel analysis of drinking and drunkenness in adolescents in 34 countries. *European Journal of Public Health*, *15*, 245–250. doi:10.1093/eurpub/cki093

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*, 117-140. doi:10.1177/001872675400700202

* Finkelstein, D. M., Kubzansky, L. D., & Goodman, E. (2006). Social status, stress, and adolescent smoking. *Journal of Adolescent Health, 39*, 678–85. doi:10.1016/j.jadohealth.2006.04.011

* Fröjd, S., Marttunen, M., Pelkonen, M., von der Pahlen, B., & Kaltiala-Heino, R. (2006). Perceived financial difficulties and maladjustment outcomes in adolescence. *European Journal of Public Health*, *16*, 542–548. doi:10.1093/eurpub/ckl012

Garbarski, D. (2010). Perceived social position and health: Is there a reciprocal relationship. *Social Science & Medicine, 70*, 692-699. doi: 10.1016/j.socscimed.2009.11.007

Glendinning, A., Love, J. G., Hendry, L. B., & Shucksmith, J. (1992). Adolescence and health inequalities: Extensions to Macintyre and West. *Social Science & Medicine*, *35*, 679–687. doi:10.1016/0277-9536(92)90006-C

Goodman, E. (1999). The role of socioeconomic status gradients in explaining differences in US adolescents' health. *American Journal of Public Health*, *89*, 1522–8. doi:10.2105/AJPH.89.10.1522

* Goodman, E., Adler, N. E., Kawachi, I., Frazier, A. L., Huang, B., & Colditz, G. A. (2001). Adolescents' perceptions of social status: development and evaluation of a new indicator. *Pediatrics*, *108*(2), e31. doi:10.1542/peds.108.2.e31

* Goodman, E., Adler, N. E., Daniels, S. R., Morrison, J. A, Slap, G. B., & Dolan, L. M. (2003). Impact of objective and subjective social status on obesity in a biracial cohort of adolescents. *Obesity Research*, *11*, 1018–1026. doi:10.1038/oby.2003.140

Goodman, E., Huang, B., Wade, T. J., & Kahn, R. S. (2003). A multilevel analysis of the relation of socioeconomic status to adolescent depressive symptoms: does school context matter? *Journal of Pediatrics*, *143*, 451–456. doi:10.1067/S0022-3476(03)00456-6

* Goodman, E., Huang, B., Schafer-Kalkhoff, T., & Adler, N. (2007). Perceived socioeconomic status: A new type of identity which influences adolescents' self-rated health. *Journal of Adolescent Health*, *41*, 479–487. doi:10.1016/j.jadohealth.2007.05.020

* Goodman, E., McEwen, B. S., Dolan, L. M., Schafer-Kalkhoff, T., & Adler, N. E. (2005). Social disadvantage and adolescent stress. *Journal of Adolescent Health*, *37*, 484–92. doi:10.1016/j.jadohealth.2004.11.126

Gore, F. M., Bloem, P. J. N., Patton, G. C., Ferguson, J., Joseph, V., Coffey, C., … Mathers, C. D. (2011). Global burden of disease in young people aged 10-24 years: A systematic analysis. *Lancet*, *377*, 2093–2102. doi:10.1016/S0140-6736(11)60512-6

* Grotvedt, L., Stigum, H., Hovengen, R., & Graff-Iversen, S. (2008). Social differences in smoking and snuff use among Norwegian adolescents: A population based survey. *BMC Public Health*, *8*, 322. doi:10.1186/1471-2458-8-322

* Hamilton, H. A, Noh, S., & Adlaf, E. M. (2009). Perceived financial status, health, and maladjustment in adolescence. *Social Science & Medicine*, *68*, 1527–34. doi:10.1016/j.socscimed.2009.01.037

Idler, E., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*, 38(1), 21–37. Retrieved from http://www.jstor.org/stable/2955359

Hanson, M. D., & Chen, E. (2007). Socioeconomic status and health behaviors in adolescence: a review of the literature. *Journal of Behavioral Medicine*, *30*, 263–85. doi:10.1007/s10865-007-9098-3

Health Canada. (2012). *Summary of results of the 2010-11 Youth Smoking Survey*. Ottawa: Health Canada. Retrieved from http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2010-2011/result-eng.php

Hou, F., & Myles, J. (2005). Neighbourhood inequality, neighbourhood affluence and population health. *Social Science & Medicine*, *60*, 1557–1569. doi:10.1016/j.socscimed.2004.08.033

Human Resources Development Canada, & Statistics Canada. (1995). *National Longitudinal Survey of Children: Overview of Survey Instruments for 1994-95 Data Collection* (Catalogue no. 89F0078XIE).

Institut de la statistique Quebec. (2002). *Enquête sociale et de santé auprès des enfants et des adolescents québécois 1999*. Quebec, QC.

* Iversen, A. C., & Holsen, I. (2008). Inequality in health, psychosocial resources and health behavior in early adolescence: The influence of different indicators of socioeconomic position. *Child Indicators Research*, *1*, 291–302. doi:10.1007/s12187-008-9015-5

* Janssen, I., Boyce, W. F., Simpson, K., & Pickett, W. (2006). Influence of individual- and area-level measures of socioeconomic status on obesity, unhealthy eating, and physical inactivity in Canadian adolescents. *American Journal of Clinical Nutrition*, *83*, 139–45. Retrieved from http://ajcn.nutrition.org/content/83/1/139.full.pdf+html

* Jovic-Vranes, A., Jankovic, J., Vasic, V., & Jankovic, S. (2011). Self-perceived health and psychological well-being among Serbian schoolchildren and adolescents: Data from National Health Survey. *Central European Journal of Medicine*, *6*, 400–406. doi:10.2478/s11536-011-0035-z

* Jung, S.-H., Watt, R. G., Sheiham, A., Ryu, J.-I., & Tsakos, G. (2011). Exploring pathways for socio-economic inequalities in self-reported oral symptoms among Korean adolescents. *Community Dentistry and Oral Epidemiology*, *39*, 221–9. doi:10.1111/j.1600-0528.2010.00595.x

* Karvonen, S., & Rahkonen, O. (2011). Subjective social status and health in young people. *Sociology of Health & Illness*, *33*, 372–83. doi:10.1111/j.1467-9566.2010.01285.x

Kaplan, G. ., & Keil, J. E. (1993). Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation*, *88*, 1973–1998. doi:10.1161/01.CIR.88.4.1973

Kawachi, I., & Kennedy, B. P. (1997). The relationship of income inequality to mortality: does the choice of indicator matter? *Social Science & Medicine*, *45*, 1121–1127. doi:10.1016/S0277-9536(97)00044-0

Kawachi, I., Kennedy, B. P., Lochner, K., & Prothrow-Stith, D. (1997). Social capital, income inequality, and mortality. *American Journal of Public Heath*, *87*, 1491–1498. doi: 10.2105/AJPH.87.9.1491

Kolbe, L. J., Kann, L., & Collins, J. L. (1993). Overview of the Youth Risk Behavior Surveillance System. *Public Health Reports*, *108*(Suppl. 1). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1403301/

Kondo, N., Sembajwe, G., Kawachi, I., van Dam, R. M., Subramanian, S. V, & Yamagata, Z. (2009). Income inequality, mortality, and self rated health: meta-analysis of multilevel studies. *British Medical Journa, 339*, b4471. doi:10.1136/bmj.b4471

Kramer, M. S., Séguin, L., Lydon, J., & Goulet, L. (2000). Socio-economic disparities in pregnancy outcome: Why do the poor fare so poorly? *Paediatric and Perinatal Epidemiology*, *14*, 194–210. doi:10.1046/j.1365-3016.2000.00266.x

Kraus, M. W., Adler, N., & Chen, T.-W. D. (2013). Is the association of subjective SES and self-rated health confounded by negative mood? An experimental approach. *Health Psychology.* doi:10.1037/a0027343

Kraus, M. W., Piff, P.K., Mendoza-Denton, R., Rheinschmidt, M. L., & Keltner, D. (2012). Social class, solipsism, and contextualism: How the rich are different from the poor. *Psychological Review, 119*, 546-572. doi:10.1037/a0028756

Kriger, N, Williamd, D. R., Moss, N.E. (1997). Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annual Review Public Health,18,*341-378. doiL10.1146/annurev.publhealth.18.1.341

Lambert, M., Delvin, E. E., Paradis, G., O`Loughlin, J., Hanley, J. A., & Levy, E. (2004). C-reactive protein and features of the metabolic syndrome in a population-based sample of the children and adolescents. *Clinical Chemistry, 50*, 1762-1768.

* Lemeshow, A., Fisher, L., Goodman, E., Kawachi, I., Berkey, C. S., & Colditz, G. A. (2008). Subjective social status in the school and change in adiposity in female adolescents. *Archives of Pediatric Adolescent Medicine*, *162*, 23–28. doi:10.1001/archpediatrics.2007.11

Leventhal, T., & Brooks-Gunn, J. (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin*, *126*, 309–337. doi:10.1037//0033-2909.126.2.309

Levin, K. A., Torsheim, T., Vollebergh, W., Richter, M., Davies, C. A, Schnohr, C. W., … Currie, C. (2011). National income and income inequality, family affluence and life satisfaction among 13 year old boys and girls: A multilevel study in 35 countries. *Social Indicators Research*, *104*, 179–194. doi:10.1007/s11205-010-9747-8

Lien, N., Friestad, C., Klepp, K. I. (2001). Adolescents' proxy reports of parents' socioeconomic status: How valid are they? *Journal of Epidemiology & Community Health, 55*, 731-737. doi:10.1136/jech.55.10.731

Lynch, J. W., Davey Smith, G., Kaplan, G. A., & House, J. S. (2000). Income inequality and mortality: Importance to health of individual income, psychosocial environment, or material conditions. *British Medical Journal, 320*, 1200. doi:http://dx.doi.org/10.1136/bmj.320.7243.1200

Lundberg, J., & Kristenson, M. (2008). Is subjective status influenced by psychosocial factors? *Social Indicators Research, 89*, 375-390. doi: 10.1007/s11205-008-9238-3

Lowry, R., Kann, L., Collins, J. L., & Kolbe, L. J. (1996). The effect of socioeconomic status onchronic disease risk behaviors among US adolescents. *Journal of the American Medical Association*, *276*, 792–7. doi:10.1001/jama.1996.03540100036025

Macintyre, S., Ellaway, A., & Cummins, S. (2002). Place effects on health: How can we conceptualise, operationalise and measure them? *Social Science & Medicine*, *55*, 125–139. doi:10.1016/S0277-9536(01)00214-3

* Magklara, K., Skapinakis, P., Niakas, D., Bellos, S., Zissi, A., Stylianidis, S., & Mavreas, V. (2010). Socioeconomic inequalities in general and psychological health

among adolescents: a cross-sectional study in senior high schools in Greece. *International Journal for Equity in Health*, *9*, 3. doi:10.1186/1475-9276-9-3

Marmot, M. G., Shipley, M. J., & Rose, G. (1984). Inequalities in death: Specific explanations of a general pattern? *The Lancet*, *323*, 1003–1006. doi:10.1016/S0140-6736(84)92337-7

Matthews, K. A., Kelsey, S. F., Meilahn, E. N., Kuller, L. H., Wing, R. (1989. Educational attainment and behavioral and biological risk factors for coronary heart disease in middle-aged women. *American Journal of Epidemiology , 129,* 1132-1144.

Ministere de l'Education du Quebec. (2003). The school population map and poverty indices. *Education Statistics Bulletin*, *26*.

* Mistry, R. S., Benner, A. D., Tan, C. S., & Kim, S. Y. (2009). Family economic stress and academic well-being among Chinese-American youth: the influence of adolescents' perceptions of economic strain. *Journal of Family Psychology, 23*, 279–90. doi:10.1037/a0015403

O'Campo, P., Xue, X., Wang, M, C., & Caughy, M. (1997). Neighborhood risk factors for low birthweight in Baltimore: a multilevel analysis. *American Journal of Public Health, 87,* 1113–1118. doi:10.2105/AJPH.87.7.1113

* Oh, I.-H., Cho, Y., Park, S.-Y., Oh, C., Choe, B.-K., Choi, J.-M., & Yoon, T.-Y. (2011). Relationship between socioeconomic variables and obesity in Korean adolescents. *Journal of Epidemiology*, *21*, 263–270. doi:10.2188/jea.JE20100099

Operario, D., Adler, N. E., & Williams, D. R. (2004). Subjective social status: Reliability and predictive utility for global health. *Psychology & Health*, *19*, 237–246. doi:10.1080/08870440310001638098

Orwin, R. G. (1983). A fail-safe N for effect size in meta-analysis. *Journal of Educational Statistics, 8,* 157-159. doi: 10.3102/10769986008002157

Paeratakul, S., Lovejoy, J., Ryan, D., & Bray, G. (2002). The relation of gender, race and socioeconomic status to obesity and obesity comorbidities in a sample of US adults. *International Journal of Obesity and Related Metabolic Disorders*, *26*(9), 1205–1210. Retrieved from http://ukpmc.ac.uk/abstract/MED/12187397

* Page, R. M., Simonek, J., Ihász, F., Hantiu, I., Uvacsek, M., Kalabiska, I., & Klarova, R. (2009). Self-rated health, psychosocial functioning, and other dimensions of adolescent health in Central and Eastern European adolescents. *European Journal of Psychiatry*, *23*, 101–114. doi:10.4321/S0213-61632009000200004

Paradis, G., Lambert, M., O'Loughlin, J., Lavallee, C., Aubin, J., Berthiaume, P... Hanley, J. A. (2003). The Quebec Child and Adolescent Health and Social Survey: Design and methods of a cardiovascular risk factor survey for youth. *Canadian Journal of Cardiology*, *19*, 523–531.

Paradis, G., Lambert, M., O'Loughlin, J., Lavallee, C., Aubin, J., Delvin, E... Hanley, J. A. (2004). Blood pressure and adiposity in children and adolescents. *Circulation, 110*, 1832-1838. doi:10.1161/01.CIR.0000143100.31752.B7

Parker, J. D., Schoendrof, K. C., & Kiely, J. L. (1994). Associations between measures of socioeconomic status and low birth weight, small for gestational age, and premature

delivery in the United States. *Annals of Epidemiology 4,* 271-278. doi:10.1016/1047-2797(94)90082-5

* Piko, B. F. (2006). Satisfaction with life, psychosocial health and materialism among Hungarian youth. *Journal of Health Psychology*, *11*, 827–31. doi:10.1177/1359105306069072

* Piko, B., & Fitzpatrick, K. M. (2001). Does class matter? SES and psychosocial health among Hungarian adolescents. *Social Science & Medicine*, *53*, 817–30. doi:10.1016/S0277-9536(00)00379-8

* Piko, B. F., & Fitzpatrick, K. M. (2007). Socioeconomic status, psychosocial health and health behaviours among Hungarian adolescents. *European Journal of Public Health*, *17*, 353–60. doi:10.1093/eurpub/ckl257

* Piko, B. F., & Gibbons, F. X. (2008). Behavioral and psychosocial influences of risk perception among Hungarian adolescents, *53*, 131–138. doi:10.1007/s000 -00-7054-9

* Piko, B. F., & Hamvai, C. (2010). Parent, school and peer-related correlates of adolescents' life satisfaction. *Children and Youth Services Review*, *32*, 1479–1482. doi:10.1016/j.childyouth.2010.07.007

* Piko, B. F., & Keresztes, N. (2007). Self-perceived health among early adolescents: role of psychosocial factors. *Pediatrics International, 49*, 577–83. doi:10.1111/j.1442-200X.2007.02430.x

* Piko, B. F., Skultéti, D., Luszczynska, A., & Gibbons, F. X. (2010). Social orientations and adolescent health behaviours in Hungary. *International Journal of Psychology*, *45*, 12–20. doi:10.1080/00207590903030279

* Piko, B. F., & Vazsonyi, A. T. (2004). Leisure activities and problem behaviours among Hungarian youth. *Journal of Adolescence*, *27*, 717–30. doi:10.1016/j.adolescence.2004.02.004

Public Health Agency of Canada. (2013). *What makes Canadians healthy or unhealthy?* Ottawa: Public Health Agency of Canada. Retrieved from http://www.phac-aspc.gc.ca/ph-sp/determinants/determinants-eng.php#status

Quon, E. C., & McGrath, J. J. (2013). Subjective socioeconomic status and adolescent health: A meta-analysis. *Health Psychology*. doi:10.1037/a0033716

Ritterman, M. L. (2007). Perceived social status and adolescent health and risk behaviors: A systematic review. *ISSC Working Paper Series 2006-2007, 24.* Retrieved from http://escholarship.org/uc/item/01s0w5m9

* Ritterman, M. L. (2010). Social hierarchy and health among adolescents : The role of perceived class identity. #3413551. Retrieved from http://gradworks.umi.com/34/13/3413551.html

* Ritterman, M. L., Fernald, L. C., Ozer, E. J., Adler, N. E., Gutierrez, J. P., & Syme, S. L. (2009). Objective and subjective social class gradients for substance use among Mexican adolescents. *Social Science & Medicine*, *68*, 1843–51. doi:10.1016/j.socscimed.2009.02.048

Rosenberg, M. S., Adams, D., & Gurevitch, J. (2000). *MetaWin. Statistical software for meta analysis, version 2.0*. Sunderland, Massachusetts: Sinauer Associates.

Rosenthal, R. (1991). *Meta-analytic procedures for social research.* Thousand Oaks, CA: Sage Publications.

Ross, N. A., Dorling, D., Dunn, J. R., Henriksson, G., Glover, J., Lynch, J., & Weitoft, G. R. (2005). Metropolitan income inequality and working-age mortality: A cross-sectional analysis using comparable data from five countries. *Journal of Urban Health*, *82*, 101–10. doi:10.1093/jurban/jti012

Sapolsky, R. M. (2005). The influence of social hierarchy on primate health. *Science, 308*, 648. doi:10.1126/science.1106477.

Sawyer, S. M., Afifi, R. A., Beringer, L. H., Blakemore, S. J., Dick, B., Ezeh, A. C., et al. (2012). Adolescence: A foundation for future health. *Lancet, 379*, 1630-1640. doi: 10:1016/S0140-6736(12)600172-5

Schmidt, F. L., Oh, I.-S., & Hayes, T. L. (2009). Fixed- versus random-effects models in meta-analysis: Model properties and an emprirical comparison of differences in results. *British Journal of Mathermatical and Statistical Psychology, 62*, 97-128. doi:10.1348/000711007X255327

Sellström, E., & Bremberg, S. (2006). The significance of neighbourhood context to child and adolescent health and well-being: a systematic review of multilevel studies. *Scandinavian Journal of Public Health*, *34*, 544–554. doi:10.1080/14034940600551251

* Shek, D. T. L. (2003). Economic stress, psychological well-being and problem behavior in Chinese adolescents with economic disadvantage. *Journal of Youth and Adolescence*, *32*, 259–266. doi:10.1023/A:1023080826557.

* Shek, D. T. L. (2005). Economic stress, emotional quality of life, and problem behavior in Chinese adolescents with and without economic disadvantage. *Social Indicators Research*,*71*, 363–383. doi:10.1007/1-4020-3602-7_12

Singh, G. K., Kogan, M. D., Siahpush, M., & van Dyck, P. C. (2009). Prevalence and correlates of state and regional disparities in vigorous physical activity levels among US children and adolescents. *Journal of Physical Activity & Health*, *6*, 73–87. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19211960

Singh, G. K., Kogan, M. D., & van Dyck, P. C. (2008). A multilevel analysis of state and regional disparities in childhood and adolescent obesity in the United States. *Journal of Community Health*, *33*, 90–102. doi:10.1007/s10900-007-9071-7

Singh-Manoux, A., Adler, N. E., & Marmot, M. G. (2003). Subjective social status: Its determinants and its association with measures of ill-health in the Whitehall II study. *Social Science & Medicine*, *56*, 1321–1333. doi:10.1016/S0277-9536(02)00131-4

Singh-Manoux, A., Marmot, M. G., & Adler, N. E. (2005). Does subjective social status predict health and change in health status better than objective status? *Psychosomatic Medicine*, *67*, 855–861. doi:10.1097/01.psy.0000188434.52941.a0

Singh-Manoux, A., Martikainen, P., Ferrie, J., Zins, M., Marmot, M., & Goldberg, M. (2006). What does self rated health measure? Results from the British Whitehall II and French Gazel cohort studies. *Journal of Epidemiology and Community Health*, *60*, 364–72. doi:10.1136/jech.2005.039883

* Spelman, A. R., Spitz, M. R., Kelder, S. H., Prokhorov, A. V., Bondy, M. L., Frankowski, R. F., & Wilkinson, A. V. (2009). Cognitive susceptibility to smoking: Two paths to experimenting among Mexican origin youth. *Cancer Epidemiology, Biomarkers & Prevention, 18*, 3459–67. doi:10.1158/1055-9965.EPI-09-0765

Statistics Canada. (2012). *Low Income Lines, 2010 to 2011*. Ministry of Industry: Ottawa, ON.

Statistics Canada. (2013a). *Gini coefficients of market, total and after-tax income of individuals, where each individual is represented by their adjusted household income, by economic family type, annual (number), CANSIM (database).* (Table 202–0709).

Statistics Canada. (2013b). *Market, total and after-tax income of individuals, where each individual is represented by their adjusted household income, by economic family type and adjusted after-tax income quintiles, 2011 constant dollars, annual, CANSIM (database)* (Table 202–0707).

Subramanian, S. V, & Kawachi, I. (2004). Income inequality and health: What have we learned so far? *Epidemiologic reviews*, *26*, 78–91. doi:10.1093/epirev/mxh003

* Sweet, E. (2010). "If your shoes are raggedy you get talked about": Symbolic and material dimensions of adolescent social status and health. *Social Science & Medicine*, *70*, 2029–35. doi:10.1016/j.socscimed.2010.02.032

Torsheim, T., Currie, C., Boyce, W., & Samdal, O. (2006). Country material distribution and adolescents' perceived health: multilevel study of adolescents in 27 countries. *Journal of Epidemiology and Community Health*, *60*, 156–161. doi:10.1136/jech.2005.037655

* Thurston, R. C., & Matthews, K. A. (2009). Racial and socioeconomic disparities in arterial stiffness and intima media thickness among adolescents. *Social Science & Medicine*, *68*, 807–13. doi:10.1016/j.socscimed.2008.12.029

* Unger, J. B., Sun, P., & Johnson, C. A. (2007). Socioeconomic correlates of smoking among an ethnically diverse sample of 8th grade adolescents in Southern California. *Preventive Medicine*, *44*, 323–7. doi:10.1016/j.ypmed.2006.12.018

* Vukovic, D. S., & Bjegovic, V. M. (2007). Brief report: Risky sexual behavior of adolescentsin Belgrade: association with socioeconomic status and family structure. *Journal ofAdolescence*, *30*, 869–77. doi:10.1016/j.adolescence.2007.06.005

*Wadsworth, M., & Compas, B. (2002). Coping with family conflict and economic strain: The adolescent perspective. *Journal of Research on Adolescence*, *12*, 243–274. doi:10.1111/1532-7795.00033

Wagstaff, A., & Van Doorslaer, E. (2000). Income inequality and health: What does the literature tell us. *Annual Review of Public Health*, *21*, 543–567.

West, P. (1997). Health inequalities in the early years: Is there equalisation in youth? *Social Science & Medicine*, *44*, 833–58. doi:10.1016/S0277-9536(96)00188-8

* West, P., Sweeting, H., Young, R., & Kelly, S. (2010). The relative importance of family socioeconomic status and school-based peer hierarchies for morning cortisol in youth: An exploratory study. *Social Science & Medicine*, *70*, 1246–1253. doi:10.1016/j.socscimed.2009.12.006

World Health Organization. (1998). *The world health report 1998. Life in the 21st century: A vision for all.* Geneva: World Health Organization.

World Health Organization. (2009). *Global health risks: mortality and burden of disease attributable to selected major risks.* Geneva: World Health Organization.

* Wilkinson, A. V., Shete, S., Spitz, M. R., & Swann, A. C. (2011). Sensation seeking, risk behaviors, and alcohol consumption among Mexican origin youth. *Journal of Adolescent Health, 48*, 65–72. doi:10.1016/j.jadohealth.2010.05.002

* Wilkinson, A. V., Shete, S., Vasudevan, V., Prokhorov, A. V., Bondy, M. L., & Spitz, M. R. (2009). Influence of subjective social status on the relationship between

positive outcome expectations and experimentation with cigarettes. *Journal of Adolescent Health, 44*, 342–8. doi:10.1016/j.jadohealth.2008.08.003

Wilkinson, R. G. (1997a). Health inequalities: Relative or absolute material standards? *British Medical Journal*, *314,* 591-595.

Wilkinson, R. G. (1997b). Comment: Income, inequality, and social cohesion. *American Journal of Public Health*, *87*(9), 1504–1506.

Wilkinson, R. G. (1999). Health, hierarchy, and social anxiety. *Annals of the New York Academy of Sciences*, *896*, 48–63. doi:10.1111/j.1749-6632.1999.tb08104.x

Wilkinson, R. G., & Pickett, K. E. (2006). Income inequality and population health: a review and explanation of the evidence. *Social Science & Medicine*, *62*, 1768–1784. doi:10.1016/j.socscimed.2005.08.036

Wilkinson, R. G., & Pickett, K. E. (2007). The problems of relative deprivation: Why some societies do better than others. *Social Science & Medicine*, *65*, 1965–1978. doi:10.1016/j.socscimed.2007.05.041

Wilkinson, R., & Pickett, K. (2009). *The spirit level: Why greater equality make societies stronger*. New York: Bloomsbury Press.

Wilson, W. J. (1987). *The truly disadvantaged: The inner city, the underclass, and public policy*. Chicago, IL: University of Chicago Press.

Winkleby, M. A., Jatulis, D. E., Frank, E., & Fortmann, S. P. (1992). Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *American Journal of Public Health*, *82*, 816–20. doi:10.2105/AJPH.82.6.816

* Zaborskis, A., Sumskas, L., Maser, M., & Pudule, I. (2006). Trends in drinking habits among adolescents in the Baltic countries for the period of transition: HBSC survey results, 1993-2002. *BMC Public Health, 6*(67). doi:10.1186/1471-2458-6-67