Income Inequality and Bullying Victimization and Perpetration: Evidence From Adolescents in the COMPASS Study

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Abstract

Previous research indicates that the disproportionate distribution of income within society is associated with aggression and violence. Although research has been conducted identifying the relationship between income inequality and bullying victimization and perpetration, little is known about possible mediators. We investigated the association between income inequality and bullying perpetration and victimization among adolescents participating in the Cannabis, Obesity, Mental health, Physical activity, Alcohol use, Smoking, and Sedentary behavior (COMPASS) study. We identified whether school connectedness and psychosocial well-being mediated the relationship between income inequality and bullying behavior. This study used pooled cross-sectional data from 147,748 adolescents aged 13 to 18 from three waves (2015–2016, 2016–2017, 2017–2018) of the COMPASS study from 157 secondary schools in British Columbia, Alberta, Ontario, and Quebec (Canada). The Gini coefficient was calculated based on the school Census Divisions (CD) using the Canada 2016 Census and linked with student data. We used multilevel modeling to investigate the relationship between income inequality and self-reported bullying victimization and perpetration, while controlling for individual-, school-, and CD-level characteristics. A standard deviation increase in Gini coefficient was associated with increased odds for bullying victimization and perpetration. Findings were observed among girls; however, inequality was only associated with perpetration among boys. We identified social cohesion and psychosocial well-being as potential mediators. To counter the adverse effects of income inequality, school-based interventions designed to increase school connectedness and student psychosocial well-being should be implemented to protect against bullying.

The distribution of income within a society has long been posited to be related to population health (Berkman et al., 2014). In other words, there may be negative consequences on population health within societies where there is a large gap between the "haves" and "have-nots." For example, previous research has indicated that individuals who live in societies in which there are high levels of income inequality are at greater risk for adverse health outcomes, such as depression and anxiety, coronary heart disease, and mortality, among others (Berkman et al., 2014; Kondo et al., 2009).

Acts of aggression between members of a society, such as violent crime, are thought to reflect the quality of the social environment (Kawachi et al., 1999). Empirical evidence has also indicated that income inequality is associated with violent crime rates, such as homicide, assault, and robbery (Kawachi et al., 1999). Individuals residing in unequal societies are more

likely to exhibit aggression and more likely to be victims of aggression, in comparison with those living in more equal societies (Kawachi et al., 1999). Findings have also been observed among adolescents. Several studies have been conducted that show a relationship between income inequality and bullying (Elgar et al., 2009, 2013, 2015, 2019; Napoletano et al., 2016). Although several ecological studies have identified a

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relationship between income inequality within countries and states and bullying rates (Elgar et al., 2013) and observational studies using individual-level data have shown a relationship between income inequality with countries and the odds for bullying behavior, studies investigating the role of income inequality within smaller areas, such as within cities, are rare. For example, income inequality within Boston neighborhoods has indicated those living in neighborhoods with high income inequality were more likely to be victims of violence and aggression, such as being attacked or beaten by someone in the neighborhood, in comparison with those living in more equal neighborhoods (Pabayo et al., 2014). Smaller areas like cities and counties may be more relevant since the social environment is more proximal for social processes to occur and thus more relevant in exploring associations between income inequality and bullying behavior.

Bullying is defined as a repeated, intentional form of aggression over time against a less powerful person or group (Aalsma & Brown, 2008). It may involve direct physical, social media, or verbal attacks; relational aggression; or indirect forms of aggression such as stealing or damaging goods (Smith et al., 2013). Approximately 20% to 40% of children report being involved in either bully victimization or perpetration in a school setting, thus making it a societal concern (Jenson et al., 2013). Furthermore, the public health burden of bullying is evident since it is associated with poor school performance (Gini & Pozzoli, 2013), poor mental health conditions, such as depression and anxiety (Wolke et al., 2013), and increased risk for suicidal ideation and suicide (Klomek et al., 2009). Bullying has also shown to be associated with increased use of health services (Kontak et al., 2019).

Several mechanisms in which income inequality leads to bullying have been proposed, but not fully studied. First, the psychosocial theory suggests that when the income gap between the wealthy and poor widens within society, it leads to stressful comparisons, which may heighten feelings of insecurity and shame (Berkman et al., 2014; Pickett & Wilkinson, 2015; Rozer & Volker, 2016). Thus, bullying others may be an adverse coping mechanism or adverse reaction to the stressful comparisons. Second, the contextual effect posits that income inequality may also erode social cohesion (Berkman et al., 2014; Harling et al., 2014; Pickett & Wilkinson, 2015; Rozer & Volker, 2016), which is feelings of trust between members of society. Social cohesion is the ongoing social process of developing community of shared values and is based on a sense of trust, hope, and reciprocity among members of a society (Berkman et al., 2014; Moore & Kawachi, 2017; Pickett & Wilkinson, 2015). School connectedness, defined as the cohesiveness between diverse groups in the school community, including students, families, school staff, and the wider community, can be seen as a proxy for social cohesion (Rowe & Stewart, 2007). An erosion of social cohesion can lead to increases in acts of bullying between members of a school community. This mechanism, combined with a sense of frustration and anomie, may be expressed in increased acts of bullying perpetration and bullying victimization (Merton, 1968; Schaible & Altheimer, 2016). Third, the absolute income effect contends that societies with high levels of income inequality tend to have a greater number of people in poverty that lack access to resources that could lead to upward mobility. Thus, limiting options for upward mobility, which may lead to frustration and increased risk for aggressive behavior (Stiglitz, 2012). Also, this theory contends that jurisdictions with high income inequality are less likely to offer social programs or interventions that may help prevent bullying, such as anti-bullying programs (Stiglitz, 2012).

Given that most youth, regardless of socioeconomic status, spend a considerable amount of time in schools annually, school-based anti-bullying programs to reduce bullying may be an option to intervene to reduce the burden of aggressive and violent behavior within schools. A systematic and meta-analytic review of 44 evaluations indicated that school-based anti-bullying programs proved to be effective and on average, bullying decreased by 20% to 23% and victimization decreased by 17% to 20% (Ttofi & Farrington, 2011). Whether these school-based programs can mitigate the effect of income inequality remains to be determined.

The objective of this study is to determine whether income inequality across schools is associated with bullying perpetration and victimization among a large sample of adolescents aged 13 to 18 years participating in the COMPASS Study. We also examined whether social cohesion, psychosocial well-being, and anti-bullying programs in schools acted as mediators between income inequality and bullying perpetration and victimization.

Methods

Data at the student level are from the COMPASS study, a school-based survey that collects data from a convenience sample of secondary school students in four Canadian provinces: British Columbia, Alberta, Ontario, and Quebec. These provinces have the largest population sizes comprising 86.5% of Canada's population. The 2016 after-tax Gini coefficient for British Columbia, Alberta, Ontario, and Quebec were 0.296, 0.297, 0.320, and 0.284, respectively (Statistics Canada, 2021). English is the official language, with exception of Quebec, in which French is the main language used by a majority of the population. This study used 3 years of pooled cross-sectional COMPASS student-level data collected from Year 4 (Y4: 2015–2016), Year 5 (Y5: 2016–2017), and Year 6 (Y6: 2017–2018). A full description of the COMPASS study can be found in print (Leatherdale et al., 2014) or online (www.compass.uwaterloo.ca). School-level data are from the 2016 Canada Census. Characteristics of the Census Divisions (CD) in which each participating school were located, were obtained using the school's postal code. In addition to student-level data, COMPASS also comprises of data collected from the evaluation of the effects of school programs and policies, as well as characteristics of the built environment, which have

been shown to be related to multiple youth health behaviors and outcomes (Leatherdale et al., 2014).

The final student-level sample included 147,748 students aged 13 to 18 attending 157 unique participating schools. Public and private schools that used active-information passive-consent parental permission protocols (passive consent) were sampled (Thompson-Haile et al., 2013).

Measures

Data were collected from students via self-administered paper-based survey completed during class between October and June every year. In addition to data on sociodemographic characteristics and modifiable chronic disease risk factors, COMPASS also collects information on bullying victimization and perpetration.

Outcome

Bullying Victimization. Students were asked, "In the last 30 days, in what ways were you bullied by other students?" Students who indicated that they had been bullied in the last 30 days were coded "yes" for bullying victimization, whereas students who responded "I have not been bullied by other students in the last 30 days" were coded as "no" for bullying victimization. Examples of bullying victimization include physical attacks (e.g., getting beaten up, pushed, or kicked), verbal attacks (e.g., getting teased, threatened, or having rumors spread about them), cyber-attacks (e.g., being sent mean text messages or having rumors spread about them on the internet), and had someone steal from them or damage their things.

Bullying Perpetration. Students were asked "In the last 30 days, how often have you taken part in bullying other students?" Students who indicated that they had bullied other students in the last 30 days were coded "yes" for bullying perpetration, whereas students who responded "I did not bully other students in the last 30 days" were coded as "no" for bullying perpetration. Examples of bullying perpetration include physical attacks, verbal attacks, cyber-attacks, and stealing or damaging a victim's property.

Bullying Victimization and Perpetration. We also tested the outcome for students who indicated that they were bullied by other students and taken part in bullying other students.

Area-Level Characteristics. The main exposure and other characteristics were measured at the CD-level.

Main Exposure of Interest. The main exposure for this research is level income inequality within the CD, which was measured using the Gini coefficient. The Gini coefficient has a theoretical range of 0 (perfect equality, where every household earns exactly the same income) to 1.0 (perfect inequality, where households earn a diverse range of incomes). The

calculation of the Gini coefficient has been described elsewhere (Kennedy et al., 1996).

CD-level covariates in the study included the population, the median income, and the percentage of visible minority, which refers to individuals, other than Aboriginal peoples, who are non-White, in the Census division. For ease of interpretation, we standardized all area-level characteristics using the z-transformation.

Student-Level Covariates. Individual-level covariates in the study were students' age, gender, race, or ethnicity (white, Black, Asian, Latinx, other, or mixed race), and spending money per week (zero dollars, $1–$5, $6–$10, $11–$20, $21–$40, $41–$100, or more than $100). Spending money per week was assessed using the question, "About how much money do you usually get *each week* to spend on yourself or to save?"

School connectedness, a proxy for social cohesion, was measured using Likert-type-scale statements, with responses ranging from strongly agree to strongly disagree. The question asked, "how strongly do you agree or disagree with each of the following statements," and the statements included (a) I feel close to people at my school; (b) I feel I am a part of my school; (c) I am happy to be at my school; (d) I feel the teachers at my school treat me fairly; (e) I feel safe in my school; and (f) getting good grades is important to me. The original variable values were reverse-scored so that higher scores indicate higher school connectedness. A school-connectedness score was calculated for each respondent who had at least half of the 6 questions answered. Each indicator was summed and divided by the number of questions answered and then multiplied by 6.

Psychosocial well-being was also tested as a mediator in this study. It was measured using the Flourishing Scale, which has been previously validated (Witten et al., 2019). It was measured using Likert-type scale statements about personal well-being, with responses ranging from strongly agree to strongly disagree. The question asked "how strongly do you agree or disagree with each of the following statements," and the statements included (a) I lead a purposeful and meaningful life; (b) my social relationships are supportive and rewarding; (c) I am engaged and interested in my daily activities; (d) I actively contribute to the happiness and well-being of others; (e) I am competent and capable in the activities that are important to me; (f) I am a good person and live a good life; (g) I am optimistic about my future; and (h) people respect me. A composite score based on these items was developed by the COMPASS research group (Patte et al., 2017). A higher score is indicative of greater psychosocial well-being.

Public health unit anti-bullying programs: School administrators were asked, "During the past 12 months, what role did your local Public Health Unit play when working with your school on addressing bullying for students?" Response options included *(i) no contact with local public health unit; (ii) provided information/resources/programs (e.g., posters, toolkits); (iii) solved problems jointly; (iv) developed/implemented program activities jointly.* Schools were categorized

as offering Public Health Unit anti-bullying programs if they selected ii through iv.

School based anti-bullying programs: School administrators were asked, "Other than classes/curriculum, does your school offer any programs that address bullying?" Response options were *(i) yes* or *(ii) no.* Schools were categorized as offering anti-bullying programs if they indicated *yes* and were offered by the school, and not offered by the Public Health Unit or any other external organization.

Data Analysis. Given that students were nested within schools, which were nested in CDs, we used three-level multilevel modeling to investigate the relationship between income inequality within CDs and adolescent bullying victimization, perpetration, and both bullying victimization and perpetration, while controlling for individual-, school-, and CD-level characteristics. Multilevel models are a generalization of the linear model used in traditional analysis. Further information regarding the use of this type of analysis in public health research is available (Diez-Roux, 2000). Multilevel logistic regression was used, which allowed us to calculate the odds for both outcomes while taking into account the random effects of the intercepts. Those with missing data were excluded from the analysis ($n = 46,831/141.181$), which was around 24.9% of the sample. Those excluded were more likely to be younger, male in comparison with female, non-White in comparison with White, and attending public school, in comparison with private school.

To investigate the potential effect of income inequality within CDs on bullying victimization, bullying perpetration, and bullying victimization and perpetration, a step-up approach was conducted. First, a set of analyses involved estimating the null model. For both binary outcomes, the null model is used to calculate the 95% plausible value range, which is an indication of the variability of the likelihood of experiencing each outcome across area-level units (Merlo et al., 2006). Then, individual-, school-, and CD-level characteristics were added to the models. Cross-level gender–income inequality interactions were then added to determine whether income inequality had a heterogeneous effect across girls and boys. Because the cross-level interaction between gender and income inequality was significant for both bullying victimization and bullying perpetration, analyses were stratified by gender. Finally, student reported social cohesion and psychosocial well-being were included in the models to test for mediation.

To further test whether social cohesion, psychosocial well-being, and the presence of public health unit or school based anti-bullying programs acted as mediators between income inequality and bullying victimization and perpetration, we applied the Baron and Kenny method to test for mediation (Baron & Kenny, 1986). More specifically, the following relationships were tested: (a) income inequality and each of the outcomes; (b) income inequality and each of the potential mediators; and (c) potential mediators and each of the two bullying outcomes. Since questions measuring whether schools offered anti-bullying programs were only administered in the 2017 and 2018 administrator questionnaires, subanalyses involving these 2 years were conducted.

Results

Characteristics of the 147,748 students, 157 secondary schools, and 49 CDs across British Columbia, Alberta, Ontario, and Quebec are described in Table 1. Overall, the sample had more females (50.3%), more than two thirds were white (69.1%), and a majority received weekly spending money of over $100 (22.5%).

The mean Gini coefficient across CDs was 0.37 ($SD = 0.03$; range = 0.30–0.46). The mean population size was 437,797.70 ($SD = 596,822.10$; range = 12,997–2,463,431). The average median income across CDs was $59,591.38 ($SD = \$9,263.32$; range = $44,293–$87,183). The mean proportion of visible minority across was 10% ($SD = 13\%$; range = 1.0% to 49.5%).

Based on the null model, we calculated the plausible value range of bullying across CDs, which indicates that there is variation across CDs in the current study (results not shown). For example, the plausible value range for experiencing the bullying victimization across CDs and schools were 7.5% to 28.0% and 6.6% to 27.8%, respectively. The plausible value range across the CDs and schools for bullying perpetration were 3.7% to 11.7% and 3.2% to 13.2%, respectively. Finally, the plausible value range across CDs and schools for both bullying perpetration and victimization were 0.8% to 4.5% and 0.6% to 4.4%, respectively. The Intraclass Correlation (ICC) indicated that 3.9% and 5.1% of the bullying victimization variance was explained at the CD and School levels, respectively. The ICC indicated that 1.5% and 4.3% of the bullying perpetration was explained at the CD and School levels, respectively. Finally, the ICC indicated that 6.2% and 7.1% of both bullying victimization and perpetration variance were explained at the CD and School level, respectively.

The crude relationship between income inequality and bullying behavior indicated, on average, a standard deviation increase in Gini coefficient within CDs was associated with increased odds of bullying victimization ($OR = 1.12$; 95% confidence interval [CI] = 1.01, 1.24), bullying perpetration ($OR = 1.10$; 95% CI = 1.02, 1.20), and both bullying victimization and perpetration ($OR = 1.16$; 95% CI = 1.10, 1.33) (results not reported in Table). When adjusting for individual-level and area-level confounders, on average, a standard deviation increase in Gini coefficient within CDs remained significantly associated with bullying victimization ($OR = 1.18$; 95% CI = 1.05, 1.32). Income inequality within CDs was related with an increased odds for bullying perpetration ($OR = 1.09$, 95% CI = 0.99, 1.20) and bullying victimization and perpetration ($OR = 1.13$; 95% CI = 0.99,1.29) (Table 2). Gender-income inequality cross-level interaction terms were then included for bullying victimization ($OR = 0.92$; 95% CI = 0.89, 0.95) and perpetration ($OR = 1.06$; 95% CI = 1.01, 1.11). When adjusted analyses were stratified by gender, an increase in standard deviation Gini coefficient within CDs

Table 1. Characteristics of adolescents participating in the COMPASS study in 2016, 2017, and 2018.

Characteristics	n	%
Individual-level characteristics		
Gender		
Female	74,270	50.27
Male	73,478	49.73
Age (years)		
12	3,479	2.35
13	8,630	5.84
14	28,561	19.33
15	36,116	24.44
16	35,807	24.24
17	27,347	18.51
18	7,107	4.81
19	701	0.47
Race/ethnicity		
White	102,111	69.11
Black	5,669	3.84
Asian	14,515	9.82
Latinx	3,905	2.64
Other	9,673	6.55
Mixed race	11,875	8.04
Spending money		
$0	28,164	19.06
$1–$5	10,365	7.02
$6–$10	12,140	8.22
$11–$20	21,894	14.82
$21–$40	19,600	13.27
$41–$100	22,290	15.09
More than $100	33,295	22.53
Year of study		
2016	38,388	25.98
2017	52,038	35.22
2018	57,322	38.8

	Mean (SD)	Max, Min
Social cohesion score	20.43 (5.72)	6, 32
Fluorish score	32.00 (5.72)	8, 40

School-level characteristics		
School type	n	%
Private	9	5.73
Public	148	94.27
Public Health Unit anti-bullying programs 2017		
No	87	71.31
Yes	35	28.69
School anti-bullying programs 2017		
No	56	45.9
Yes	66	54.1
Public Health Unit anti-bullying programs 2018		
No	88	64.71
Yes	48	35.29
School anti-bullying programs 2018		
No	65	47.79
Yes	71	52.21

CD-level characteristics	Mean (SD)	Max, Min
Gini coefficient	0.37 (0.03)	0.30, 0.46
Population	437,797.70 (596,822.10)	12,997, 2,463,431
Median income	59,591.38 (9,263.32)	44,293, 87,183
Visible minority %	0.10 (0.13)	0.01, 0.49

Note. COMPASS = Cannabis, Obesity, Mental health, Physical activity, Alcohol use, Smoking, and Sedentary behavior; CD = Census Divisions.

was related with an increased odds of bullying victimization among girls ($OR = 1.16$; 95% CI = 1.04, 1.29) and boys ($OR = 1.19$; 95% CI = 1.06, 1.34). However, although an increase in standard deviation of Gini coefficient within CDs was significantly associated with increased odds of bullying perpetration among girls ($OR = 1.12$; 95% CI = 1.01, 1.24), this association was not statistically significant among boys ($OR = 1.06$; 95% CI = 0.96, 1.17) (Table 2). Income inequality within CDs was not associated with both bullying victimization and perpetration among boys and girls.

The addition of mediators resulted in a slight attenuation for the estimate for Gini coefficient for both bullying victimization and bullying perpetration (Table 3). Only social cohesion ($OR = 0.60$; 95% CI = 0.59, 0.61) and psychosocial well-being ($OR = 0.61$; 95% CI = 0.60, 0.62) were associated with decreased odds in bullying victimization for an increase in standard deviation of Gini coefficient. Social cohesion ($OR = 0.62$; 95% CI = 0.60, 0.64), psychosocial well-being ($OR = 0.70$; 95% CI = 0.68, 0.72), and Public Health Unit anti-bullying programs ($OR = 0.84$, 95% CI = 0.78, 0.91) were associated with decreased odds for bullying perpetration (Table 3).

Table 4 presents results from the mediation analyses examining bivariate associations between each of the four proposed mediators. An increase in standard deviation of the Gini coefficient within CDs was associated with lower social cohesion scores ($\beta = -0.05$, 95% CI = -0.10, -0.01) and psychosocial well-being scores ($\beta = -0.07$, 95% CI = -0.12, -0.02). Income inequality was not associated with anti-bullying programs offered by the Public Health Unit or the schools. In models controlling for income inequality within CDs, social cohesion and psychosocial well-being were associated with decreased odds for bullying victimization and perpetration. An increase in standard deviation of social cohesion ($OR = 0.61$, 95% CI = 0.60, 0.62) and psychosocial well-being ($OR = 0.90$, 95% CI = 0.86, 0.94) was associated with decreased odds for bullying perpetration. Similar findings were observed when odds for bullying perpetration was the outcome.

Discussion

The objectives of our study were twofold: to identify the association between income inequality within Census Districts and bullying victimization and perpetration, and to identify possible variables mediating any such associations in a large sample of adolescents. Our multilevel analysis takes advantage of individual-level data collected among adolescents, nested within schools and CDs. We found evidence that income inequality is associated with increased odds for bullying victimization and perpetration. We also found evidence that school connectedness (a relevant proxy for social cohesion among adolescents) and psychosocial well-being partially mediated the relationship between CD-level income inequality and bullying outcomes.

This study is one of the first, particularly among adolescents, to investigate the possible effect of income inequality

Table 2. The association between income inequality, bullying victimization, bullying perpetration, and both victimization and perpetration among adolescents participating in the COMPASS study 2016, 2017, and 2018.

	Bullying victimization			Bullying perpetration			Both bullying victimization and perpetration		
	Among all students	Among girls	Among boys	Among all students	Among girls	Among boys	Among all students	Among girls	Among boys
		Adjusted model			Adjusted model			Adjusted model	
Variable	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI
Area-level characteristics									
Census division characteristics									
Gini, z-transformed	1.18	1.16	1.19	1.09	1.12	1.06	1.13	1.15	1.10
	1.05, 1.32	1.04, 1.29	1.06, 1.34	0.99, 1.20	1.01, 1.24	0.96, 1.17	0.99, 1.29	0.99, 1.33	0.95, 1.26
Population, z-transformed	0.95	0.94	0.96	0.84	0.81	0.88	0.87	0.86	0.89
	0.67, 1.34	0.67, 1.31	0.68, 1.37	0.65, 1.09	0.64, 1.04	0.68, 1.14	0.60, 1.27	0.57, 1.28	0.60, 1.31
Median income, z-transformed	1.21	1.24	1.20	1.13	1.13	1.12	1.21	1.22	1.20
	1.09, 1.36	1.11, 1.38	1.07, 1.34	1.03, 1.23	1.02, 1.26	1.02, 1.23	1.06, 1.37	1.05, 1.42	1.05, 1.38
% Visible minority, z-transformed	0.90	0.92	0.87	1.15	1.21	1.09	0.99	1.02	0.97
	0.65, 1.23	0.67, 1.26	0.63, 1.21	0.89, 1.45	0.94, 1.57	0.85, 1.41	0.69, 1.42	0.68, 1.53	0.66, 1.41
School-level characteristics									
School type (ref: Public)		1.00			1.00			1.00	
Private	0.83	0.71	0.95	0.73	0.64	0.77	0.68	0.68	0.64
	0.69, 1.00	0.57, 0.88	0.76, 1.18	0.56, 0.94	0.45, 0.91	0.59, 1.00	0.46, 0.99	0.39, 1.19	0.42, 0.98
Individual-level characteristics									
Gender (ref: Male)		1.00			1.00			1.00	
Female	1.22			0.48			0.47		
	1.19, 1.26			0.45, 0.50			0.43, 0.51		
Age, years (ref: 12)		1.00			1.00			1.00	
13	0.83	0.87	0.79	0.67	0.74	0.65	0.52	0.57	0.50
	0.74, 0.94	0.74, 1.02	0.67, 0.94	0.57, 0.78	0.58, 0.93	0.53, 0.78	0.39, 0.70	0.36, 0.90	0.34, 0.74
14	0.74	0.82	0.66	0.46	0.46	0.49	0.31	0.32	0.33
	0.66, 0.82	0.71, 0.95	0.57, 0.78	0.40, 0.53	0.37, 0.57	0.41, 0.58	0.24, 0.40	0.21, 0.48	0.23, 0.47
15	0.65	0.75	0.56	0.45	0.40	0.50	0.31	0.26	0.38
	0.58, 0.72	0.65, 0.88	0.47, 0.65	0.39, 0.52	0.32, 0.50	0.42, 0.60	0.24, 0.41	0.17, 0.39	0.27, 0.53
16	0.54	0.60	0.50	0.43	0.35	0.50	0.33	0.22	0.44
	0.49, 0.61	0.51, 0.69	0.43, 0.59	0.37, 0.49	0.28, 0.43	0.42, 0.60	0.26, 0.43	0.15, 0.34	0.31, 0.62
17	0.47	0.50	0.45	0.43	0.33	0.51	0.47	0.23	0.45
	0.42, 0.53	0.42, 0.58	0.38, 0.53	0.37, 0.49	0.26, 0.42	0.42, 0.61	0.35, 0.63	0.15, 0.35	0.32, 0.64
18	0.44	0.47	0.42	0.55	0.51	0.61	0.47	0.40	0.56
	0.39, 0.50	0.39, 0.56	0.35, 0.51	0.47, 0.65	0.39, 0.66	0.50, 0.74	0.35, 0.63	0.25, 0.65	0.39, 0.82
19	1.06	1.19	0.94	1.75	2.50	1.46	1.87	2.35	1.81
	0.86, 1.31	0.87, 1.64	0.71, 1.25	0.42, 2.17	1.79, 3.50	1.11, 1.91	1.32, 2.65	1.35, 4.09	1.16, 2.82
Race (ref: White)		1.00			1.00			1.00	
Black	1.07	0.89	1.25	3.12	3.54	2.95	3.72	4.30	3.47
	0.99, 1.16	0.79, 1.01	1.13, 1.38	2.89, 3.38	3.08, 4.07	2.68, 3.24	3.23, 4.29	3.32, 5.56	2.92, 4.11
Asian	0.70	0.53	0.91	1.38	1.52	1.33	1.52	1.33	1.62
	0.66, 0.75	0.48, 0.58	0.83, 0.99	1.28, 1.49	1.34, 1.74	1.20, 1.46	1.31, 1.78	1.00, 1.77	1.35, 1.94
Latinx	0.78	0.68	0.89	1.59	1.78	1.50	1.86	1.85	1.84
	0.70, 0.86	0.59, 0.79	0.77, 1.02	1.41, 1.79	1.46, 2.19	1.30, 1.74	1.49, 2.31	1.25, 2.75	1.42, 2.39
Other	1.07	1.00	1.15	2.02	2.27	1.92	2.06	2.07	2.06
	1.01, 1.14	0.92, 1.09	1.05, 1.24	1.89, 2.17	2.00, 2.57	1.75, 2.10	1.80, 2.36	1.62, 2.64	1.75, 2.43
Mixed race	1.34	1.28	1.43	1.67	1.56	1.74	2.25	1.94	2.42
	1.28, 1.41	1.19, 1.37	1.33, 1.54	1.55, 1.79	1.38, 1.76	1.59, 1.90	1.99, 2.55	1.56, 2.43	2.08, 2.82
Spending money (ref: Zero)		1.00			1.00			1.00	
$1–$5	1.18	1.20	1.15	1.07	1.07	1.07	0.99	1.08	0.94
	1.11, 1.25	1.10, 1.31	1.05, 1.26	0.98, 1.18	0.92, 1.25	0.96, 1.20	0.83, 1.19	0.80, 1.45	0.75, 1.18
$6–$10	1.09	1.02	1.17	1.02	1.06	0.99	0.84	0.82	0.84
	1.02, 1.16	0.94, 1.12	1.07, 1.27	0.94, 1.12	0.92, 1.23	0.89, 1.11	0.70, 1.01	0.59, 1.12	0.67, 1.05
$11–$20	0.99	0.99	0.99	0.97	1.01	0.93	0.83	0.91	0.77
	0.94, 1.04	0.92, 1.06	0.92, 1.07	0.90, 1.04	0.89, 1.15	0.85, 1.02	0.71, 0.96	0.71, 1.17	0.64, 0.93
$21–$40	1.03	1.07	0.99	1.02	1.02	1.01	0.83	0.92	0.79
	0.98, 1.09	0.99, 1.15	0.92, 1.07	0.94, 1.10	0.90, 1.17	0.92, 1.11	0.72, 0.97	0.71, 1.19	0.65, 0.95
$41–$100	1.07	1.11	1.02	1.01	0.91	1.07	0.96	0.85	1.03
	1.01, 1.12	1.03, 1.19	0.94, 1.10	0.94, 1.09	0.80, 1.04	0.98, 1.18	0.83, 1.11	0.65, 1.12	0.87, 1.23
More than $100	1.21	1.28	1.15	1.43	1.41	1.43	1.61	1.71	1.57
	1.15, 1.27	1.19, 1.37	1.07, 1.23	1.34, 1.52	1.25, 1.58	1.32, 1.54	1.43, 1.81	1.36, 2.13	1.36, 1.80
Study year (ref: 2016)		1.00			1.00			1.00	
2017	0.99	0.97	1.00	1.23	1.18	1.23	0.76	0.64	0.81
	0.95, 1.03	0.92, 1.02	0.94, 1.06	1.15, 1.30	1.06, 1.31	1.15, 1.33	0.68, 0.84	0.53, 0.77	0.71, 0.91
2018	0.90	0.88	0.92	1.21	1.15	1.21	0.75	0.71	0.75
	0.87, 0.94	0.83, 0.93	0.86, 0.97	1.14, 1.28	1.04, 1.28	1.13, 1.31	0.68, 0.83	0.59, 0.85	0.66, 0.85

Note. COMPASS = Cannabis, Obesity, Mental health, Physical activity, Alcohol use, Smoking, and Sedentary behavior.

Table 3. Multilevel regression analyses while adjusting for mediators: Social cohesion, psychosocial flourishing, and anti-bullying programs.

Variable	Bullying victimization				Bullying perpetration			
	Adjusted model + Social cohesion	Model + FLOURISH mediator	Adjusted model + school anti-bullying program	Adjusted model + Public Health Unit anti-bullying program	Adjusted model + social cohesion	Model + FLOURISH mediator	Adjusted Model + School anti-bullying program	Adjusted Model + Public Health Unit anti-bullying program
	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI
Area-level characteristics								
Gini (z-transformed), Census division-level	1.16 (1.05, 1.29)	1.15 (1.04, 1.28)	1.16 (1.04, 1.31)	1.16 (1.04, 1.31)	1.08 (0.99, 1.17)	1.05 (0.96, 1.15)	1.08 (0.98, 1.19)	1.06 (0.96, 1.18)
Population of Census division, z-transformed	0.94 (0.89, 1.30)	0.93 (0.68, 1.28)	0.92 (0.65, 1.32)	0.92 (0.64, 1.31)	0.86 (0.69, 10.8)	0.84 (0.66, 1.05)	0.76 (0.58, 1.00)	0.78 (0.59, 1.04)
Median income Census division, z-transformed	1.20 (1.08, 1.33)	1.17 (1.05, 1.31)	1.19 (1.06, 1.34)	1.19 (1.06, 1.35)	1.12 (1.03, 1.21)	1.07 (0.98, 1.17)	1.08 (0.98, 1.20)	1.09 (0.98, 1.21)
Visible minority percentage in Census division, z-transformed	0.92 (0.69, 1.24)	0.95 (0.71, 1.29)	0.96 (0.68, 1.34)	0.96 (0.68, 1.35)	1.04 (0.83, 1.30)	1.22 (0.96, 1.54)	1.34 (1.02, 1.77)	1.32 (0.99, 1.75)
School characteristics								
School type (ref: Public)			1.00				1.00	
Private	0.97 (0.81, 1.16)	0.95 (0.77, 1.18)	0.86 (0.68, 1.09)	0.85 (0.68, 1.07)	0.83 (0.65, 1.08)	0.87 (0.67, 1.13)	0.71 (0.53, 0.94)	0.70 (0.52, 0.93)
Individual characteristics								
Gender (ref: Male)			1.00				1.00	
Female	1.24 (1.21, 1.28)	1.12 (1.08, 1.16)	1.20 (1.16, 1.24)	1.20 (1.16, 1.24)	0.44 (0.41, 0.46)	0.44 (0.41, 0.47)	0.47 (0.45, 0.50)	0.47 (0.45, 0.50)
Age (ref: 12)			1.00				1.00	
13	0.78 (0.69, 0.88)	0.76 (0.67, 0.87)	0.83 (0.73, 0.93)	0.82 (0.73, 0.93)	0.64 (0.82, 0.78)	0.70 (0.59, 0.84)	0.66 (0.57, 0.77)	0.66 (0.56, 0.77)
14	0.64 (0.57, 0.72)	0.65 (0.58, 0.73)	0.74 (0.66, 0.83)	0.74 (0.66, 0.83)	0.39 (0.33, 0.47)	0.46 (0.39, 0.54)	0.47 (0.41, 0.55)	0.47 (0.41, 0.54)
15	0.53 (0.48, 0.60)	0.55 (0.48, 0.61)	0.65 (0.58, 0.73)	0.65 (0.58, 0.73)	0.38 (0.32, 0.46)	0.43 (0.37, 0.51)	0.46 (0.40, 0.53)	0.46 (0.40, 0.530)
16	0.43 (0.38, 0.48)	0.44 (0.39, 0.49)	0.54 (0.48, 0.60)	0.54 (0.48, 0.60)	0.35 (0.29, 0.42)	0.38 (0.32, 0.45)	0.43 (0.37, 0.49)	0.43 (0.67, 0.49)
17	0.37 (0.33, 0.41)	0.38 (0.33, 0.43)	0.47 (0.42, 0.53)	0.47 (0.42, 0.53)	0.34 (0.28, 0.42)	0.37 (0.31, 0.44)	0.43 (0.37, 0.49)	0.43 (0.37, 0.49)
18	0.33 (0.29, 0.38)	0.33 (0.28, 0.38)	0.41 (0.35, 0.47)	0.41 (0.35, 0.47)	0.43 (0.35, 0.54)	0.42 (0.35, 0.52)	0.46 (0.39, 0.55)	0.46 (0.39, 0.55)
19	0.73 (0.59, 0.91)	0.73 (0.58, 0.92)	1.09 (0.88, 1.35)	1.09 (0.88, 1.35)	1.52 (1.16, 1.99)	1.45 (1.12, 1.86)	1.79 (1.145, 2.22)	1.79 (1.44, 2.22)
Race (ref: White)			1.00				1.00	
Black	0.94 (0.86, 1.02)	0.90 (0.82, 0.99)	0.98 (0.89, 1.08)	0.98 (0.89, 1.08)	2.87 (2.58, 3.20)	2.64 (2.37, 2.95)	2.90 (2.64, 3.18)	2.89 (2.64, 3.17)
Asian	0.72 (0.67, 0.77)	0.61 (0.57, 0.66)	0.68 (0.63, 0.73)	0.68 (0.63, 0.73)	1.41 (1.26, 1.58)	1.24 (1.12, 1.37)	1.32 (1.21, 1.45)	1.32 (1.21, 1.44)
Latinx	0.73 (0.66, 0.81)	0.76 (0.68, 0.86)	0.75 (0.66, 0.85)	0.75 (0.66, 0.85)	1.64 (1.40, 1.92)	1.49 (1.28, 1.75)	1.46 (1.27, 1.68)	1.47 (1.28, 1.68)
Other	0.97 (0.91, 1.03)	0.96 (0.89, 1.04)	1.07 (0.99, 1.15)	1.07 (0.99, 1.15)	1.78 (1.61, 1.97)	1.91 (1.74, 2.11)	2.04 (1.88, 2.22)	2.04 (1.87, 2.22)
Mixed race	1.25 (1.19, 1.32)	1.21 (1.14, 1.28)	1.30 (1.22, 1.48)	1.30 (1.22, 1.38)	1.76 (1.60, 1.93)	1.54 (1.41, 1.70)	1.59 (1.46, 1.73)	1.59 (1.46, 1.73)
Spending money (ref: Zero)			1.00				1.00	
$1–$5	1.24 (1.16, 1.32)	1.28 (1.18, 1.38)	1.18 (1.10, 1.27)	1.18 (1.10, 1.28)	1.07 (0.94, 1.22)	1.20 (1.06, 1.35)	1.12 (1.01, 1.24)	1.12 (1.01, 1.24)
$6–$10	1.20 (1.12, 1.27)	1.26 (1.17, 1.36)	1.11 (1.04, 1.20)	1.11 (1.04, 1.20)	1.15 (1.01, 1.30)	1.23 (1.09, 1.38)	1.04 (0.94, 1.15)	1.04 (0.94, 1.15)
$11–$20	1.07 (1.02, 1.13)	1.17 (1.10, 1.25)	1.00 (0.94, 1.06)	1.00 (0.94, 1.06)	1.07 (0.97, 1.19)	1.15 (1.04, 1.27)	0.98 (0.90, 1.07)	0.98 (0.90, 1.06)
$21–$40	1.13 (1.07, 1.20)	1.24 (1.16, 1.32)	1.06 (0.99, 1.12)	1.06 (0.99, 1.12)	1.08 (0.97, 1.20)	1.22 (1.10, 1.35)	1.04 (0.95, 1.13)	1.04 (0.95, 1.13)
$41–$100	1.16 (1.10, 1.22)	1.29 (1.22, 1.38)	1.08 (1.02, 1.15)	1.08 (1.12, 1.15)	1.16 (1.04, 1.29)	1.22 (1.10, 1.35)	1.03 (0.94, 1.12)	1.03 (0.94, 1.12)
More than $100	1.24 (1.18, 1.30)	1.38 (1.30, 1.46)	1.17 (1.10, 1.24)	1.17 (1.10, 1.24)	1.73 (1.58, 1.89)	1.69 (1.55, 1.85)	1.38 (1.28, 1.49)	1.38 (1.28, 1.49)
Study year (ref: 2016)	1.00				1.00			
2017	0.99 (0.95, 1.03)	0.94 (0.86, 1.02)	1.00		0.92 (0.85, 1.00)	1.38 (1.18, 1.61)	1.00	
2018	0.90 (0.82, 0.94)	0.85 (0.78, 0.92)	0.91 (0.88, 0.95)	0.92 (0.89, 0.95)	0.93 (0.86, 1.00)	1.37 (1.17, 1.60)	0.98 (0.94, 1.03)	1.00 (0.95, 1.05)
Mediators								
Social cohesion, z-transformed	0.60 (0.59, 0.61)				0.62 (0.60, 0.64)			
FLOURISH, z-transformed		0.61 (0.60, 0.62)				0.70 (0.68, 0.72)		
School-developed anti-bullying programs (ref: no)			1.00				1.00	
Yes			0.97 (0.92, 1.03)				1.07 (1.00, 1.16)	
Public Health Unit-involved anti-bullying programs (ref: no)				1.00				1.00
Yes				0.96 (0.91, 1.02)				0.84 (0.78, 0.91)

Table 4. Bivariate analysis of the relationships between potential mediators and income inequality and bullying victimization and perpetration.

	Social cohesion	Flourish	Public Health Unit anti-bullying programs	School anti-bullying	Bullying victimization	Bullying perpetration
Covariate			β (95% CI)			OR (95% CI)
CD Gini	−0.05 (−0.10, −0.005)	−0.07 (−0.12, −0.02)	0.98 (0.61, 1.59)	0.81 (0.52, 1.25)	1.12 (1.01, 1.24)	1.10 (1.02, 1.20)
Possible mediators						
Social cohesion					0.61 (0.60, 0.62)	0.59 (0.58, 0.61)
Flourish					0.90 (0.86, 0.94)	0.71 (0.70, 0.73)
Public Health Unit anti-bullying					0.98 (0.94, 1.02)	0.97 (0.89, 1.07)
School anti-bullying					0.99 (0.95, 1.03)	1.02 (0.93, 1.11)

Note. CD = Census Divisions.

within smaller area units, such as Census Districts on bullying behavior. Our novel results are consistent with ecological studies and investigations that utilize larger area units, such as nations (Elgar et al., 2009, 2013, 2015, 2019; Napoletano et al., 2016). Also, the results of our mediation analysis underscore the potential benefit of improving adolescent social cohesion and psychosocial well-being, especially among those living in areas with high-income inequality.

Results also indicate associations between income inequality and bullying may be heterogeneous across genders, whereby income inequality was associated with the odds for bullying perpetration among girls, but among boys, the relationship was attenuated and not significant. One reason for this possible heterogeneous relationship is that girls may be more susceptible to characteristics of their social environment (Peterson & Hughey, 2004; Stafford et al., 2005; Van Droogenbroeck et al., 2018). For example, evidence has indicated girls, in comparison with boys, are more likely to be influenced by the presence of other children and the social interactions between themselves and their peers (Bocarro et al., 2015). Thus, when social cohesion is eroded by income inequality, girls are more likely to experience its detrimental impacts.

Policy makers and researchers have identified schools as ideal sites for promoting social cohesion since most students, regardless of socioeconomic status, spend a large portion of their time annually within school environments (Chiong & Menzies, 2016; Oder, 2005). Comprehensive School Health (CSH) is an approach to improving educational and health outcomes of students (Roberts et al., 2016; Veugelers & Schwartz, 2010). CSH distinguishes four pillars for action, teaching and learning, social and physical environments, health school policy, and partnerships and services, that collectively improve the school culture including school connectedness and psychological well-being (Roberts et al., 2016; Veugelers & Schwartz, 2010). For example, schools can teach principles of good citizenship, with the aim to increase the likelihood that a student will see a point of view other than his or her own (Merry, 2020) which contributes to a school culture of tolerance. Schools could also address their social and physical environments such that good citizenship is promoted and re-enforced in their classrooms, schoolyards, hallways, and communities.

Encouraging socialization between students from different social origins and backgrounds will foster mutual respect and herewith a strengthening of the "glue" between students and other members of the community (Banks, 2008). Furthermore, schools could incorporate the interests of the diverse groups of students and provide a common foundation for citizenship (Oder, 2005). Any differences should be resolved in a fair and transparent way (OECD, 2012).

Schools may also be ideal environments in which to increase psychosocial well-being (Barry Margaret et al., 2017; Fazel et al., 2014). School-based interventions are low-cost and can directly target youth. Interventions that target psychosocial assets, such as resilience, have shown to have a beneficial impact on psychosocial well-being, such as lower depression and greater life satisfaction. Consequently, these interventions have also shown to improve youth's behaviors (e.g., decreasing aggression, school suspensions) and emotional distress (e.g., depression, anxiety) (Barry Margaret et al., 2017; Fazel et al., 2014).

Findings from this study should be interpreted in light of several limitations. First, a cross-sectional study design was utilized to study the association between income inequality and bullying and therefore we cannot infer causality. However, our theory of income inequality and bullying behavior is logically sound. Future analyses will be conducted that will take advantage of the longitudinal aspect of the COMPASS data set. Furthermore, the cross-sectional study design did not allow us to test whether the anti-bullying programs prevented bullying, or were implemented in schools with high bullying rates. Second, since we used self-reported measures of bullying victimization and perpetration, there may be misclassification due to the social stigma attached to bullying, which can lead to a response bias. Third, findings may not be generalizable to other adolescent populations since COMPASS was not conducted using a population-based and representative sample. Fourth, characteristics that make certain children more vulnerable to victimization, such as those with chronic conditions and disability, were not collected. Fifth, around a quarter of the sample were excluded due to missing data, which may have included a selection bias.

In conclusion, findings from this study suggest that income inequality is associated with bullying victimization

and perpetration among Canadian adolescents. Income inequality may erode social cohesion and detrimentally affect adolescent psychosocial well-being. Public health interventions may involve not only decreasing income inequality, but also implementing interventions that increase social cohesion and psychosocial well-being, particularly within school settings. Future research should investigate the possible mediating role of bullying in the relationship between income inequality and health outcomes, such as anxiety, depression, and overall well-being.

Greater contextual income inequality is associated with greater odds for bullying victimization and perpetration among adolescents. To create safer school environments, possible interventions should not only aim to decrease income inequality, but to increase social cohesion and improve psychological well-being. School are ideal avenues to implement interventions since adolescents spend a majority of their waking hours within such environments (OECD, 2020). Planning, development, and implementation should include student involvement to maximize the effectiveness of interventions.

Declaration of Conflicting Interests

Funding

Human Subjects Approval Statement

The University of Waterloo Office of Research Ethics, the University of Alberta Research Ethics Office, and appropriate school board and school committees approved all procedures.

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