



# Income inequality and depression among Canadian secondary students: Are psychosocial well-being and social cohesion mediating factors?

Claire Benny<sup>a,\*</sup>, Karen A. Patte<sup>b</sup>, Paul Veugelers<sup>a</sup>, Scott T. Leatherdale<sup>c</sup>, Roman Pabayo<sup>a</sup>

<sup>a</sup> 3-300 Edmonton Clinic Health Academy, University of Alberta School of Public Health, 11405-87 Ave, Edmonton, Alberta, T6G 1C9, Canada

<sup>b</sup> Brock University Department of Health Sciences, 1812 Sir Isaac Brock Way, St. Catharines, Ontario, L2S 3A1, Canada

<sup>c</sup> University of Waterloo School of Public Health and Health Systems, 200 University Ave West, TJB 2317, Waterloo, Ontario, N2L 3G1, Canada

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## ABSTRACT

**Background:** Nearly one-third of secondary school students report experiencing depressive symptoms in the past year. Existing research suggests that increasing rates of depression are due in part to increasing income inequality. The aim of this study is to identify mechanisms by which income inequality contributes to depression among Canadian secondary school students.

**Methods:** We used data from a large sample of Canadian secondary school students that participated in the 2017/18 wave of the Cannabis, Obesity, Mental health, Physical activity, Alcohol, Smoking, and Sedentary behaviour (COMPASS) study. The sample included 61,642 students across 43 Census divisions (CDs) in Quebec, Ontario, Alberta, and British Columbia. We used multilevel path analysis to determine if the relationship between CD-level income inequality and depression was mediated by student's psychosocial well-being and/or social cohesion.

**Results:** Attending schools in CDs with higher income inequality was related to higher depression scores among Canadian secondary students [unstandardized  $\beta$  ( $\beta$ ) = 5.36; 95% CI = 0.74, 9.99] and lower psychosocial well-being ( $\beta$  = -14.83, 95% CI = -25.05, -4.60). Income inequality was not significantly associated with social cohesion, although social cohesion was associated with depression scores among students ( $\beta$  = -0.31; 95% CI = -0.34, -0.28).

**Discussion:** Findings from this study indicate that income inequality is associated with adolescent depression and that this relationship is mediated by psychosocial well-being. This study is the first of its kind in Canada to assess the mechanisms by which income inequality contributes to adolescent depression. These findings are applicable to school-level programs addressing mental health.

## 1. Introduction

Mental illnesses are a collection of disorders characterized by their impact on cognitive, behavioural, and emotion regulation functions (American Psychiatric Association, 2013; McIntyre et al., 2013), with the most prevalent being mood disorders (Whiteford et al., 2013). Depression is one of the most common mental illnesses in Canada, affecting roughly 8% of Canadians at some point throughout the lifespan (Canadian Mental Health Association, 2014), and is most common among Canadians aged 15–24 years (Statistics Canada, 2013). Indeed, mental health among adolescents is a major public health concern. School-based studies have shown that 28.5% of adolescents report experiencing depression symptoms, such as feeling sad or hopeless, in

the previous 12 months (Canadian Mental Health Association, 2014). Moreover, the probability of having experienced depression in adolescence ranges from approximately 5% (Costello et al., 2005) to 20% with increasing age (Lewinsohn et al., 1999). Depression is also, at times, less detectable in adolescents in comparison to their older counterparts (Thapar et al., 2012). This is because the hormonal fluctuations associated with puberty often results in negative affect and angst, which are different, but may resemble some symptoms of depression (Thapar et al., 2012). Young people may be more vulnerable to depression as they navigate increasingly complex social environments, which have shown to be significant predictors of mental health (NCCS for Environmental Health and Determinants of Health, 2001).

Income inequality is a contextual factor that represents the

\* Corresponding author.

E-mail address: [cbenny@ualberta.ca](mailto:cbenny@ualberta.ca) (C. Benny).

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disproportionate distribution of income within a given group or area, and is increasingly recognized as a key social determinant of health (Pabayo et al., 2016). A common measure of income inequality within an area is the Gini coefficient, which ranges from 0 (low income inequality) to 1 (high income inequality). Canada experienced a 5.9% increase in income inequality since 1990 with Gini coefficients increasing from 0.286 to 0.303 in 2018 (Statistics Canada, 2020). For example, in the decade leading up to 2006, there was a 7.5% increase in income inequality across Canadian Census divisions (Breau, 2014). The significant increases in income inequality across Canada present an urgent need to investigate their impact in light of the putative association of income inequality with depression (Statistics Canada, 2020).

The relationship between income inequality and health is best conceptualized using the income inequality hypothesis (Rodgers, 1979). This hypothesis posits that an individual's level of income not only influences a person's health, but also by the distribution of incomes in the area in which they live (Rodgers, 1979). Several empirical studies investigated the association between income inequality and adverse mental health outcomes (Heflin & Iceland, 2009; Lund et al., 2010; Marshall et al., 2005; Ridley et al., 2020) and, specifically, depression (Fan et al., 2011; Masselink et al., 2018). Among adolescents, income inequality within residential neighbourhoods was shown to be associated with increased depressive symptoms among girls, but not boys, in the United States (Pabayo et al., 2016). Given the rising levels of income inequality and self-reported adolescent depression in Canada (Breau, 2014; Statistics Canada, 2020), it is critically important to understand the role of income inequality in depression among Canadian adolescents.

Schools represents a key context for consideration when discussing adolescent mental health as the environment where most adolescents spend the majority of their waking hours (Abrams et al., 2005). Research has previously demonstrated that school-level characteristics are important for adolescent mental health (Goodman et al., 2003). In addition, the high school experience might be an especially challenging time for students, who may experience stress due to puberty, as well as academic and social pressures (Pascoe et al., 2020). As such, studying the effect of income inequities within school environments is crucially important.

## 2. Theory

The current study draws on two of the main mechanisms proposed by Kawachi and colleagues (1999). Existing studies highlight two potential mechanisms that explain the relationship between income inequality and depression. First, the literature demonstrates that people who live in areas with vastly different incomes than their peers may face feelings of shame and worsened psychosocial well-being due to their living conditions (Wilkinson & Pickett, 2006), with psychosocial well-being operationally defined as a person's positive/negative affect and satisfaction with life [collectively influenced by, for example, their self-esteem, and ability to succeed (Gu erin, 2012)]. Coined the "theory of social comparison", these feelings may, in turn, manifest in symptoms of depression (Kawachi & Kennedy, 1999). Second, exposure to polarized incomes may lead people to feel segregated from their peers and mistrust in their community or social groups, thus eroding social cohesion, or feelings of trust, acceptance/rejection, and tolerance between members of society (Buttrick & Oishi, 2017; Kawachi & Kennedy, 1999; Moody & White, 1999). Those experiencing worsened social cohesion may develop depressive symptoms because they feel isolated and disconnected from their peers.

Declines in psychosocial well-being and social cohesion may synergistically or independently contribute to the risk of depression (Akh-tar-Danesh & Landeen, 2007; Kawachi & Kennedy, 1999). These same mechanisms could be identified among adolescents; however, limited research exists that explains the relationship between income inequality and depression among adolescents. For example, in a study of 15 and 16

year old adolescents from Iceland, researchers investigated the role of social capital as a mediator between income inequality and adolescent emotional distress and found that while higher levels of income inequality were associated with increased emotional distress, social capital was not a mediating factor (Vilhjalmsdottir et al., 2016). Also, Pabayo et al. (2016) found no evidence that social cohesion mediated the relationship between neighborhood income inequality and depressive symptoms among adolescents living in Boston, Massachusetts. Nonetheless, we wanted to see if social cohesion acted as a mediator between income inequality and depressive symptoms in a Canadian setting.

## 3. Methods

### 3.1. Data

Data come from the Cannabis, Obesity, Mental health, Physical activity, Alcohol, Smoking, and Sedentary behaviour (COMPASS) study, which is a prospective cohort study (2012–2021) collecting hierarchical data from adolescents in grades 9 through 12 attending a convenience sample of over 120 secondary schools in British Columbia, Alberta, Ontario, and Quebec (Leatherdale et al., 2014). For this investigation, we completed a cross-sectional analysis among students who participated in Wave 6 (2017–2018) of the COMPASS study.

The current study utilized the Student Questionnaire component of the COMPASS, which was deterministically linked to the 2016 Canadian Census Health and Environment Cohort Profile (CanCHEC) by Census division (CD) (Tjepkema et al., 2019). An in-class, pen-to-paper questionnaire was administered to collect student reported data on behaviours, mental and physical health, school connectedness, and academic outcomes. All students attending participating schools were invited to participate using active-information passive-consent parental permission protocols (Leatherdale et al., 2014), which are critical for collecting robust youth depression data (Chartier et al., 2008) Further details of COMPASS methods are available online ([www.compass.uwaterloo.ca](http://www.compass.uwaterloo.ca)) or in print (Leatherdale et al., 2014).

### 3.2. Ethics

The research team completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2) certification requirement to access and disseminate the COMPASS data. The current study was approved by the University of Alberta IRB, the University of Waterloo Research Ethics Board (ORE 30118), as well as all participating school board review panels.

### 3.3. Measures

#### 3.3.1. Exposure measure: Income inequality

We used the Gini coefficient to measure income inequality at the CD-level using the 2016 Canada Census. The calculation of the Gini coefficient has been described elsewhere (Left Business Observer, 1993). CD-level income inequality was deterministically linked (Zhu et al., 2015) to the COMPASS data using each students' postal code. Z-transformed Gini coefficient were used in the standardized path models.

#### 3.3.2. Outcome measure: depressive symptoms

The study outcome was adolescent depression, measured using the 10-item Center for Epidemiologic Studies Depression Scale revised (CES-D). The CES-D is a validated scale in the COMPASS used to identify potential cases of adolescent depression (Herge et al., 2013). A higher score on the CES-D is indicative of a greater number of depressive symptoms and, therefore, a higher likelihood of adolescent depression (Herge et al., 2013). Z-transformed depression scores were used in the standardized path models.

### 3.3.3. Mediating variables

We identified individual-level measures based on the existing literature and the availability of data in the COMPASS study. COMPASS contains scales on psychosocial well-being [e.g., Flourishing Scale (Diener et al., 2010)] and school connectedness, which will serve as a proxy for social cohesion in adolescence. Diener's Flourishing Scale provides a total score that reflects overall psychosocial well-being and consists of 8-items that assess perceived success in relationships, self-esteem and competence, life satisfaction and optimism, and engagement and interest in their daily activities (e.g., "I am a good person and live a good life", "People respect me", and "I am optimistic about my future."). The original 7-point Likert scale was simplified to 5 points, omitting the "slightly agree" and "slightly disagree", to be suitable for a large school-based survey. The scale has demonstrated validity in youth populations, including measurement invariance in the COMPASS study (Romano et al., 2020). COMPASS uses the 5-item version of the National Longitudinal Study of Adolescent Health School Connectedness Scale (McNeely et al., 2002; Resnick et al., 1993). Students were asked to respond using a 4-point Likert scale from 'strongly agree' to 'strongly disagree' to the following items: "I feel close to people at my school", "I am a part of my school", "I feel safe at my school", "I feel the teachers at my school treat me fairly", and "I am happy to be at my school."

### 3.3.4. Covariates

We controlled for the proportion of lone parent households, proportion of low-income households, and the proportion of visible minority households (with visible minority referring to "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour") at the CD-level and gender, age, and race at the individual-level to account for potential confounding in the modelling procedures. Gender was self-reported in the COMPASS questionnaire, with students reporting that they identify as "male", "female", or "other". Race was measured in COMPASS by asking students if they identify as White, Black, Asian, Latin, First Nations, Métis, Inuit, or Other. Students were told to select all that apply. We then categorized race into a dichotomous variable, with students identifying as "white" or "non-white".

## 3.4. Statistical analysis

### 3.4.1. Model overview

The data were examined using histograms to check the normality assumption of each variable, correlations to check the bivariate relationships between variables, and frequencies to describe the relevant characteristics of the sample. We fit an intercept-only model to calculate the Intraclass Correlation Coefficient (ICC), which allowed us to quantify the proportion of variance in depression explained at the individual- and CD-levels. A statistically significant ( $p$ -value < 0.05) ICC value indicated that a clustered model was necessary.

Our study used nested data (individuals nested within CDs), because the exposure, income inequality was measured at the CD-level (i.e., Level 2), and our mediating and outcome variables were measured at the

individual-level (i.e., Level 1). As such, it was important to account for between-level indirect effects. This analysis was described as a multi-level path analysis, which tests the indirect effects of CD-level income inequality on adolescents' mental health outcomes via social cohesion and psychosocial well-being. These multi-level path analyses were conducted using Stata IC v16.0. The paths proposed in the current study are illustrated in Fig. 1. We report both standardized and unstandardized coefficients. This allowed us to draw direct comparisons on the strength of associations (via standardized coefficients) and interpret the results based on the raw data and scales (via unstandardized coefficients).

### 3.4.2. Assessing model fit

We assessed the model fit using the  $X^2$  test, in conjunction with the comparative fit index, Tucker-Lewis Index and the Root Mean Square Error of Approximation (RMSEA) test. With a sample size of 61,642, using the comparative fit test and Tucker-Lewis Index, an estimate of less than 0.95 was appropriate for identifying acceptable model fit; and, using the RMSEA, an estimate of less than 0.8 was deemed an acceptable model fit (Hu & Bentler, 1999).

The individual-level model had  $X^2$  value that demonstrated that there were significant differences between groups and a poor model fit. However, existing evidence suggested that the  $X^2$  test is heavily influenced by sample size (DiLalla, 2000), so we tested model fit using alternative methods. RMSEA, CFI, and TLI tests indicated that the path modelled in this study was well fit with values of 0.00, 1.00, and 1.00, respectively. At the CD-level, the  $X^2$  test also indicated poor fit. Using the same reasoning, we tested the RMSEA, CFI, and TLI which indicated good model fit with values of 0.000, 1.000, and 1.000, respectively.

## 4. Results

### 4.1. Descriptive statistics

Characteristics of the 61,642 students attending the 124 schools from 43 Census divisions are presented in Table 1. The sample included near equal parts male and female participants (49.6% and 49.5%, respectively). Most participants were between the ages of 15 and 16 (24.2% and 23.7%, respectively). Nearly three-quarters of the sample identified as being white (72.5%). The mean Gini coefficient at the CD-level was 0.37 (SD=0.025; range=0.30 to 0.46). Correlations among study variables are presented in Tables 2 and 3.

The intra-class coefficient (ICC) demonstrated that there was significant variation in depression between the individual- and CD-levels (ICC=0.030,  $p$  < 0.001). The ICC indicates that 3.0% of the variance in depression score is explained at the CD-level.

### 4.2. Path analysis

We were initially interested in the paths proposed in Fig. 1 (see Methods), but local and global fit testing indicated that the proposed model was not well fit ( $X^2 p$  < .001; CFI = 0.517; RMSEA = 0.656; and TLI = -1.897). The modification indices suggested that including covariance between psychosocial well-being and social cohesion was an

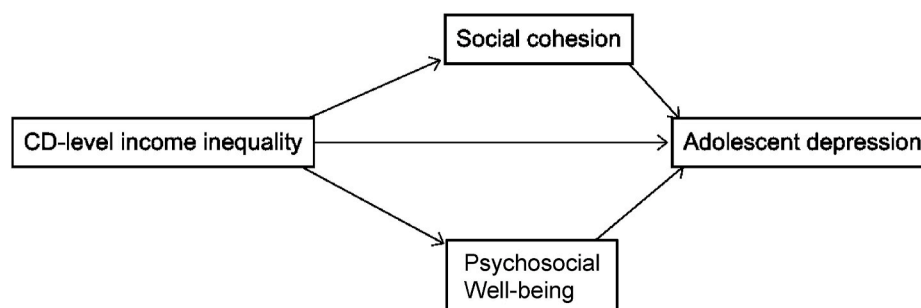


Fig. 1. Diagram illustrating the proposed structural relationship between income inequality and adolescent depression.

**Table 1**

Table demonstrating the distribution of characteristics of the sample at the individual- and CD-levels, COMPASS (2017–2018).

Individual-level Characteristics			
Variable		n	%
Gender	Female	32,886	49.48
	Male	32,986	49.64
	Other or not listed	582	0.88
Race	White	48,148	72.45
	Non-white	18,306	27.55
		Mean (Min, Max)	Standard deviation
Age	In years	15.35 (12, 19)	1.43
Depression score		8.70 (0, 30)	6.03
Social cohesion score		18.32 (6, 24)	3.40
Psychosocial well-being score		31.94 (8, 40)	3.74
CD-level Characteristics			
Gini coefficient		0.37 (0.30, 0.46)	0.03
Percentage of visible minority households		13.58% (0.59, 49.16%)	14.7%
Percentage of lone-parent households		15.80% (10.22, 22.41%)	2.16%
Percentage of low-income households		7.73% (1.17, 13.94%)	3.13%

**Table 2**

Table of correlations between the model variables at the individual level, COMPASS (2017–2018).

	1	2	3	4
1. Gender	1.000			
2. Social cohesion	0.044*	1.000		
3. Psychosocial well-being	0.047*	0.059*	1.000	
4. Depression	-0.189	-0.464*	-0.586*	1.000

\* =  $p < 0.001$ .

**Table 3**

Table of correlations between the model variables at the CD-level, COMPASS (2017–2018).

	1	2	3	4
1. Income inequality	1.000			
2. % visible minority households	0.683*	1.000		
3. % lone-parent households	0.251*	-0.157*	1.000	
4. % low-income households	0.774*	0.741*	0.221*	1.000

\* =  $p < 0.001$ .

appropriate way to improve model fit. Conceptually, social cohesion should be associated with psychosocial well-being (Cameron & Stinson, 2017). Our revised model had improved fit. Fig. 2 illustrates the standardized coefficients for the direct and indirect paths in the revised, well-fit model.

An analysis of the relationship between income inequality and depression demonstrated that a one-standard deviation (SD) increase in Gini coefficient was associated with a significant increase in depression score [unstandardized  $\beta$  ( $\beta$ ) = 5.36; 95% CI = 0.74, 9.99] when adjusting for % of lone parent households, % low-income households, and % visible minority households at the CD-level and gender at the individual-level. The results from the mediated, adjusted path demonstrated that a one-SD increase in Gini coefficient was also significantly associated with a 14.82 reduction in psychosocial well-being score (95% CI = -25.02, -4.63); however, the Gini coefficient was not significantly associated with a change in social cohesion score ( $\beta$  = -2.86; 95% CI -8.29, 2.57). Additionally, a one-SD increase in social cohesion was

significantly associated with a reduction in depression scores ( $\beta$  = -0.31; 95% CI = -0.34, -0.28); and a one-SD increase in psychosocial well-being score was associated with a reduction in depression scores ( $\beta$  = -0.50; 95% CI = -0.52, -0.47). As per the revised model, social cohesion was significantly associated with psychosocial well-being ( $\beta$  = 11.58; 95% CI = 10.65, 12.52). The results of this path analysis are described in full detail in Table 4.

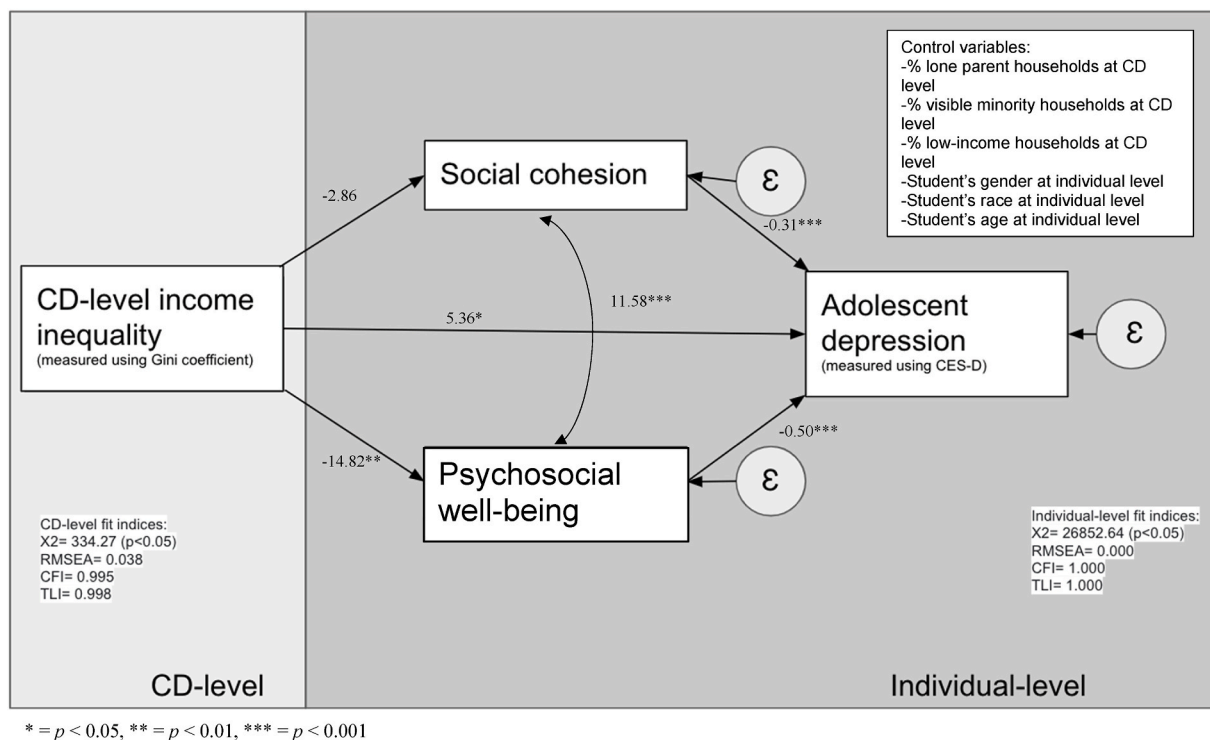
Based on the standardized results, we see that the strongest associations are between psychosocial well-being and depression ( $\beta$  = -0.47; 95% CI = -0.49, -0.45), social cohesion and depression ( $\beta$  = -0.17; 95% CI = -0.19, -0.16), and CD-level income inequality and psychosocial well-being ( $\beta$  = -0.07; 95% CI = -0.11, -0.02). The standardized results from this path analysis are available in Table 5.

## 5. Discussion

This study examined mechanisms by which income inequality may contribute to depression outcomes among a large sample of Canadian adolescents. Our results align with the literature that proposed income inequality may affect psychosocial well-being, which may have deleterious effects on adolescent mental health (Pabayo et al., 2016; Vilhjálmsdóttir et al., 2016). We examined whether the association between income inequality and depression was mediated by psychosocial well-being and school connectedness, which served as a proxy for social cohesion within the school environment, as a key context for adolescent mental health. The current study demonstrated that CD-level income inequality was associated with depression among Canadian secondary students and that this relationship was mediated by psychosocial well-being. The results indicate that students who live in areas with high levels of income inequality and had low psychosocial well-being scores were more likely to have higher depression scores than their counterparts with higher psychosocial well-being scores. Unsurprisingly, we found that psychosocial well-being and social cohesion were highly related in our research. Finally, the Gini coefficient appeared inversely associated with psychosocial well-being and social cohesion, aligning with the literature (Coburn, 2000; Jahan et al., 2015; Osborne et al., 2015; Wilkinson, 1997).

The mechanism by which income inequality contributes to adolescent depression is likely affected by several mediating variables. Those identified in the existing literature include feelings of inferiority and superiority (Wilkinson & Pickett, 2017), despise and humiliation (Walker et al., 2013), social isolation (Wilkinson & Pickett, 2017), mistrust (Kawachi & Kennedy, 1999), and dominance and subordination (Johnson et al., 2012; Wilkinson & Pickett, 2017). These items can be grouped into two overarching constructs: social cohesion (e.g., feelings of mistrust) and psychosocial well-being (e.g., self-esteem and feelings of inferiority, superiority, despise, humiliation, dominance, and subordination). Previous research has also demonstrated an indirect relationship between income inequality and adverse mental health that was mediated by feelings of shame and eroded social cohesion (Akhtar-Danesh & Landeen, 2007; Buttrick & Oishi, 2017; Patel et al., 2018).

Consistent with the existing literature (Vilhjálmsdóttir et al., 2016), social cohesion was not a significant mediator between income inequality and depression. However, the direction of the association between income inequality and social cohesion was as hypothesized, with higher levels of income inequality associated with lower social cohesion. The lack of statistically significant findings could also be explained by the idea that social cohesion differentially affects socio-demographic groups. Social cohesion, community and school participation, or social inclusion are unequally beneficial to adolescent mental health in differing socio-demographic groups (Jenson, 1998). For example, some research demonstrates that social cohesion is experienced differently by different racial groups, potentially owing to discrimination, which may increase isolation, thereby reducing social cohesion in some people and groups (Reitz & Banerjee, 2007; Reitz et al., 2009; Romano et al., 2020). Nonetheless, the current study provides



**Fig. 2.** Path diagram and unstandardized coefficients of the revised multi-level path analysis between CD-level income inequality and adolescent depression as mediated by social cohesion and psychosocial well-being, COMPASS (2017–2018).

**Table 4**  
 Table of unstandardized multi-level path analysis results, COMPASS (2017–2018).

Outcome	Predictors	Coefficient ( $\beta$ )	p-value	95% CI (lower-bound)	95% CI (upper-bound)
Social cohesion	Gini coefficient	-2.86	0.301	-8.29	2.57
Psychosocial well-being	Gini coefficient	-14.82	0.004	-25.02	-4.63
Depression	Social cohesion	-0.31	<0.001	-0.34	-0.28
	Psychosocial well-being	-0.50	<0.001	-0.52	-0.47
Gini coefficient	Gini coefficient	5.36	0.023	0.74	9.99
	Gender (female)	-1.89	<0.001	-1.98	-1.80
	Age (years)	0.18	<0.001	0.14	0.22
	Race (White)	-0.03	0.734	-0.19	0.13
	% lone parent households in the CD	0.10	0.419	-0.14	0.34
	% visible minority households in the CD	0.04	<0.309	-0.04	0.12
Social cohesion * Psychosocial well-being	% low-income households in the CD	0.46	0.027	0.05	0.87
		11.58	<0.001	10.65	12.52

**Table 5**  
 Table of standardized results from multi-level path analysis, COMPASS (2017–2018).

Outcome	Predictors	Coefficient ( $\beta$ )	p-value	95% CI (lower-bound)	95% CI (upper-bound)
Social cohesion	Gini coefficient	-0.02	0.301	-0.06	0.02
Psychosocial well-being	Gini coefficient	-0.07	0.004	-0.11	-0.02
Depression	Social cohesion	-0.17	<0.001	-0.19	-0.16
	Psychosocial well-being	-0.47	<0.001	-0.49	-0.45
Gini coefficient	Gini coefficient	0.02	0.023	0.003	0.04
	Gender (female)	-0.16	0.734	-0.17	-0.15
	Age (years)	0.04	<0.001	0.03	0.05
	Race (White)	-0.002	0.734	-0.01	0.01
	% lone parent households in the CD	0.00	0.419	-0.12	0.29
	% visible minority households in the CD	0.25	0.309	-0.23	0.72
Social cohesion * Psychosocial well-being	% low-income households in the CD	0.57	0.027	0.06	1.08
		0.59	<0.001	0.55	0.64

some evidentiary support of the link between income inequality and depression is primary through psychosocial well-being and not through social cohesion.

This study provides evidence in support of the income inequality

hypothesis, as it identified an independent relationship between income inequality and adolescent depression. A key takeaway from the income inequality hypothesis is that increases in inequality can lead to feelings of low self-esteem, which contribute to the risk of poor psychosocial

well-being and subsequent poor mental health (Akhtar-Danesh & Landeen, 2007; Buttrick & Oishi, 2017). This principle is echoed in the current research, considering that not only was CD-level income inequality associated with depression, but it was also associated through poor psychosocial well-being, which may worsen in adolescents as a result of polarization or segregation (Pijl et al., 2011).

### 5.1. Strengths

The current study offers several strengths. This study is the first of its kind using Canadian data to evaluate the paths by which income inequality in adolescents' CD contributes to their mental health. School-based studies are important in the study of income inequality and adolescent mental health (Goodman et al., 2003), as the social context where adolescents spend most of their waking hours (Abrams et al., 2005). Additionally, while COMPASS was not designed to be representative, the large sample size, full school samples, and passive consent protocols support this study's generalizability to other similarly distributed student populations in Canada. Furthermore, the study used a well validated measure for identifying depressive symptoms.

### 5.2. Limitations

Some evidence has argued against the use of multi-level structural equation modelling (SEM), such as multi-level path analysis, when the number of clusters is less than 100 (McNeish, 2017; McNeish & Stapleton, 2016). Methodologists propose the use of multiple multi-level models may be a more appropriate method given that with too few clusters (McNeish, 2017), estimates are often biased toward the null and standard error coefficients, thereby reduced, resulting in an increased likelihood of Type I error (Maas & Hox, 2005). Additionally, the current study used cross-sectional data to assess the research question. As such, we were not able to infer temporality nor a causal relationship between income inequality and depression based on our study results. The lagged impacts of income inequality may be a contributing reason as to why the relationship between income inequality and social cohesion was not statistically significant in the current study.

Also, there is a possibility of residual confounding in this study. Covariates were selected based on the existing literature, and those that were available in the COMPASS system were included in the modelling. Unfortunately, as a large school-based study and given the passive-consent protocols, the COMPASS system does not include information on some important risk factors for depression, including adverse childhood experience, physiological comorbidities, and cumulative stress over the lifespan. Such factors are reported to have significant effects on mental health among teens (Goldstein et al., 2015; Hughes et al., 2017; Masarik & Conger, 2017; Nishikawa et al., 2018; Rottenberg et al., 2014) and should be addressed in future research.

The results of the current study may be subject to social desirability and selection bias. Marginalized populations or those at risk of depression are less likely to respond truthfully or at all to surveys (Johnson, 2014; Qian et al., 2015). However, COMPASS uses passive consent protocols which are shown to improve response rates and better reach students at risk of depression (Johnson, 2014; Qian et al., 2015) and does not require student names, helping to preserve perceptions of anonymity for honest reporting. More specifically, students who have mental health problems or engage in substance use behaviours may be less likely to respond to the COMPASS, as attendance rates are lower in these samples and students may not have been present for the pen-to-paper survey (Qian et al., 2015).

There is, of course, a possibility that the relationship between income inequality and depression, as well as relationships between social cohesion, psychosocial well-being, and depression, exist due to other mechanisms beyond the scope of this paper. For example, access to mental health services may be an important mediator to consider in future research considering that the existing literature has demonstrated

that an association exists between access to mental health services and depression in adolescents (Masselink et al., 2018; Skrove et al., 2013; Werner-Seidler et al., 2017); and, conceptually, area-level income inequality could impact a person's ability to access mental health services. Additionally, some research suggests that social cohesion within social groups varies greatly across socio-economic groups (Copeland et al., 2018; Schiefer & Van der Noll, 2017). Moreover, social cohesion may differ between and within groups [e.g., students may feel connected with peers, but not with teachers' (Patte et al., 2021)]. Future research should explore additional mediating factors in their research by testing the effects of social cohesion independently across socioeconomic groups. Also, researchers should evaluate natural experiments (e.g., increases in minimum wage, cash transfers).

## 6. Conclusions

The current research confirms for the Canadian setting that income inequality is harmful for adolescent mental health, both in terms of psychosocial well-being and depressive symptoms. The results have important implications, with youth mental health promotion and mental illness prevention identified as public health priorities and schools as a key context for interventions. Additionally, the study is novel as few studies have investigated the role of income inequality among secondary school students, nor the pathways by which this determinant contributes to adolescent mental health. Psychosocial well-being, but not social cohesion, might mediate the relationship between income inequality and depression. However, lack of social cohesion was significantly associated with higher depressive symptoms. Further investigations should utilize longitudinal data, including information preceding secondary school, to gain a better understanding of mechanisms. Interventions targeting social cohesion and psychosocial well-being in schools may reduce the burden of adolescent depression and promote psychosocial wellbeing. Additionally, the study may have broader policy and upstream implications as it provides evidence-based findings on the harmful effects of income inequality for policymakers, the scientific community, and the general public.

## 7. Ethics

The research team completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2) certification requirement to access and disseminate the COMPASS data. The current study was approved by the University of Alberta IRB, the University of Waterloo Research Ethics Board (ORE 30118), as well as all participating school board review panels.

### CRedit authorship contribution statement

**Claire Benny:** contributed to the, Conceptualization, Formal analysis, Methodology, and Writing – original draft, and the revision. **Karen A. Patte:** contributed to, Funding acquisition, Project administration, Investigation, and editing of the, Writing – original draft, and the revision. **Paul Veugelers:** contributed to the Conceptualization, Supervision, and editing of the Writing – original draft. **Scott T. Leatherdale:** contributed to, Funding acquisition, Project administration, Investigation, and editing of the, Writing – original draft. **Roman Pabayo:** contributed to the, Conceptualization, Funding acquisition, Project administration, Methodology, Supervision, and writing and editing of the Writing – original draft, and the revision.

### Declaration of competing interest

None declared.

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