



Socio-economic resources and adult mental health in Canada: controlling for time-invariant confounders and investigating causal directionality

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Abstract

Objective The aim of this study was to investigate whether family income and education have a causal effect on psychological distress among Canadian adults.

Methods We executed fixed-effects regression analyses using data from the Longitudinal and International Study of Adults (LISA). We investigated whether changes in family income and education from wave 2 (2014) to wave 3 (2016) corresponded with changes in psychological distress during this same time period. We also investigated whether changes in these socio-economic resources from wave 1 (2012) to wave 2 (2014) corresponded with lagged changes in psychological distress from wave 2 (2014) to wave 3 (2016). These models controlled for all time-invariant confounders with time-invariant effects, as well as the time-varying factors age, marital status, household size, and employment status.

Results Obtaining a postsecondary degree corresponded with lagged decreases in psychological distress among women ages 18 to 32 ($b = -1.97$; 95% CI = $-3.53, -0.42$) and men over the age of 32 ($b = -1.86$; 95% CI = $-3.57, -0.15$). The effect of postsecondary education was stronger when considering adults who stayed married throughout the three waves ($b = -2.29$; 95% CI = $-4.37, -0.21$).

Conclusion Completing postsecondary education may have a lagged causal effect on psychological distress, and the life course timing for when postsecondary completion reduces distress is different for women and men.

Résumé

Objectif L'objectif de cette étude était de déterminer si le revenu familial et le niveau de scolarité ont un effet causal sur la détresse psychologique chez les adultes canadiens.

Méthodes Nous avons exécuté des analyses de régression à effets fixes en utilisant les données de l'Étude longitudinale et internationale des adultes (ELIA). Nous cherchions à savoir si les changements dans le revenu familial et le niveau de scolarité de la deuxième vague (2014) à la troisième vague (2016) correspondaient à des changements dans la détresse psychologique au cours de cette même période. Nous cherchions également à savoir si les changements dans ces ressources socio-économiques de la première vague (2012) à la deuxième vague (2014) correspondaient à un futur changement de la détresse psychologique de la deuxième vague (2014) à la troisième vague (2016). Ces modèles contrôlaient tous les facteurs de confusion invariant dans le temps, ainsi que quelques facteurs variant dans le temps (l'âge, l'état matrimonial, la taille du ménage et la situation d'emploi).

Résultats L'obtention d'un diplôme d'études postsecondaires correspondait à des diminutions futures de la détresse psychologique chez les femmes de 18 à 32 ans ($b = -1,97$; IC à 95% = $-3,53, -0,42$) et les hommes de plus de 32 ans ($b = -1,86$; IC à 95% = $-3,57, -0,15$). L'effet des études postsecondaires était plus grand chez les adultes qui sont restés mariés pendant les trois vagues ($b = -2,29$; IC à 95% = $-4,37, -0,21$).

Conclusion L'accomplissement des études postsecondaires peut avoir un effet causal sur la détresse psychologique. On note aussi que la période de vie pendant laquelle cette réduction est observée est différente pour les hommes et les femmes.

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Mots-clés Revenu familial · éducation · Échelle de Kessler de la détresse psychologique · santé mentale · effets fixes

Introduction

Research shows strong associations between indicators of socio-economic status (SES) and mental health in the Canadian adult population, but most existing studies are cross-sectional (Hay, 1988; Stephens et al., 1999; Varin et al., 2020; Veenstra, 2007; Veenstra & Vanzella-Yang, 2020a). These studies only control for a limited number of possible confounders and cannot establish causal directionality. Although a few longitudinal studies have provided important insights in this regard (Koltai et al., 2018; Wang et al., 2010), more research is needed to investigate whether the association between socio-economic resources and mental health is causal in the Canadian context. In order to address confounding in observational research, researchers typically recommend using instrumental variable analysis or fixed-effects models applied to longitudinal data with repeated measures of SES-related resources and health outcomes (Glymour et al., 2014; Imlach Gunasekara et al., 2011). Fixed-effects models can additionally provide insights on causal directionality when using at least three waves of longitudinal data (Vaisey & Miles, 2017). Previous research investigating the causal effects of SES on mental health using these methodological strategies offers inconclusive evidence.

An American study using fixed-effects models found no evidence that income was causally related to depression (Zimmerman & Katon, 2005). Similarly, a study from rural Malawi using fixed-effects models found no evidence that increases in income led to improvements in mental health (MCS-12 scores) but found that income gains were associated with an improvement in subjective well-being (Chin, 2010). In contrast, an Australian study found significant causal associations between income and wealth and a variety of mental health scores (Kendall et al., 2019). In a natural experiment of lottery winners, researchers found that people who won prizes between £1000 and £120,000 had significant improvements in psychological health (GHQ score) two years after winning the prize compared with groups with smaller or no wins (Gardner & Oswald, 2007). Similarly, another study of lottery winners found that wins of over £500 had positive effects on mental health but also led to increases in smoking and social drinking (Apouey & Clark, 2015).

In regards to education, a British study controlling for fixed effects found causal effects for education on depression, with stronger effects for women and for people at greater risk of mental illness (Chevalier & Feinstein, 2006). However, a study of adult identical twins showed that within-twin differences in education did not explain differences in depression,

panic-phobia, and somatization, suggesting that the association between education and mental health may be a product of confounding variables (Halpern-Manners et al., 2016). Similarly, a German study using instrumental variable analysis found no evidence of causal protective effects for education (Dahmann & Schnitzlein, 2019). The links between indicators of SES and mental health are therefore much less evident when adjusting for unobserved confounders.

In Canada, few studies have used longitudinal data to investigate the causal links between socio-economic resources and mental health. Using fixed-effects models applied to three waves of the Canadian Work, Stress and Health Survey, researchers found that subjective financial strain was associated with anger and psychological distress, but low income was not significantly associated with these outcomes (Koltai et al., 2018). Using a longitudinal cohort of the Canadian National Population Health Survey, Wang et al. (2010) found that low education and financial strain were associated with higher odds of a major depressive episode (MDE) among employed individuals without previous occurrences of MDE. However, among the unemployed in the previous 12 months, low education was associated with lower odds of MDE (Wang et al., 2010).

In this paper, we applied fixed-effects models to data from the Longitudinal and International Study of Adults linked to family income data from the Canada Revenue Agency. The application of this statistical method to a large, nationally representative longitudinal dataset with valid and precise measures of income is rare, especially in the Canadian context, and can offer important insights on the potentially causal nature of associations between socio-economic resources and mental health.

Methods

We used data from the three available waves of the Longitudinal and International Study of Adults (LISA) collected by Statistics Canada in 2012, 2014, and 2016. The survey data was linked to T1 Family Files from Canada Revenue Agency. The LISA provides longitudinal information on labour market, education, skills, family, health, and— from the second wave onward—mental health. The LISA survey used a stratified multi-stage, multi-phase design; a detailed description of the survey methodology is available on Statistics Canada's webpage (Statistics Canada, 2016). 72.0% of randomly selected households (11,458 out of 15,907) participated in the first wave of the study. The person-level

response rate within households was 89.0%, producing an initial sample of approximately 23,900 individuals. Given our focus on adult mental health, we restricted the sample to participants aged 18 and older in wave 1 and who were present in all three waves (approximately 6500 women and 5600 men). A previous study indicated that respondents who dropped out were more likely to be young, single, and less educated in comparison with those who remained present in all three LISA waves, with an attrition rate of 36.8% (Veenstra & Vanzella-Yang, 2020b). Statistics Canada's confidentiality policies when using LISA data linked to Canada Revenue Agency income data prevents us from providing unweighted frequency distributions of the variables and exact sample sizes for the analyses used in our study. We provided weighted descriptive statistics for reviewer use only. The study was approved by the Behavioural Research Board at the University of British Columbia.

The dependent variable for our analyses was the Kessler (K-10) scale of psychological distress (Andrews & Slade, 2001; Kessler et al., 2003). The Kessler 10-item scale was created from respondents' responses to questions asking how often during the last 30 days they felt (i) tired out for no good reason, (ii) nervous, (iii) so nervous that nothing could calm them down, (iv) hopeless, (v) restless or fidgety, (vi) so restless they could not sit still, (vii) depressed, (viii) that everything was an effort, (ix) that nothing could cheer them up, and (x) worthless. The response categories for each item were 1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time. The Kessler scale variable ranged from 10 to 50 with higher scores representing more psychological distress. The primary independent variables were Census family income in dollars¹ and postsecondary educational attainment. We adjusted family income for inflation and then divided it by 10,000 for easier interpretation. Education was coded as 0 = high school or less and 1 = postsecondary degree (certificate, diploma, bachelor, or postgraduate degree).

We executed a series of OLS first difference fixed-effects models (also known as the "change score" method). Fixed-effects regression models enable researchers "to control for variables that have not or cannot be measured" (Allison, 2009), such as genetics, personality, and mental health in early life, which could be important confounders of SES-related mental health inequalities. With three-wave panel data, researchers recommend running contemporaneous and lagged models (Vaisey & Miles, 2017). Our contemporaneous models explored how changes in family income and educational attainment from 2014 to 2016 were associated with

changes in Kessler scores from 2014 to 2016 (waves 2 to 3). Our lagged models explored how changes in family income and educational attainment from 2012 to 2014 (waves 1 to 2) were associated with changes in Kessler scores from 2014 to 2016 (waves 2 to 3).

Given that adults on average complete their postsecondary education in their mid-twenties (Statistics Canada, 2017), we ran separate analyses for younger adults (ages 18 to 32) and relatively older adults (ages above 32) to assess the effects of obtaining a postsecondary degree in normative and non-normative timing. Moreover, there is evidence that the relative importance of SES indicators for mental health varies by sex (Kessler, 1982), and it is now relatively common for analyses in health research to be stratified by sex, including ones that use fixed-effects models (Frijters et al., 2005; Zimmerman & Katon, 2005). Thus, we ran our models for women and men separately. In an additional analysis, we stratified our models by marital status, investigating the effects of socio-economic resources among adults aged 18 and over who remained married or in a common-law union and among those who remained single/never married throughout the three waves of the LISA.

The control variables for these analyses were the time-varying variables age in years, marital status, household size, and labour market status. Marital status distinguished between married or common-law couples with or without children and everyone else (lone-parent families and people living alone). Family size referred to the number of people in the Census family. Labour market status distinguished between respondents currently working in the labour market and everyone else. To account for the sampling design of the LISA, we applied longitudinal person weights provided by Statistics Canada. These weights were designed to make the sample representative of the Census population in the ten provinces in 2012 (Statistics Canada, 2016). Analyses were conducted using Stata 16 in the Research Data Centre at UBC-Vancouver.

Results

Table 1 presents results for contemporaneous and lagged models among younger adults (ages 18–32). We found no significant evidence that changes in socio-economic resources from 2014 to 2016 corresponded to changes in psychological distress within this same period. However, we found that obtaining a postsecondary degree between 2012 and 2014 corresponded to a lagged decrease in psychological distress approximately two years later, but only among women ($b = -1.97$; 95% CI = $-3.53, -0.42$). Among men in this age group, obtaining a postsecondary degree did not correspond to lagged changes in psychological distress ($b = -0.13$; 95% CI = $-3.73, 3.48$).

¹ The T1 Family File contains income data for Census families. A Census family is comprised of a married couple with or without children of either or both spouses, a common-law couple with or without children of either or both partners, a lone parent living with at least one child, or a person living alone. Economic families and households can contain more than one Census family.

Table 1 Fixed-effects modelling of changes in Kessler score from 2014 to 2016 with changes in independent variables for adults ages 18–32 (weighted data)

	Women		Men	
	b	(95% CI)	b	(95% CI)
Contemporaneous (2014–2016)				
Family income in \$10,000s	0.02	−0.04, 0.09	−0.06	−0.21, 0.10
Postsecondary degree	−0.20	−1.51, 1.10	−0.30	−1.95, 1.35
Age in years	0.04	−1.42, 1.50	0.83	−0.34, 2.00
Marital status (married or common-law)	0.34	−0.94, 1.62	−0.37	−2.34, 1.59
Household size	−0.11	−0.61, 0.39	−0.00	−0.54, 0.54
Labour market status (employed)	0.69 [†]	−0.08, 1.45	−0.87	−2.02, 0.29
Survey year (reference = 2014)				
2016	0.18	−2.70, 3.07	−1.49	−3.74, 0.75
Lagged (2012–2014)				
Family income in \$10,000s	−0.02	−0.06, 0.02	0.06	−0.08, 0.19
Postsecondary degree	−1.97*	−3.53, −0.42	−0.13	−3.73, 3.48
Age in years	−0.14	−1.06, 0.79	0.52	−0.70, 1.73
Marital status (married or common-law)	0.21	−0.76, 1.18	−0.27	−2.48, 1.94
Household size	−0.23	−0.63, 0.17	−0.20	−0.79, 0.40
Labour market status (employed)	−0.34	−1.08, 0.40	0.19	−1.07, 1.45
Survey year (reference = 2014)				
2016	0.59	−1.41, 2.59	−1.00	−3.49, 1.50

[†] $p < 0.10$

* $p < 0.05$

Table 2 presents results for contemporaneous and lagged models among relatively older adults (over the age of 32). Again, we found no significant evidence that changes in socio-economic resources corresponded to contemporaneous changes in psychological distress. We found that obtaining a postsecondary degree corresponded to a lagged decrease in psychological distress approximately two years later, but only among men ($b = -1.86$, 95% CI = $-3.57, -0.15$). Among women in this age group, obtaining a postsecondary degree did not correspond to lagged changes in psychological distress ($b = 0.71$, 95% CI = $-1.29, 2.71$). When it comes to improving psychological distress, it therefore appears that obtaining a postsecondary degree matters for women when the degree is obtained in an age-normative timing, whereas it matters for men when it is obtained in non-age-normative timing.

Table 3 presents the results for contemporaneous and lagged models stratified by marital status. Interestingly, we found weak evidence that a \$10,000 increase in family income corresponded to a contemporaneous *increase* in psychological distress among those who remained single/never married throughout the three waves ($b = 0.05$; 95% CI = $-0.00, 0.10$; $p < 0.10$). It may be that efforts to improve one's financial circumstances result in poorer mental health for those with less social support. The size of the effect, however, was small. Obtaining a postsecondary degree appears to have a lagged

effect among those who remained married throughout the three waves ($b = -2.29$; 95% CI = $-4.37, -0.21$), further supporting the notion that social support is a factor here. For those who remained single/never married throughout the three waves, obtaining a postsecondary degree did not correspond to lagged changes in psychological distress ($b = 0.49$; 95% CI = $-1.30, 2.28$). Additional analyses stratified by marital status and gender (results not shown) suggested that the effect of obtaining a postsecondary degree was only significant among women who remained married throughout the three waves ($b = -2.84$; 95% CI = $-5.16, -0.53$; $p < 0.05$).

Discussion

We found no strong evidence that changes in family income corresponded to changes in psychological distress within the time periods analyzed. Our findings for income are consistent with a recent study that also uses LISA data to investigate effects of family income on self-rated health during a similar time period (Veenstra & Vanzella-Yang, 2020b). It is possible that the processes linking income to lower levels of distress take more time, as appears to be the case with physical health (Berry, 2007). Executing fixed-effects models that go farther back in time could illuminate

Table 2 Fixed-effects modelling of changes in Kessler score from 2014 to 2016 with changes in independent variables for adults over the age of 32 (weighted data)

	Women		Men	
	b	(95% CI)	b	(95% CI)
Contemporaneous (2014–2016)				
Family income in \$10,000s	0.00	−0.01, 0.01	−0.00	−0.02, 0.01
Postsecondary degree	0.51	−0.42, 1.43	0.04	−1.32, 1.40
Age in years	−0.15	−0.89, 0.58	−0.27*	−0.51, −0.02
Marital status (married or common-law)	−0.90*	−1.77, −0.04	0.13	−0.82, 1.08
Household size	0.24	−0.11, 0.58	−0.46*	−0.92, −0.00
Labour market status (employed)	−0.43	−0.97, 0.11	−0.58*	−1.08, −0.09
Survey year (reference = 2014)				
2016	0.44	−1.02, 1.89	0.39	−0.10, 0.88
Lagged (2012–2014)				
Family income in \$10,000s	−0.01	−0.02, 0.01	−0.00	−0.02, 0.02
Postsecondary degree	0.71	−1.29, 2.71	−1.86*	−3.57, −0.15
Age in years	−0.06	−0.26, 0.13	0.06	−0.40, 0.53
Marital status (married or common-law)	0.65	−0.18, 1.48	0.46	−0.15, 1.07
Household size	0.11	−0.22, 0.44	0.06	−0.20, 0.32
Labour market status (employed)	0.39 [†]	−0.04, 0.81	0.41	−0.06, 0.88
Survey year (reference = 2014)				
2016	0.30	−1.13, 0.73	−0.22	−1.22, 0.77

[†] $p < 0.10$

* $p < 0.05$

Table 3 Fixed-effects modelling of changes in Kessler score from 2014 to 2016 with changes in independent variables for adults who remained married or single throughout the three waves (weighted data)

	Married		Single	
	b	(95% CI)	b	(95% CI)
Contemporaneous (2014–2016)				
Family income in \$10,000s	−0.00	−0.01, 0.01	0.05 [†]	−0.00, 0.10
Postsecondary degree	0.24	−0.49, 0.96	−0.19	−1.21, 0.84
Age in years	−0.36	−0.91, 0.20	−0.26	−0.49, 0.04
Household size	−0.08	−0.34, 0.19	−0.48 [†]	−0.96, 0.00
Labour market status (employed)	−0.27	−0.65, 0.10	−0.28	−1.11, 0.56
Survey year (reference = 2014)				
2016	0.72	−0.38, 1.81	0.50	−0.04, 1.05
Lagged (2012–2014)				
Family income in \$10,000s	−0.01	−0.02, 0.01	−0.03	−0.09, 0.03
Postsecondary degree	−2.29*	−4.37, −0.21	0.49	−1.30, 2.28
Age in years	−0.08	−0.34, 0.18	0.52	−0.36, 1.41
Household size	0.18	−0.05, 0.42	−0.14	−0.61, 0.34
Labour market status (employed)	0.07	−0.25, 0.38	0.12	−0.74, 0.98
Survey year (reference = 2014)				
2016	0.22	−0.32, 0.76	−1.06	−2.88, 0.76

[†] $p < 0.10$

* $p < 0.05$

whether similarly long lags are also observable for causal effects of family income on mental health. Our non-significant results for family income are also consistent with previous studies using fixed-effects models to assess causality in associations between income and mental health (Chin, 2010; Zimmerman & Katon, 2005) but inconsistent with studies using instrumental variable analysis to the same end (Apouey & Clark, 2015; Gardner & Oswald, 2007).

However, our findings suggested that obtaining a postsecondary degree may have a lagged effect on mental health. Obtaining a postsecondary degree corresponded to reductions in psychological distress approximately two years later among younger women (ages 18–32) and relatively older men (ages over 32). Education may provide a greater feeling of control over one's life, and a sense of mastery arguably mediates the association between education and psychological distress (Dalgard et al., 2007). In addition, education may provide access to valuable social networks, which in turn are associated with positive mental health outcomes (Nieminen et al., 2013). Overall, the attainment of an education credential is a prestigious milestone that signals the accomplishment of a culturally legitimized goal (Bourdieu & Passeron, 1990).

Importantly, our findings suggest that the timing of postsecondary completion seems to matter for psychological distress, with women benefiting more from a degree when it is attained earlier in life in an age-normative manner and men benefiting more from a degree when it is attained later in life in a non-age-normative manner. This likely reflects the gendered nature of certain life course transitions (e.g., Baxter et al., 2008); understanding why education reduces psychological distress earlier for women and later for men is an important topic for future research. Furthermore, because the effects of postsecondary education on distress were strongest among people who remained married throughout the three waves, future studies should investigate in more detail how the positive effects of education may be related to levels of social support and other related life circumstances.

The discrepancy in the findings for family income and education resonates with recent calls to avoid overly simplistic measures of SES and for more theory on how SES-related resources are deployed in the production of health outcomes (Mrig, 2020). Indeed, our findings are consistent with the idea that thinking in terms of “socio-economic resources” may be more analytically useful than the more generic concept of “socio-economic status” typically used in public health research (Veenstra, 2017).

Our study has important strengths and limitations. The availability of longitudinal survey data linked with family income data that are valid and precise to the dollar is quite uncommon and, in the Canadian context, unprecedented when

investigating the causal nature of associations between socio-economic resources and mental health. We focused on one important dimension of income (absolute income), arguably the strongest predictor of financial distress (Litwin & Sapir, 2009), but future studies should investigate relative income or income adequacy which may also be impactful for mental health.

The application of fixed-effects models allowed us to control for all time-invariant confounders with time-invariant effects. However, we were not able to control for time-invariant confounders with time-varying effects, and we controlled for some but not all time-varying confounders. In addition, this longitudinal survey, like most others of its kind, suffers from attrition. Statistics Canada makes every effort possible to mitigate issues associated with non-participation (Statistics Canada, 2016), but this may still potentially bias the associations studied, as the onset of mental illness has been shown to be associated with non-participation (Bergman et al., 2010; Haapea et al., 2007).

Conclusion

The attainment of a postsecondary degree likely reduces psychological distress a few years later for women ages 18 to 32 and men over the age of 32. Our finding that completion of postsecondary education temporally preceded changes in psychological distress is consistent with a causal relationship between completion of postsecondary education and reductions in distress. This finding echoes the idea that “education policy is health policy” (Ross & Mirowsky, 2011, p. 597), but also indicates that the life course timing for completing this socially meaningful milestone is relevant and differs by gender. Although we did not find significant effects for family income on psychological distress, it is possible that the processes linking income to positive mental health have lags that are beyond the time period covered by this study, as suggested by previous research on physical health. Future research should, when possible, investigate longer time frames as well as other dimensions of income, such as relative income or perceived income adequacy, which may have significant causal impacts on mental health.

Contributions to knowledge

What does this study add to existing knowledge?

- Most research examining associations between socio-economic status and mental health in Canada is cross-sectional. These studies only control for a limited number

of possible confounders and cannot establish causal directionality.

- In our study, we examine the association between socio-economic resources and psychological distress using nationally representative longitudinal data and methods that allow us to control for all time-invariant confounders with time-invariant effects (as well as some time-varying confounders).

What are the key implications for public health interventions, practice, or policy?

- We found that completing postsecondary education corresponded to reductions in psychological distress a few years later for women ages 18 to 32 and men over the age of 32.
- Our findings are consistent with a causal relationship between the completion of postsecondary education and reductions in distress, echoing the notion that “education policy is health policy” (Ross & Mirowsky, 2011).
- Importantly, our results also suggest that the life course timing for obtaining a postsecondary degree is relevant and differs by gender.

Author contributions AVY and GV: conceptualization, methodology, formal analysis, data curation. AVY: writing of original draft; funding acquisition. GV: review and editing; funding acquisition.

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Availability of data and materials Data cannot be shared publicly because of Statistics Canada’s confidentiality policies when using survey data linked to Canada Revenue Agency income data. Data are available from the Research Data Centres in 32 universities across Canada for researchers who meet the criteria for access to confidential data (<https://www.statcan.gc.ca/eng/microdata/data-centres>). The analyses for this study were conducted in the Research Data Centre at UBC-Vancouver.

Code availability Syntax files require vetting by RDC staff.

Declarations

Ethics approval The study was approved by the Behavioural Research Board at the University of British Columbia (H18-02461). Clearance to access the raw data was granted by Statistics Canada.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

Disclaimer The funders had no role in the design of the study, in the collection, analysis, and interpretation of the data, and in the writing of the manuscript.

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