# The effect of mental health on social capital: An instrumental variable analysis

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A B S T R A C T

Although a large body of literature has examined the effect of social capital on health and theoretical models suggest a reciprocal relationship between the two variables, there are relatively few studies that have investigated the effect of mental health on social capital. This paper evaluates the impact of mental health on the stock of social capital using data from the cross-sectional 2012 (N = 21,844) and 2002 (N = 31,089) Canadian Community Health Survey – Mental Health editions. Mental health was measured retrospectively as self-rated mental health, past year mental health conditions, and past 30-day psychological distress. Given the reciprocal relationship, we used an instrumental variable approach with family history of mental health problems as the instrument and examined forms of social capital – sense of belonging and workplace social support – that are largely measures of social capital provided by non-family members in the community and workplace. The analysis suggests there are large and significant associations between measures of mental health and both outcomes, which persist in the instrumental variable analyses. These findings highlight the urgent need for policy makers to implement greater prevention and treatment of poor mental health, and provide greater support for individuals with poor mental health so they can build and maintain their social capital.

## 1. Introduction

Social capital reflects resources available within social networks, which are derived from past investments (Lin, 2017). In a seminal paper, Granovetter (1973) developed the notion of strong and weak ties, each of which can provide different types of resources to an individual such as useful information (Granovetter, 1973). Grannovetter theorized that the strength of the connection between two network members, consisting of the level of time, emotional intensity and reciprocation involved in the relationship, is inversely related to the social capital it provides (Granovetter, 1973). Given that weak ties such as acquaintances, coworkers and neighbours are less similar in their characteristics to an individual than strong ties such as family members and close friends, Granovetter noted weak ties are able to provide more useful job information and provide greater access to other social networks (Granovetter, 1973).

A large body of research has examined how different types of social capital affect health (Ehsan and De Silva, 2015; Rodgers et al., 2019); economic theory has also increasingly recognized social capital as important in the production of health (Laporte, 2014). However, economic theory also predicts that poor health results in lower social capital since it reduces the ability of individuals to create social capital (Laporte, 2014). Despite acknowledgment that this simultaneous relationship may exist, most studies have largely relied on cross-sectional data (Ehsan and De Silva, 2015; Rodgers et al., 2019) and relatively few studies have examined the effect of health or mental health on social capital. This is an important gap since one study using longitudinal data found the effects of health on social capital to be much larger than the effects of social capital on health (Sirven and Debrand, 2012).

There are two major methodological challenges to estimating the causal effect of mental health on social capital. First is the possibility of reciprocal causation (Ehsan and De Silva, 2015), which violates a key assumption in most regression models of the independent variable not being correlated with the error term, potentially resulting in biased coefficients. The instrumental variable (IV) approach is a commonly used statistical approach in applied economics and social science more broadly to estimate causal effects even in the presence of reciprocal

causality, as long as a valid IV can be found (Angrist et al., 1996). Second is measurement error given that poor mental health may result in pessimistic assessments of social capital (Cohen et al., 1988).

The objective of this study is to examine the causal effect of mental health on weak tie social capital as measured by sense of belonging and workplace social support by using an IV approach to address reciprocal causation. The study also aims to investigate several mental health measures reflecting different periods of time to address the possibility of measurement error.

## 2. Literature review: the effect of mental health on social capital

A number of studies in the non-economics literature have examined the bidirectional relationship between measures of mental health and social capital, showing a negative impact. However, these studies are typically limited in two key ways. First, studies frequently have included mental health measured through symptom scales that reflect short-term (i.e., typically past one to four weeks) depressive or other mental health symptoms (Hakulinen et al., 2016; Saeri et al., 2018; Yu et al., 2015) rather than psychiatric diagnoses (Patten et al., 2010) that better reflect the chronic nature of mental health disorders. The association between short-term depressive symptoms scales and social capital may also reflect short-term differences in negative perception as demonstrated by a study that found reduced perception of social capital due to experimentally induced depressive symptoms (Cohen et al., 1988). Second, most studies are limited by using methods sensitive to omitted variable bias. For example, the most common approach used has been the cross-lagged panel model, which includes lagged values of the independent and dependent variables (Kaniasty and Norris, 2008; Landstedt et al., 2016; Li and Zhang, 2015; Saeri et al., 2018; Yu et al., 2015). However, without using an IV approach, omitted variables may continue to be correlated with both the dependent and the lagged variables, which leads to biased estimates (Hamaker et al., 2015).

Only a handful of studies in the economics literature have used causal econometric methods that can address reciprocal causation to study the causal effect of mental health on social capital. Sirven and Debrand (2012) assessed the reciprocal effects of health and social capital in a panel sample of older European adults (Sirven and Debrand, 2012). Health was measured as depressive symptoms over the last month, self-rated health, and several measures of physical health, while social capital was defined as a binary indicator of any social participation including voluntary/charity work, training course, sport/social club, religious organisation, or political/community organisation (Sirven and Debrand, 2012). With the use of recursive dynamic probit models with a Mundlak specification, Sirven and Debrand (2012) found the effect of all health variables on social capital to be greater than the effect of social capital on health (Sirven and Debrand, 2012).

Corman et al. (2014) examined the effect of post-partum depression on social capital investments in a sample of American mothers (Corman et al., 2014). Social participation (i.e., organizational/group participation) was measured at approximately three years post-partum while regular religious attendance (i.e., at least several times per month) was measured one and three-years post-partum (Corman et al., 2014). Using a family history of depressive symptoms among the respondent's parents as an IV in bivariate probit models, Corman et al. (2014) found no effects of post-partum depression on either type of social capital (Corman et al., 2014).

Using data from Australia, Ding et al. (2015) investigated the bidirectional relationship between past month mental well-being measured with the SF-36 and community participation (Ding et al., 2015). Community participation was separately modeled as informal social connectedness (i.e., making contact with friends, relatives and neighbours) and civic engagement (i.e., religious participation, volunteering and attending community events) (Ding et al., 2015). Using a longitudinal fixed effects regression with a one-year lag to account for simultaneity, Ding et al. (2015) found a positive bidirectional relationship

between mental well being and informal social connectedness; they did not find a relationship between mental well being and civic engagement (Ding et al., 2015).

In sum, a limited number of studies have used econometric methods, most of which found significant effects of mental health on social participation. However, these studies largely relied on short-term symptoms scales or measures of depression, which may have influenced the measured level of social capital in part due to differences in perception (Cohen et al., 1988). Furthermore, this literature has focused on measures of social participation, which represents investments into social capital (Laporte, 2014). Therefore, further research is necessary to investigate the effect of longer-term multi-dimensional measures of mental health on stock measures of social capital.

## 3. Theoretical model: the demand for social capital and health

This study uses Grossman (1972) as a starting point but includes stocks of both physical health ($PH_t$) and mental health ($MH_t$) and social capital as an input in health production (Grossman, 1972; Laporte, 2014). The stock of health reflects an individual's overall level of health, which depreciates over time (Grossman, 1972). The depreciation rate for physical health ($\delta_{PH}$) rises with increasing age, risky health behaviours ($RB_t$) (Grossman, 1972), and poor mental health. In contrast, the depreciation rate of mental health ($\delta_{MH}$) is heavily influenced by and increases with experiences of stressful or traumatic conditions such as child abuse, poverty, or poor physical health. The state of health in a given period (t) is a function of the stock of physical and mental health in the last period (t-1), the depreciation rate ($\delta$), and the health production function (g) (Laporte, 2014). The health production function includes inputs such as medical care ($M_{t-1}$), healthy behaviours ($HB_{t-1}$), and social capital withdrawals ($v_{t-1}$) (i.e., individuals use up their social capital to produce health) (Laporte, 2014). This is represented by the following equations (Laporte, 2014):

$$PH_t = (1 - \delta PH)PH_{t-1} + g(M_{t-1}, HB_{t-1}, V_{t-1}|PH_{t-1})$$

$$MH_t = (1 - \delta MH)MH_{t-1} + g(M_{t-1}, HB_{t-1}HB_{t-1}V_{t-1}|MH_{t-1})$$

Laporte conceptualizes social capital as a stock of capital variable ($SV_t$) reflecting accumulated resources that provides a flow of market (e. g., job information) and non-market (i.e., support that improves health) returns (Laporte, 2014). Investments add to the stock of social capital through different forms of social participation measured in hours of contribution ($h_{t-1}$), while withdrawals ($v_{t-1}$) deplete social capital (Laporte, 2014). The stock of social capital depreciates over time with rate γ (Laporte, 2014), influenced by factors such as child abuse (Sheikh, 2018). Poor health decreases the efficiency of social capital production ($\theta(PH_{t-1}, MH_{t-1})$) and results in greater withdrawals ($v_{t-1}$) (Laporte, 2014). This is represented by the following equation (Laporte, 2014):

$$Sv_t = (1 - \gamma(MH_t))Sv_{t-1} + \theta(PH_{t-1}, MH_{t-1})h_{t-1} - V_{t-1}$$

Poor mental health may further decrease social capital investment by increasing the opportunity costs of socializing since a lack of pleasure, termed anhedonia, and social withdrawal are common symptoms across numerous mental illnesses (Rubin and Burgess, 2015). Poor mental health may also increase γ, since individuals with mental illnesses experience discrimination associated with lower levels of social capital ($\gamma(MH_t)$) (Webber et al., 2014).

Laporte's model highlights the reciprocal relationship between mental health and social capital, which will be addressed by the use of IV methods to estimate the causal effect of mental health on social capital.

## 4. Materials and methods

### 4.1. Data

This study included a secondary analysis of Statistics Canada's cross-

sectional 2012 Canadian Community Health Survey – Mental Health (CCHS-MH), which sampled individuals aged 15 years and older from the 10 provinces (Statistics Canada, 2013). Excluded from the survey's sampling frame were individuals living on Indigenous reserves or settlements, homeless individuals, full-time members of the Canadian armed forces, and those living in prisons or long-term care institutions (Statistics Canada, 2013). The overall response rate was 68.9% (Statistics Canada, 2013).

Of an initial sample of 25,113 respondents, 21,844 and 11,373 were included in the main analysis sample for sense of belonging and workplace social support, respectively. Individuals with missing data were excluded from the analysis. Of the individuals who were dropped in the sense of belonging analyses, 2024 were excluded as they were ages 15–19 and had not been asked the questions on child abuse. In addition to the exclusion of individuals aged 15–19, the workplace social support analyses also excluded 12,093 individuals who were not asked the required questions, which included respondents older than age 75, those who did not work in the past 12 months, or respondents without co-workers/supervisors. Missing data on primary independent and dependent variables was small (<1% for each variable). Study variables were presented separately for individuals with and without missing data in Table 1. Mental health and social capital variables were generally similar across both groups with greatest differences found for education and age, with individuals with missing data more likely be older and less educated.

### 4.2. Mental health

Mental health was assessed using retrospective self-reported assessments. Self-rated mental health (SRMH) was assessed using the question "In general, would you say your mental health is: excellent, very good, good, fair or poor?". SRMH is most strongly associated with past month mental illnesses but it is also highly associated with past year and to a lesser extent lifetime mental illnesses (Mawani and Gilmour, 2010).

The total number of past-year mental health and addictions (MHA) conditions was assessed using the World Health Organisation's Composite International Diagnostic Interview (CIDI) 3.0. The CIDI 3.0 is a validated structured diagnostic interview that assesses the occurrence over an individual's lifetime and the past year of episodes of select mental illnesses diagnosed according to the Diagnosis and Statistical Manual (DSM) IV (Statistics Canada, 2014). This includes unipolar depression, bipolar depression consisting of bipolar 1 with severe manias and bipolar 2 with less severe manias termed hypomanias, generalized anxiety disorder (GAD), and substance abuse and dependence conditions including alcohol, marijuana, and all other substances combined.

The Kessler's six item Psychological Distress scale (K6) (Kessler et al., 2003) assesses past 30-day depression and anxiety symptoms and ranges from 0 to 24, with higher scores reflecting greater psychological distress. A cut-off of 13 reflects serious mental illness (i.e., any non-substance 12-month DSM-IV disorder resulting in serious impairment) (Kessler et al., 2003).

### 4.3. Social capital

Sense of belonging to a local community, henceforth referred to as "sense of belonging", and workplace social support both closely approximate the concept of a stock of capital as a source of social resources and reflect weak ties (Carpiano and Hystad, 2011; Granovetter, 1973). Sense of belonging was ascertained by: "How would you describe your sense of belonging to your local community?: Very strong, somewhat strong, somewhat weak, or very weak". Sense of belonging is a proxy for the stock of social capital available through neighbours and is largely independent of family members (Carpiano and Hystad, 2011).

Workplace social support was measured using the social support section of the abbreviated version of the Job Content Questionnaire

**Table 1**

Variables for individuals age 20 and older who are missing/not missing study variables among the full sample (i.e. individuals included in sense of belonging analyses).

| | Not missing data | | Missing data | | % Difference[e] |
|---|---|---|---|---|---|
| | Frequency[d] | % | Frequency[d] | % | |
| Ages | | | | | |
| 20-24 | 1928 | 8.8 | 61 | 4.9 | −44.3 |
| 25–29 | 1554 | 7.1 | 63 | 5.1 | −28.2 |
| 30–34 | 1803 | 8.3 | 66 | 5.3 | −36.1 |
| 35–39 | 1647 | 7.5 | 81 | 6.5 | −13.3 |
| 40–44 | 1618 | 7.4 | 73 | 5.9 | −20.3 |
| 45–49 | 1600 | 7.3 | 70 | 5.6 | −23.3 |
| 50–54 | 1863 | 8.5 | 93 | 7.5 | −11.8 |
| 55–59 | 2107 | 9.6 | 138 | 11.1 | 15.6 |
| 60–64 | 2096 | 9.6 | 110 | 8.8 | −8.3 |
| 65–69 | 1797 | 8.2 | 121 | 9.7 | 18.3 |
| 70–74 | 1327 | 6.1 | 105 | 8.4 | 37.7 |
| 75–79 | 1087 | 5.0 | 97 | 7.8 | 56 |
| 80+ | 1417 | 6.5 | 166 | 13.3 | 104.6 |
| Male | 9778 | 44.8 | 595 | 47.8 | 6.7 |
| Non-Immigrant | 18,048 | 82.6 | 860 | 77.5 | −6.2 |
| Immigrant in Canada for 0–9 years | 1006 | 4.6 | 57 | 5.2 | 13 |
| Immigrant in Canada for 10–20 years | 656 | 3.0 | 16 | 1.5 | −50 |
| Immigrant in Canada for ≥20 years | 2134 | 9.8 | 169 | 15.3 | 56.1 |
| Non-white ethnicity | 3386 | 15.5 | 237 | 20.6 | 32.9 |
| Less than secondary education | 3789 | 17.3 | 324 | 28.5 | 64.7 |
| Secondary education | 3521 | 16.1 | 152 | 13.4 | −16.8 |
| Some post-secondary education | 1247 | 5.7 | 67 | 5.9 | 3.5 |
| Post-secondary education | 13,287 | 60.8 | 594 | 52.2 | −14.1 |
| Single Detached | 13,630 | 62.4 | 673 | 54.3 | −13 |
| Apartment | 4810 | 22.0 | 375 | 30.2 | 37.3 |
| Other Housing | 3404 | 15.6 | 192 | 15.5 | −0.6 |
| Income Decile | 21,844 | 5.3 | 1235 | 4.3 | −18.9 |
| Physical Health Conditions Count | 21,844 | 0.9 | 1245 | 1.1 | 22.2 |
| Physical Abuse | 5696 | 26.1 | 247 | 30.1 | 15.3 |
| Sex Abuse | 2624 | 12.0 | 106 | 12.5 | 4.2 |
| Witness Intimate Partner Violence | 1781 | 8.2 | 86 | 9.2 | 12.2 |
| Workplace social support | 11,330 | 8.4 | 383 | 8.3 | −1.2 |
| Sense of Belonging | 21,844 | 1.7 | 1072 | 1.7 | 0 |
| MHA[a] Count Past Year | 21,844 | 0.1 | 1245 | 0.2 | 100 |
| SRMH[b] | 21,844 | 1.3 | 1220 | 1.4 | 7.7 |
| K6[c] | 21,844 | 3.0 | 1088 | 3.2 | 6.7 |
| Family MHA[a] Number | 21,844 | 0.8 | 960 | 0.5 | −37.5 |
| Family Treatment Life | 7655 | 35.0 | 281 | 27.6 | −21.1 |
| Family Treatment Past Year | 3942 | 18.1 | 136 | 13.6 | −24.9 |
| Family Police Interaction Past Year | 463 | 2.1 | 12 | 1.0 | −52.4 |

[a] MHA = mental health and addiction conditions.
[b] SRMH = self-rated mental health.
[c] K6 = Kessler six item psychological distress scale.
[d] Frequency of numerator for binary variables and total frequency for non-binary variables.
[e] % Difference comparing Not missing data compared to Missing data (i.e., $-100 \times$ ((% for Not missing data - % for Missing data)/% for Not missing data)).

(JCQ) that assessed six psychosocial dimensions of the respondent's main job over the past 12 months (Karasek et al., 1998): decision latitude, decision authority, psychological demands, physical exertion, job insecurity, and social support. The social support component assessed hostility/conflict at work, helpfulness of coworkers, and helpfulness of

supervisors (Karasek et al., 1998). Each question had response options ranging from Strongly Agree (0) to Strongly Disagree (4) (hostility/conflict question is reverse coded compared to other two questions). The total social support score was derived by summing the three individual questions and ranged from 0 to 12, with 12 being the lowest possible social support (Statistics Canada, 2014). We reversed this order so that a greater score reflected more workplace social support in order to match the direction of sense of belonging.

### 4.4. Covariates

We controlled for socio-demographic, physical health and child abuse variables to reduce the likelihood of any direct effect of the IVs on the dependent variable. Age was included as five-year intervals. Immigration status was coded as non-immigrant or immigrant and immigrant categories were defined by length of stay: 0–9, 10–19, and ≥20 years in Canada. Race was measured as white or non-white racial minority. Education was measured as less than secondary education, secondary school education, some post-secondary education, and completed post-secondary education. Household income deciles were adjusted for household size and community size (Statistics Canada, 2014). We included all physical health conditions including asthma, arthritis, high blood pressure, migraine headaches, chronic bronchitis, emphysema, or chronic obstructive pulmonary disease, diabetes, heart disease, cancer, and stroke. We did not include chronic fatigue syndrome or multiple chemical sensitivities given high levels of comorbidity with psychiatric conditions (Afari and Buchwald, 2003; Das-Munshi et al., 2007). Housing type was assessed as single detached house, living in an apartment, or other, which included double, row or terraces, duplex, mobile home or other types of housing, all of which had a low prevalence (i.e., between 0 and 5%). Child abuse experienced before the age of 16 was assessed using the validated Childhood Experiences of Violence Questionnaire, consisting of six questions on physical abuse, sexual abuse, and witnessing intimate partner violence, each assessed as never, 1–2 times, 3–5 times, 6–10 times or >10 times. Given that responses are highly correlated within a type of abuse (e.g., sexual activity and sexual touching), the presence or absence of three specific types of abuse, witnessing intimate partner violence, physical abuse, and sexual abuse, were classified according to the survey guidelines and past research (Afifi et al., 2014).

### 4.5. Analysis

Descriptive analyses included the examination of the mean of sense of belonging and workplace social support across levels of SRMH, number of MHA diagnoses, and K6 categorized as low (0–7), medium (8–12), and high (13–24).

We used family history of mental health conditions as an IV for individual mental health similar to several previous studies, which examined the impacts of mental health on labour market outcomes (Banerjee et al., 2017; Ettner et al., 1997; Kessler et al., 1999) and social capital investments (Corman et al., 2014). Four questions were used to ascertain the mental health history of the individual's family members: number of problems with their emotions, mental health or use of alcohol or drugs, lifetime treatment for an emotional or mental health problem, past 12 months treatment for an emotional or mental health problem, and past 12 months contact with the police for reasons related to family members problems with their emotions, mental health or use of alcohol or drugs. Family members included a spouse or partner, children, parents, parents-in-law, grandparents, brothers and sisters, cousins, aunts, uncles, nieces, or nephews, which were mentioned at the start of the section in the survey. The number of mental health conditions as phrased by the survey question may not necessarily be severe enough to be a diagnosable mental health condition as specified by the DSM-IV. However, mental health conditions that require treatment are likely diagnosable conditions given that a large majority of those who receive

mental health treatment (~82%) have either a past 12 month or lifetime disorder (Druss et al., 2007). Meanwhile, interactions with police are rare and although these interactions may occur with individuals with less severe mental health conditions such as depression, they are more prevalent among individuals with severe mental health conditions such as psychotic disorders (Lee et al., 2008). From these variables, the number of family members with a MHA condition and whether a family member received treatment during their lifetime for a mental health condition were chosen as the IVs. We did not use whether the individual had past year mental health treatment or police interactions among family members as IVs given the greater potential for the family member's mental health to affect the individual's social capital.

An IV analysis requires the instruments to be highly correlated with the endogenous variable and have no direct effects on the outcome conditional on the endogenous and exogenous variables (i.e., is uncorrelated with the error term), which is referred to as the exclusion restriction. The first assumption is very likely satisfied with the chosen instruments given that depression (Sullivan et al., 2000), anxiety disorders (Hettema et al., 2001), bipolar depression (Smoller and Finn, 2003), and addictions (Agrawal and Lynskey, 2008) and other mental illnesses run in families, and heritability is highly due to genetics. This was assessed by the F-statistic from the first stage regression examining the strength of the association between the instruments and the endogenous variable, which should be greater than 10 (Staiger and Stock, 1994).

The second assumption, the exclusion restriction, is plausible given that familial mental health problems are not expected to affect sense of belonging since it is largely social capital provided by neighbours and unrelated to family members. Carpiano & Hystad found an odds ratio of 6.73 for the association between sense of belonging and knowing over 10 people in their neighbourhood they can ask a favour from, and an odds ratio of 3.78 for knowing most people in their neighbourhood; however, the odds ratio for knowing over 10 close relatives in the city/local community was 1.24 (Carpiano and Hystad, 2011). A similar argument can be made for workplace social support as it is provided by coworkers and supervisors. To check the validity of this assumption, we ran Sargan's over-identifying test given the presence of multiple instruments.

All measures of mental health and social capital were examined in separate models. F-statistics and over-identification tests have not yet been programmed into available statistical packages for IV ordered probit or tobit models. Therefore, we followed the strategy of Chyi and Mao (2012) who modeled an ordinal happiness variable with ordinary least squares (OLS) and two stage least squares (TSLS) to examine the validity of the IVs and used IV ordered probit models as robustness checks (Chyi and Mao, 2012). We used the Stata command iv regress to conduct TSLS analysis, assess the F-statistic, and conduct the over-identification test. The cumulative mixed process (CMP) (Roodman, 2011) command was used to estimate the IV ordered probit models for sense of belonging and IV tobit models for workplace social support. Given the emphasis on causal regression modelling and not on generalizing the results to the Canadian population, survey weights were not used.

We conducted a number of sensitivity analyses to examine the robustness of our IV approach. First, to reduce the possibility of a direct effect of the instrument on the social capital variables, we further excluded from the sample individuals who had a family member who received mental health treatment or had interactions with the police for a mental health reason in the past year.

Spouses and children were included in the list of family members in the instrument questions about family member's mental health. However, given a potential reciprocal relationship between spousal/child and individual mental health, the IV analyses were re-estimated in two subsamples: individuals who were unattached and lived alone, and individuals aged 15–24 years. For the age 15–24 sample, we did not control for child abuse experiences since this variable is not available

and the longest immigrant length of stay category was coded as ≥10 years.

We conducted a sensitivity analysis using the number of mental health conditions with onset at ages 0–14 years and 15–19 years as IVs for adult mental health. Mental health conditions often have onset during childhood and are relapsing and remitting conditions (Burcusa and Iacono, 2007; Scholten et al., 2013). Therefore, it is very likely that there is a strong first stage relationship between the instrument and the endogenous variables. Regarding the exclusion restriction, it is very unlikely that childhood onset mental health would have any effect on relationship with neighbours or coworkers, beyond the individual's current mental health. Our use of this IV is consistent with several past studies that have used it to study the effect of mental health on labour market outcomes (Banerjee et al., 2017; Chatterji et al., 2007; Ettner et al., 1997). Although using an alternative IV may result in a different Local Average Treatment Effect (LATE) from the primary IV, this sensitivity analysis aims to test the robustness of an IV strategy and our conclusions in general. Given age of onset of mental health conditions was not available in the 2012 CCHS-MH, we conducted this sensitivity analysis using the 2002 CCHS-MH data. The 2002 CCHS-MH survey had an overall response rate of 77%, had very similar sampling criteria as the 2012 CCHS-MH survey, and the analysis sample was similarly limited to individuals aged 20 years and older (Statistics Canada, 2004). Of an initial sample of 36,984 respondents, 31,089 and 20,242 were included in the main analysis sample for sense of belonging and workplace social support, respectively. The mental health conditions measured included unipolar depression, mania, panic disorder, social phobia and agoraphobia. We did not use social phobia as it may induce an artificial association with social capital. The same variables were controlled for except for housing type and child abuse, which were not available. Other differences between the surveys included that in the 2002 CCHS-MH the highest length of stay category for immigrants was ≥10 years and only household income was available (0, 1–15000, 15000–29999, 30000–49999, 50000–79999, and 80000+).

A sensitivity analysis examined a longer-term measure of mental health as measured by the lifetime number of mental health conditions among individuals with no past year mental health conditions.

Finally, given possible violations of the exclusion restriction, we conducted a sensitivity analysis using the approach developed by Nevo and Rosen (2012) which applies in the case of "imperfect IVs" (Clarke and Matta, 2018; Nevo and Rosen, 2012). This method replaces the strict assumption of no correlation between the instrument and the error term with a weaker set of assumptions: 1) the instrument is associated with the error term in the same direction as the association between the endogenous variable and the error term, and 2) that the correlation between the endogenous variable and the error term is greater than the correlation between the instrument and the error term (i.e., that the instrument has less endogeneity than the endogenous variable). Using this approach, bounds can be generated on the IV parameters; two-sided bounds were generated with the use of two imperfect IVs using the Stata command imperfectiv (Clarke and Matta, 2018).

As this study relied on previously collected publicly available data that are de-identified (i.e., no names, no low-level geography, age aggregated to 5-year intervals), ethics review was not required.

## 5. Results

For all mental health variables, there were decreasing levels of sense of belonging and lower workplace social support with increasing mental health severity (Table 2).

All measures of mental health were significantly negatively associated with a sense of belonging in the ordinary least squares (OLS) analysis (all p < 0.001) (Table 3). Two stage least squares (TSLS) regression were significant (p ≤ 0.001) and coefficients were larger than the corresponding OLS model results except for K6, which were the same magnitude (Table 4). In all cases, the F-statistic was much greater than

**Table 2**
Proportion of categories for primary independent variables and mean level of workplace social support and sense of belonging across primary independent variables.

|  | %[d] | Workplace Social Support[e] | Sense of Belonging[f] |
|---|---|---|---|
| MHA[a] Count |  |  |  |
| 0 | 90.0 | 8.53 | 1.76 |
| 1 | 7.1 | 7.95 | 1.46 |
| 2 | 2.1 | 7.48 | 1.24 |
| 3-6 | 0.8 | 7.16 | 1.18 |
| SRMH[b] |  |  |  |
| Excellent | 22.7 | 8.93 | 1.90 |
| Very Good | 39.8 | 8.54 | 1.77 |
| Good | 28.4 | 8.15 | 1.63 |
| Fair | 7.7 | 7.66 | 1.39 |
| Poor | 1.4 | 6.79 | 1.01 |
| K6[c] |  |  |  |
| 0-7 | 89.8 | 8.55 | 1.77 |
| 8-12 | 7.4 | 7.47 | 1.44 |
| 13-24 | 2.7 | 7.25 | 1.09 |

[a] MHA = mental health and addiction conditions in the past year.
[b] SRMH = self-rated mental health.
[c] K6 = Kessler Psychological Distress Scale.
[d] Prevalences were calculated among full-sample, not workplace social support sample.
[e] Workplace social support ranges from 0 to 12 (high).
[f] Sense of belonging response options includes very weak (0), somewhat weak (1), somewhat strong (2), very strong (3).

**Table 3**
Associations between each measure of mental health and sense of belonging (N = 21,692) and workplace social support (N = 11,373) in Ordinary Least Squares models.

|  |  | β | LCL | UCL |
|---|---|---|---|---|
| Sense of Belonging | MHA Count Past Year[a,b] | −0.16 | −0.18 | −0.13 |
|  | SRMH[a,c] | −0.15 | −0.16 | −0.14 |
|  | K6[a,d] | −0.04 | −0.04 | −0.04 |
| Workplace Social Support | MHA Count Past Year[a,b] | −0.41 | −0.49 | −0.33 |
|  | SRMH[a,c] | −0.36 | −0.40 | −0.31 |
|  | K6[a,d] | −0.12 | −0.13 | −0.11 |

[a] Each row is a different regression with one of the measures of mental health.
[b] MHA = mental health and addiction conditions.
[c] SRMH = self-rated mental health.
[d] K6 = Kessler Psychological Distress Scale.

10 and the overidentification tests were not significant (p > 0.05). In sensitivity analyses, coefficients for mental health variables remained significant (p < 0.05) except for lifetime mental health conditions (p < 0.1); F-statistics were >10, and over-identification tests were not significant (p > 0.05). Coefficients for mental health variables were similar in magnitude to the main TSLS analyses in most sensitivity analyses. The model results remained significant as the bounds in the Nevo and Rosen (2012) sensitivity analysis did not cross zero.

All measures of mental health were significantly negatively associated with workplace social support in the OLS models (all p < 0.001) (Table 3). The TSLS regression results were significant (p < 0.001) and coefficients were larger than corresponding OLS results (Table 5). In all cases, the F-statistic was much greater than 10 and the over-identification tests were not significant (p > 0.05). In the sensitivity analyses, the coefficients for mental health variable remained significant (p < 0.05), F-statistics were >10, and over-identification tests were not significant (p > 0.05). Coefficients for mental health variables were similar in magnitude to the main TSLS analyses in most sensitivity analyses (Table 5). The Nevo and Rosen (2012) sensitivity analysis resulted in bounds that did not cross zero, demonstrating the results were still significant.

**Table 4**
Main Two Stage Least Squares (TSLS) regression of the association between each measure of mental health and sense of belonging and corresponding sensitivity analyses.

| Analysis[a] | Measure of Mental Health | β | LCL | UCL | F-Statistic | Sargan Overidentification p |
|---|---|---|---|---|---|---|
| Main TSLS specification (N = 21,844) | MHA Count (Past Year)[b] | −0.37 | −0.59 | −0.15 | 136.1 | 0.73 |
| | SRMH[c] | −0.17 | −0.27 | −0.07 | 167.0 | 0.97 |
| | K6[d] | −0.04 | −0.07 | −0.02 | 199.9 | 0.95 |
| Individuals who live alone (N = 6853) | MHA Count[b] | −0.35 | −0.69 | −0.02 | 53.0 | 0.60 |
| | SRMH[c] | −0.21 | −0.39 | −0.02 | 49.1 | 0.94 |
| | K6[d] | −0.05 | −0.10 | −0.01 | 54.4 | 0.91 |
| Ages 15–24 (N = 1928) | MHA Count[b] | −0.52 | −0.87 | −0.16 | 27.3 | 0.77 |
| | SRMH[c] | −0.28 | −0.47 | −0.09 | 46.9 | 0.52 |
| | K6[d] | −0.07 | −0.11 | −0.02 | 64.0 | 0.91 |
| Excluding individuals with past year family members with mental health treatment/ police interaction (N = 17,680) | MHA Count[b] | −0.30 | −0.58 | −0.01 | 96.6 | 0.65 |
| | SRMH[c] | −0.15 | −0.29 | −0.01 | 85.6 | 0.68 |
| | K6[d] | −0.04 | −0.08 | 0 | 94.8 | 0.62 |
| Number of lifetime diagnoses among people with no past year MHA diagnosis (N = 19,658) | Lifetime MHA count | −0.11 | −0.24 | 0.01 | 182.6 | 0.44 |
| IV Ordinal Probit Model (N = 21,844) | MHA Count[b] | −0.45 | −0.72 | −0.17 | | |
| | SRMH[c] | −0.21 | −0.34 | −0.08 | | |
| | K6[d] | −0.05 | −0.09 | −0.02 | | |
| Nevo and Rosen (2012) (N = 21,844)[e] | MHA Count[b] | | −0.63 | −0.13 | | |
| | SRMH[c] | | −0.32 | −0.13 | | |
| | K6[d] | | −0.08 | −0.03 | | |
| 2002 CCHS - Alternative IV: Number of MH conditions with onset in childhood (0–14) and adolescence (15–19) (N = 31,089)[f] | MH Count[f] | −0.21 | −0.27 | −0.15 | 5578.2 | 0.72 |
| | SRMH[c] | −0.22 | −0.28 | −0.16 | 545.6 | 0.61 |
| | K6[d] | −0.04 | −0.05 | −0.03 | 1136.2 | 0.64 |
| 2002 CCHS - Alternative IV: Number of MH conditions with onset in childhood (0–14) and adolescence (15–19) Nevo and Rosen (2012) (N = 31,089)[e,f] | MH Count[f] | | −0.75 | −0.12 | | |
| | SRMH[c] | | −0.94 | −0.13 | | |
| | K6[d] | | −0.17 | −0.03 | | |

[a] Each row is a different IV regression with one of the measures of mental health and the 2nd stage regression shown.
[b] MHA = mental health and addiction conditions in the past year.
[c] SRMH = self-rated mental health.
[d] K6 = Kessler Psychological Distress Scale.
[e] Only bounds are estimated.
[f] MH = mental health conditions.

## 6. Discussion

All measures of mental health (i.e., number of MHA conditions, SRMH and K6) were significantly negatively associated with lower sense of belonging and workplace social support, even after adjusting for a number of important confounders. The coefficients in most of the IV models were of greater magnitude than those in the OLS models. First stage F-statistics were greater than 10 and the overidentification tests were not significant. Furthermore, results were consistent for both outcomes in all sensitivity analyses, including a sample where individuals with family members with greater severity of mental health problems were excluded and in analyses conducted using an alternate IV (i.e., onset of mental health conditions during childhood and adolescence). The mental health measures reflected varying lengths of chronicity demonstrating that these effects are not solely due to short-term symptom changes and reflect long-standing differences in social capital.

We found the relationship between family mental health instruments and each measure of mental health to be strong in first stage regressions (F»10), consistent with past literature, which found that mental health conditions are highly heritable largely through genetic transmission (Agrawal and Lynskey, 2008; Hettema et al., 2001; Smoller and Finn, 2003; Sullivan et al., 2000). Prior research has also demonstrated that a family history of mental health problems is associated with greater mental health severity, beyond increased risk of onset of a mental health condition (Milne et al., 2009; Post et al., 2015).

We tested the exclusion restriction in four ways. First, in all cases over-identification tests were not significant. Second, sensitivity analyses excluded individuals with family members who required mental health treatment or had police interactions in the past year, which did not substantively influence the results for either outcome. This finding is in line with both outcomes reflecting weak tie social capital with sense of belonging proxying connections with neighbours (Carpiano and Hystad, 2011) and workplace social support measuring support provided by coworkers and supervisors. Third, we tested an alternative IV, the number of mental health conditions with onset in childhood and adolescence. Although this IV would result in a different LATE identifying the effect among a different set of compliers (i.e., individuals whose value on the endogenous variable is influenced by the IV), these models resulted in the same qualitative conclusion of an effect on both social capital outcomes; moreover, most coefficients were of similar magnitude. Therefore, we believe this supports the overall validity of our IV strategy and the robustness of our conclusions. The same approach using both of these IVs has been taken in other studies examining the causal effects of mental health on labour market outcomes (Banerjee et al., 2017; Ettner et al., 1997). The robustness of the results was further enhanced by adding controls for education, household income, housing status, physical health and child abuse in all specifications. Fourth, we relaxed the strict IV exclusion restriction assumptions using weaker assumptions of the method described in Nevo and Rosen (2012) and found the bounds did not cross zero (Nevo and Rosen, 2012).

### 6.1. Study implications

Our results suggest a large negative causal effect of mental health on sense of belonging and workplace social support. Both outcomes are "weak ties" (i.e., neighbours, coworkers, supervisors) social capital, which are theorized to be more important than "strong ties" (i.e., family, friends) for job search information (Granovetter, 1973). This may help explain past findings of a negative effect of mental health on employment (Banerjee et al., 2017; Ettner et al., 1997). This study examined a neglected topic, with no studies to our knowledge having used

**Table 5**
Main Two Stage Least Squares (TSLS) regression of the association between each measure of mental health and workplace social support and corresponding sensitivity analyses.

| Analysis[a] | Measure of Mental Health | β | LCL | UCL | F-Statistic | Sargan Overidentification p |
|---|---|---|---|---|---|---|
| Main TSLS specification (N = 11,373) | MHA Count (Past Year)[b] | −1.88 | −2.60 | −1.16 | 80.9 | 0.32 |
| | SRMH[c] | −0.84 | −1.15 | −0.54 | 129.2 | 0.62 |
| | K6[d] | −0.22 | −0.29 | −0.14 | 152.8 | 0.60 |
| Individuals who live alone (N = 2911) | MHA Count[b] | −1.17 | −2.16 | −0.18 | 32.6 | 0.37 |
| | SRMH[c] | −0.68 | −1.21 | −0.15 | 39.2 | 0.71 |
| | K6[d] | −0.17 | −0.31 | −0.04 | 43.8 | 0.82 |
| Ages 15–24 (N = 1564) | MHA Count[b] | −1.56 | −2.60 | −0.51 | 20.3 | 0.68 |
| | SRMH[c] | −0.78 | −1.29 | −0.28 | 43.3 | 0.52 |
| | K6[d] | −0.19 | −0.32 | −0.07 | 56.6 | 0.70 |
| Excluding individuals with past year family members with mental health treatment/ police interaction (N = 8935) | MHA Count[b] | −1.56 | −2.41 | −0.72 | 61.4 | 0.25 |
| | SRMH[e] | −0.81 | −1.23 | −0.38 | 66.7 | 0.25 |
| | K6[d] | −0.21 | −0.32 | −0.10 | 78.6 | 0.28 |
| Number of lifetime diagnoses among people with no past year MHA diagnosis (N = 10,036) | Lifetime MHA count | −0.84 | −1.22 | −0.47 | 112.0 | 0.78 |
| IV Tobit Model (N = 11,373) | MHA Count[b] | −1.98 | −2.76 | −1.21 | | |
| | SRMH[c] | −0.89 | −1.22 | −0.56 | | |
| | K6[d] | −0.23 | −0.31 | −0.14 | | |
| Nevo and Rosen (2012) (N = 21,844)[e] | MHA Count[b] | | −2.49 | −0.86 | | |
| | SRMH[c] | | −1.19 | −0.40 | | |
| | K6[d] | | −0.30 | −0.10 | | |
| 2002 CCHS - Alternative IV: Number of MH conditions with onset in childhood (0–14) and adolescence (15–19) (N = 20,242)[f] | MH Count[f] | −1.01 | −1.18 | −0.84 | 3539.5 | 0.40 |
| | SRMH[c] | −1.04 | −1.22 | −0.86 | 391.5 | 0.44 |
| | K6[d] | −0.20 | −0.24 | −0.17 | 861.111 | 0.55 |
| 2002 CCHS - Alternative IV: Number of MH conditions with onset in childhood (0–14) and adolescence (15–19) Nevo and Rosen (2012) (N = 20,242)[e] | MH Count[f] | | −4.000 | −0.8180 | | |
| | SRMH[c] | | −4.25 | −0.82 | | |
| | K6[d] | | −0.64 | −0.16 | | |

[a] Each row is a different IV regression with one of the measures of mental health and the 2nd stage regression shown.
[b] MHA = mental health and addiction conditions in the past year.
[c] SRMH = self-rated mental health.
[d] K6 = Kessler Psychological Distress Scale.
[e] Only bounds are estimated.
[f] MH = mental health conditions.

econometric methods to examine the effect of mental health on the stock of social capital. These results are important given they test a key assumption of an existing economic theory (Laporte, 2014).

Our study results further highlight the deleterious influence of mental health on life outcomes and support the need for policy makers to increase funding around improved access to evidence-based mental health treatment and prevention strategies. These results also suggest the need to include measures of social capital in the evaluation of mental health interventions. Furthermore, individuals with mental health conditions may require additional supports since their ability to build or maintain social capital may be inhibited. Our findings demonstrate the need for further research on social participation interventions in populations with mental illness given a lack of effectiveness among the limited number of studies conducted to date on interventions such as social skills training and supported socialization (Mann et al., 2017). Future studies should also consider conducting mediation analyses to identify potential mechanisms of mental health on social capital, which may potentially identify intervention targets to improve social capital.

The results of this and prior studies demonstrating a negative effect of mental health on social capital investments (Ding et al., 2015; Sirven and Debrand, 2012) suggest that simultaneity bias is a significant methodological consideration in the social capital literature. This is important given that a significant majority of studies in this field have used cross-sectional data (Ehsan and De Silva, 2015; Rodgers et al., 2019).

### 6.2. Strengths & limitations

In contrast to prior studies, this study examined short and long-term measures of mental health and examined multidimensional aspects of mental health such as psychiatric diagnoses and SRMH. Furthermore,

this study employed an IV approach with instruments that have been used in several prior studies and that have strong theoretical justification. Multiple sensitivity analyses were conducted to demonstrate the robustness of the results.

This study is not without limitations. First, this study relied on retrospective self-reported assessments, which may underestimate certain symptoms or conditions due to reporting biases. However, the use of biochemical testing or imaging is not yet established in the diagnosis of mental illnesses (Milham et al., 2017; The Lancet Psychiatry, 2016) and linkages to administrative data were not available. Relying on multiple measures of mental health likely mitigated this issue to some extent given differential sensitivity of the questions. Second, family mental health history variables included spousal and child mental health. Sensitivity analyses conducted in two sub-populations (i. e., individuals who were unattached and lived alone and individuals aged 15–24 years), where this bias is expected to be insignificant, showed similar results suggesting this is unlikely to be an issue. Third, this study used a cross-sectional survey. However, population-based data with comprehensive assessments of mental health, including multiple psychiatric illnesses assessed with validated diagnostic interviews, are rare, especially in longitudinal surveys. Fourth, some of the association between family history of mental health and respondent mental health reflects environmental characteristics such as the environment the individual was raised in, including exposure to child abuse and family violence (McLaughlin et al., 2012; Post et al., 2015). We attempted to account for this by controlling for measures of child abuse and witnessing intimate partner violence, but were limited in the childhood characteristics we could control for. Fifth, the overall response rate to the survey was 69% and we were unable to determine how non-respondents differed from respondents (Statistics Canada, 2013). Sixth, although our instrument relied on lifetime mental health

conditions and treatment, there is the possibility of family members having a past year mental health condition and this being influenced by the endogenous variable, which may reflects reverse causation. However, this is unlikely to be an issue for a large majority of the model specifications including mental health measured over shorter time frames (i.e., past 30 psychological distress), and in the sensitivity analyses conducted among individuals who live alone and among family members with past year mental health treatment or police interactions excluded. This would also not affect our alternative IV, childhood mental health conditions. Finally, IV analyses, including those conducted in this paper, are sensitive to the exclusion restriction assumptions, and monotonicity assumptions, which are impossible to prove. For example, it is possible that there may be violations to the monotonicity condition if some individuals take preventive steps to improve their mental health if they have family members with mental health problems. It is possible that there are violations of the exclusion restriction if individuals with family members with mental health conditions are less likely to seek co-worker support or if childhood mental health conditions influence the individual's social skills making it more difficult for them to connect with neighbours. However, the greater the instrument strength in the first stage, the less sensitive the model is to violations of the exclusion restriction and monotonicity assumptions in the second stage (Angrist et al., 1996; De Chaisemartin, 2017). Given that our F-statistics in the first stage regression were quite high (F > 100 for family history and F»100 for onset of mental health conditions in childhood and adolescence), we believe the bias due to violations in these assumptions would be minimal (Angrist et al., 1996). Furthermore, we examined two different types of weak tie social capital provided by work colleagues and neighbours and undertook multiple sensitivity analyses, including restricting the analysis to a population with markedly less severe family mental health history and alternative IVs (i.e., childhood and adolescent mental health conditions), where we think violations to the exclusion restriction would be less likely. We conducted a sensitivity analysis that relaxes the assumption of no correlation between the instrument and the error (Nevo and Rosen, 2012) and found bounds on the parameters that were fairly similar to the main model specification. Therefore, given the high F-statistics and consistent findings of a substantial negative relationship between mental health and social capital across all model specifications, including several sensitivity analyses, we believe it is plausible that our findings demonstrate a negative causal effect of mental health on social capital.

## 7. Conclusions

In conclusion, our analyses suggest a negative causal effect of shorter- (i.e., distress) and longer-term (i.e., psychiatric diagnoses and SRMH) measures of mental health on sense of belonging and workplace social support. This highlights the need for policy makers to implement supports for individuals with poor mental health so they can build and maintain their social capital and greater prevention and treatment of poor mental health, which may also enable individuals to further build and maintain their social capital.

## Credit author statement

Michael Lebenbaum: Conceptualization, Formal analysis, Writing - original draft, Writing - review & editing. Audrey Laporte: Conceptualization, Writing - review & editing. Claire de Oliveira: Conceptualization, Writing - review & editing.

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