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Does life satisfaction predict future mental health service use? An observational population-based cohort study

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ABSTRACT

Objective: To investigate the impact of life satisfaction on future mental health service use in two settings: (1) hospitals/emergency departments, and (2) outpatient visits.

Design and setting: Population-based cohort study of adults from Ontario, Canada. Baseline data were captured through pooled cycles of the Canadian Community Health Survey (CCHS 2005-2014) and linked to health administrative data for up to five years of follow-up.

Participants: 131,809 men and women aged 18 years and older.

Main outcome measure: The number of mental health-related visits within five-years of follow-up.

Results: Poisson regression models were used to estimate rate ratios in each setting, adjusting for sociodemographic measures, visit history, and health behaviours. In the hospital/emergency setting, compared to those most satisfied with life, those with the poorest satisfaction exhibited a rate ratio of 3.71 (95% confidence interval=2.14, 6.45) for future visits. In the outpatient setting, this same comparison group exhibited a rate ratio of 1.83 (95% confidence interval=1.42, 2.37). When the joint effects of household income were considered, compared to the highest income and most satisfied individuals, the lowest income and least satisfied individuals exhibited the highest rate ratio in the hospital/emergency setting (11.25, 95% confidence interval=5.32, 23.80), whereas the highest income and least satisfied individuals exhibited the highest rate ratio in the outpatient setting (3.33, 95% confidence interval=1.65, 6.70).

Conclusion: The findings suggest that life satisfaction is an independent risk factor for future mental health visits. Those with the poorest life satisfaction exhibited a disproportionate rate and risk of mental health-related emergency visits, which was less pronounced in the outpatient setting. The magnitude of effect in the hospital/emergency setting was exacerbated when low income was considered. Identifying factors that reduce service use supports the development of upstream socio-ecological interventions for a more sustainable health system.

Abstract word count: 292

Keywords: mental health; health service use; epidemiology; public health; life satisfaction; wellbeing

ARTICLE SUMMARY

Strengths and Limitations

- This large provincially representative study links multiple cycles of the Canadian Community Health Survey with health administrative databases to evaluate the association between life satisfaction and mental health service use in two care settings.
- Insight into participants' history of mental health visits prior to survey interview allowed for more robust analyses that considered baseline mental health status and therefore limited the potential for reverse causation.
- Mental health-related visits to types of care providers that are not captured by the administrative databases could not be accounted for during follow-up, which could confound the reported association.
- Life satisfaction and health behaviours were only measured once at baseline, increasing the potential for misclassification bias.

INTRODUCTION

Mental and substance use disorders account for approximately 7.4% of all disability-adjusted life-years worldwide, and in Canada, 1 in 5 people live with a mental health problem or illness.[1 2] Mental illness is often accompanied by workforce participation barriers, excess comorbidity, high health care utilization, and shortened life expectancy.[3-5] In Canada's most populous province of Ontario, the burden of mental illness and addictions is estimated to exceed 1.5 times the burden of all cancers, and seven times that of all infectious disease.[6]

In recent years, the idea that the prevention and treatment of mental health issues can have a widespread positive impact on health system outcomes as a whole has been highlighted.[4] This notion also falls in line with the increased attention that measures of psychological wellbeing are gaining among population health researchers and decision-makers. One measure, life satisfaction, is concerned with the subjective evaluation of one's life, and hence broader in scope than transient positive or negative emotions, referring to a global evaluation of one's quality of life. Previous studies support this measure as encompassing mental, physical, and social facets of wellbeing.[3 7 8] Happiness-cultivating interventions, such as positive psychology, drive motivations to study the associations between happiness and health system outcomes.

Several studies have examined associations between life satisfaction and multiple domains of health, such as with health behaviours, chronic disease, death, preventable hospitalizations, general health care use, and mental health, yet to the authors' knowledge, no studies have examined prospective and population-wide associations with subsequent mental health service use.[3 9-11] Using a large, representative population-based cohort, we aim to investigate the impact of life satisfaction on future mental healthcare utilization in two settings: (i) hospitals and emergency departments (EDs), and (ii) outpatient visits.

METHODS

Study population

Data from five pooled cycles of Statistics Canada's Canadian Community Health Survey (CCHS, cycles 2005, 2007/08, 2009/10, 2011/12, 2013/14) were linked with population-based health administrative databases in Ontario, Canada. Datasets were linked using unique encoded identifiers and analysed at the Institute of Clinical Evaluative Sciences (ICES), which is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse health care and demographic data, without consent, for health system evaluation and improvement.

Administered by Statistics Canada, the CCHS is a cross-sectional survey representative of 98% of the Canadian population aged 12 years or older living in private dwellings. The CCHS gathers data concerning health determinants, use, and outcomes across Canada, with response rates ranging from 66% to 79%. Detailed survey methodology is available elsewhere.[12] All CCHS participants were asked if they consented to share their survey responses with provincial ministries of health and linking responses to administrative databases. Respondents from Ontario who consented to share their survey data were linked to the Registered Persons Database (RPDB), Ontario's universal health insurance registry. Canada has a universal health care system controlled by each province or territory. In Ontario, all permanent residents are covered by a single-payer insurance system known as the Ontario Health Insurance Plan (OHIP) where all related healthcare encounters are recorded in health administrative databases. Each participant had up to five years of follow-up and a three-year lookback window from their baseline CCHS interview.

Mental health care utilization was documented in two settings: hospital or ED visits and outpatient visits. The RPDB was used to obtain age and sex for all participants. Measures of life satisfaction, health behaviours, and other sociodemographic measures were obtained from the CCHS.

Pooling the Ontario component of the five selected CCHS cycles (N=213,687), 167,442 participants were successfully linked to the RPDB. After removing duplicate records, those with invalid death dates or postal codes, those under 18 years of age, those missing life satisfaction measures, those who were never eligible for OHIP during follow-up, 131,809 respondents were included (Figure 1).

Measures

Exposure: The focal exposure was a one-item measure of self-reported life satisfaction. All CCHS respondents were prompted with the question: *How satisfied are you with your life in general?* For cycles 2005 and 2007/08, CCHS respondents were directly given five response options: *very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, or very dissatisfied.* For cycles 2009/10, 2011/12, 2013/14, the response option was an 11-point scale (from 0 labelled *very dissatisfied* to 10 labelled *very satisfied*), which was then converted to the same 5-point scale by Statistics Canada. For the purpose of this study, *very satisfied and satisfied* response levels were collapsed due to perceived similarity with mental health outcomes. As mentioned, this single item measure has been shown to be reliable and valid, as well as a moderately stable measure over time.[13-16] Compared to multi-item measures, this single measure has been shown to capture information very similarly to multidimensional measures.[17]

Outcome: The primary outcome was a count of the number of mental health visits in either of the two settings in the five years following interview date. Secondary analyses were conducted to

examine binary measures of having ever had a mental health visit in five years of follow-up. Hospital admissions were identified from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) (2002–2019) and the Ontario Mental Health Reporting System (OMHRS) (2005–2019). ED visits were obtained through the National Ambulatory Care Reporting System (NACRS) (2002–2019). Outpatient visits (defined as a visit to a primary care physician for any mental health condition or to a psychiatrist for any reason) were determined from the OHIP billings database between 2002 and 2019 (Supplementary Table 1).

Covariates: Having had any prior mental health service use (in either of the two defined settings) was estimated from administrative data captured in the three years before the baseline interview for each participant. All other covariates were captured in the CCHS and included survey interview year, immigrant status, household income, smoking, alcohol consumption, physical activity level and body mass index (BMI). These variables were chosen as they have been shown to be important confounders in the relationship between life satisfaction and health system and population health outcomes in previous studies.[9-11]

Statistical Analyses

The distributions of mental health care service use and selected covariates were estimated according to the four defined categorizations of life satisfaction (*very satisfied/satisfied; neither satisfied nor dissatisfied; dissatisfied; very dissatisfied*).

Poisson regression models were used to estimate rate ratios of mental health visits in hospital/ED or outpatient settings with a person-days offset. In addition, we estimated risk ratios for the binary outcome ever/never having had a subsequent visit in each setting. Estimates from four sequentially adjusted models were reported to transparently demonstrate the impact of the various

adjustments: (i) unadjusted; (ii) age-, sex-, and survey cycle-adjusted; (iii) minimally adjusted; and (iv) fully adjusted. Minimally adjusted models included age, sex, survey cycle, immigrant status, and household income quintile. Fully adjusted models additionally adjusted for having had any mental health visit three years prior to the baseline interview, smoking status, alcohol consumption, physical activity level, and BMI. To examine whether the association between life satisfaction and counts of mental health visits varied by socioeconomic status, fully adjusted joint-effects models were conducted which included a 12-category joint-effects variable combining life satisfaction with a collapsed measure of household income (*low income,* quintile 1/*mid income,* quintiles 2 and 3/*high income,* quintiles 4 and 5).

Median values were imputed for all missing observations. Income had the highest proportion of missing observations at 6.3% and we conducted a separate sensitivity analysis where missing observations were coded as a separate category. We conducted another sensitivity analysis to limit the potential influence of reverse causation and capture any baseline mental illness that may have influenced life satisfaction by estimating models wherein participants with any documented mental health visit within their three-year lookback window or one year following their interview day were excluded. Finally, a third sensitivity analysis excluded participants who lost OHIP eligibility for one year.

Pooled survey weights were used to adjust for the complex survey design of the CCHS and provide provincially representative estimates. Bootstrap weights were applied using balanced repeated replication to estimate variance.[18] Statistical analyses were performed in 2020 using SAS version 9.3 and Stata version 15.1.

Patient and Public Involvement

Patients were not involved in the development of the research question, outcome measures, recruitment, design or the implementation of the study objectives. Furthermore, no patients were consulted on the interpretation of results, and there are no **specific** plans to disseminate the results **to patients**.

RESULTS

Of the study cohort, 90.9% reported being very satisfied or satisfied with life, 5.8% reported being neither satisfied nor dissatisfied, 2.7% reported being dissatisfied, and 0.6% reported being very dissatisfied. Those who reported being very dissatisfied with life were older (mean age of 51.8 years versus 45.7, compared to those reporting being satisfied), more likely to be in the lowest household income quintile (48.8% versus 15.3%), current smokers (41.7% versus 18.6%), non-drinkers (35.3% versus 19.9%), physically inactive (70.2% versus 46.8%), underweight or very obese, and have had any mental health visit in both lookback and follow-up windows (Table 1). The mean follow-up time (which was only censored by death date) was 4.93 years.

Table 1: Proportion (%) and mean[a] characteristics for pooled participants surveyed from 2005 to 2014 (N=131,809), Canadian Community Health Survey, Ontario, Canada.

		Life Satisfaction			
	Overall (N=131,809)	**Satisfied** (n=119,543)	**Neither** (n=7,541)	**Dissatisfied** (n=3,745)	**Very dissatisfied** (n=980)
	Mean[a]				
Age	46.0	45.7	48.4	48.9	51.8
Total # hospital/ED visits	0.07	0.06	0.16	0.28	0.53
Total # outpatient visits	2.9	2.5	5.4	9.4	8.6
	%[a]				
Sex					
Female	**51.1**	51.0	54.0	50.1	51.7
Male	**48.9**	49.0	46.0	49.3	48.3
CCHS Cycle					

2005/06	**16.2**	16.2	16.0	17.1	13.4
2007/09	**22.3**	22.1	23.8	24.1	21.0
2009/10	**23.0**	23.0	23.4	22.4	20.3
2011/12	**23.3**	23.5	21.3	22.9	25.1
2013/14	**15.1**	15.1	15.5	13.6	20.2
Immigrant					
No	**67.3**	68.1	56.4	64.7	69.3
Yes	**32.7**	31.9	43.6	35.3	30.7
Household income					
Q1 (Lowest)	**16.9**	15.3	29.4	40.0	48.8
Q2	**17.4**	17.0	22.1	19.7	15.9
Q3	**26.0**	26.1	26.8	22.3	17.9
Q4	**19.2**	20.0	12.4	9.3	8.1
Q5 (Highest)	**20.5**	21.6	9.3	8.7	9.3
Smoking status					
Non-smoker	**58.3**	59.3	51.3	44.0	34.9
Former	**21.9**	22.1	19.4	20.9	21.5
Current	**19.8**	18.6	29.4	35.1	41.7
Alcohol consumption					
No past-year	**20.6**	19.9	27.0	28.1	35.3
Occasional	**16.3**	15.8	21.3	22.7	21.5
Regular	**28.3**	28.8	24.1	21.4	17.0
Regular & binge	**34.8**	35.5	27.6	27.8	26.2
Physical activity[b]					
Active	**26.4**	27.4	17.1	15.9	15.9
Moderate	**25.1**	25.7	19.1	18.8	13.9
Inactive	**48.5**	46.8	63.8	65.3	70.2
Body mass index					
Underweight (<18.5)	**2.6**	2.4	3.8	3.8	6.5
Normal (18.5-24.9)	**43.7**	44.3	39.4	35.4	33.7
Overweight (25-29.9)	**36.6**	36.7	36.6	34.7	35.6
Mod obese (30-34.9)	**12.1**	11.9	12.9	15.3	13.0
Very obese (≥35)	**5.0**	4.7	7.3	10.8	11.3
Hospital or emergency department visit (5-year follow-up)					
No	**96.3**	96.8	93.3	88.4	84.3
Yes	**3.7**	3.2	6.7	11.6	15.7
Outpatient visit (5-year follow-up)					
No	**62.1**	63.8	50.0	37.8	32.6
Yes	**37.9**	36.2	50.0	62.2	67.4
Any MH visit (3-year lookback)					
No	**69.9**	71.6	56.7	44.8	41.7
Yes	**30.1**	28.4	43.3	55.2	58.3

[a] Survey sampling weights were used to produce population estimates.

Compared to those reporting being most satisfied with life, those who reported being very

dissatisfied exhibited a fully adjusted rate ratio of 3.71 (95% CI: 2.14, 6.45) for a future hospital/ED visit. In the outpatient setting, the same comparison group exhibited a fully adjusted rate ratio of 1.83 (95% CI: 1.42, 2.37). Covariate adjustments attenuated the magnitude of the life satisfaction effect (i.e., the unadjusted to fully adjusted rate ratios decreased from 9.48 to 3.71 in the hospital/ED setting and from 3.66 to 1.83 in the outpatient setting). Adjustment for prior mental health visits and health behaviours at baseline resulted in the most substantial decrease in effect size (Table 2).

Table 2: Rate ratios[a] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition. Source: pooled participants surveyed from 2005 to 2014 (N=131,809), Canadian Community Health Survey, Ontario, Canada.

	Unadjusted	Age, sex, cycle-adjusted	Minimally adjusted[b]	Fully adjusted[c]
Hospital or emergency department visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.86 (1.92, 4.27)	3.08 (2.05, 4.62)	2.63 (1.77, 3.90)	1.89 (1.30, 2.73)
Dissatisfied	4.93 (3.91, 6.21)	5.40 (4.29, 6.80)	3.81 (2.96, 4.91)	2.29 (1.77, 2.96)
Very dissatisfied	9.48 (5.59, 16.08)	10.98 (6.49, 18.60)	7.00 (4.09, 11.99)	3.71 (2.14, 6.45)
Outpatient visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.24 (1.97, 2.56)	2.27 (1.99, 2.59)	2.24 (1.96, 2.56)	1.62 (1.42, 1.84)
Dissatisfied	3.92 (3.33, 4.62)	4.03 (3.42, 4.75)	3.67 (3.11, 4.33)	2.20 (1.88, 2.58)
Very dissatisfied	3.66 (2.85, 4.71)	3.84 (2.97, 4.95)	3.31 (2.56, 4.29)	1.83 (1.42, 2.37)

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up up to 5 years following interview.
[b] Minimally adjusted model includes age, sex, survey cycle, immigrant status, and household income.
[c] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Across all levels of adjustment in the hospital/ED setting, a dose-response effect was observed for decreasing levels of life satisfaction: higher rate ratios for having any mental health hospital/ED visit were observed among individuals more dissatisfied with their lives. This dose-response relationship was less pronounced in the outpatient setting. Examining the outcomes as binary measures (having had at least one visit during follow-up), the dose-response relationship was again less

pronounced in the outpatient setting. Those reporting the poorest level of life satisfaction exhibited the highest relative risk of having at least one hospital/ED visit (relative risk: 2.58, 95% CI: 1.92, 3.47), as well as the highest risk of having an outpatient visit (relative risk: 1.38, 95% CI: 1.28, 1.50) (Table 3).

Table 3: Risk ratios[a] and 95% confidence intervals for risks of (i) hospitalization or emergency department visit, or (ii) outpatient visit for any mental health condition. Source: pooled participants surveyed from 2005 to 2014 (N=131,809), Canadian Community Health Survey, Ontario, Canada.

	Unadjusted	Age, sex, cycle-adjusted	Minimally adjusted[b]	Fully adjusted[c]
Hospital or emergency department visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.12 (1.78, 2.53)	2.23 (1.87, 2.65)	2.02 (1.71, 2.40)	1.58 (1.33, 1.87)
Dissatisfied	3.73 (3.18, 4.38)	3.99 (3.40, 4.68)	3.16 (2.69, 3.71)	2.15 (1.84, 2.52)
Very dissatisfied	5.12 (3.84, 6.83)	5.77 (4.31, 7.72)	4.22 (3.14, 5.67)	2.58 (1.92, 3.47)
Outpatient visit				
Very satisfied or satisfied	Ref.	Ref	Ref.	Ref.
Neither	1.40 (1.34, 1.46)	1.38 (1.33, 1.44)	1.37 (1.32, 1.43)	1.18 (1.13, 1.23)
Dissatisfied	1.76 (1.68, 1.84)	1.76 (1.68, 1.84)	1.70 (1.62, 1.78)	1.33 (1.27, 1.38)
Very dissatisfied	1.93 (1.80, 2.07)	1.93 (1.79, 2.08)	1.84 (1.70, 1.98)	1.38 (1.28, 1.50)

[a] Multivariable adjusted risk ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) comparing those who had at least one (i) hospitalization or emergency department visit, or (ii) outpatient visit for any mental health condition, per person-days of follow-up up to 5 years following interview.
[b] Minimally adjusted model includes age, sex, survey cycle, immigrant status, and household income.
[c] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

The life satisfaction and household income joint-effects models showed that compared to the most satisfied, high income group, individuals very dissatisfied with life who also had the lowest household income exhibited a fully adjusted rate ratio of 11.25 (95% CI: 5.32, 23.80) in the hospital/ED setting, which differed substantially from the fully adjusted rate ratio for those very dissatisfied with life presented in Table 2 (rate ratio = 3.71). In the outpatient setting, the rate ratio for the very dissatisfied, low income group was lower than that of the very dissatisfied, high income group

(rate ratios of 1.84 and 3.33, respectively) (Table 4).

Table 4: Joint-effects of life satisfaction and income on counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition. Source: pooled participants surveyed from 2005 to 2014 (N=131,809), Canadian Community Health Survey, Ontario, Canada.

Hospital or emergency department visit	
Satisfied & high income	Ref.
Satisfied & mid income	1.37 (1.08, 1.73)
Satisfied & low income	2.93 (2.23, 3.84)
Neither & high income	0.96 (0.67, 1.39)
Neither & mid income	2.73 (1.71, 4.35)
Neither & low income	6.10 (3.20, 11.61)
Dissatisfied & high income	2.74 (1.54, 4.86)
Dissatisfied & mid income	4.39 (2.57, 7.50)
Dissatisfied & low income	5.33 (3.81, 7.45)
Very dissatisfied & high income	6.20 (3.62, 10.64)
Very dissatisfied & mid income	3.04 (1.70, 5.43)
Very dissatisfied & low income	11.25 (5.32, 23.80)
Outpatient visits	
Satisfied & high income	Ref.
Satisfied & mid income	0.89 (0.79, 1.00)
Satisfied & low income	1.13 (1.00, 1.28)
Neither & high income	1.50 (1.31, 2.27)
Neither & mid income	1.47 (1.23, 1.83)
Neither & low income	1.64 (1.32, 2.04)
Dissatisfied & high income	2.09 (1.55, 2.82)
Dissatisfied & mid income	1.94 (1.45, 2.60)
Dissatisfied & low income	2.51 (1.98, 3.18)
Very dissatisfied & high income	3.33 (1.65, 6.70)
Very dissatisfied & mid income	1.37 (1.03, 1.83)
Very dissatisfied & low income	1.84 (1.29, 2.63)

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up up to 5 years following interview.

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Sensitivity analyses

In our count models that excluded participants with a history of a mental health visits or in the first year following their CCHS interview, the overall magnitude and direction of all rates remained consistent. However, rate ratios for those reporting being neither satisfied nor dissatisfied became statistically insignificant in both settings and due to small cell counts, there was considerable uncertainty around the estimate for those reporting being very dissatisfied in the hospital/ED setting (Supplementary Table 2). In the second sensitivity analysis (excluding participants who lost OHIP eligibility for one consecutive year or more), all estimates' general magnitude and direction remained consistent (Supplementary Table 3). Categorizing missing income observations as a separate response category resulted in no meaningful differences (Supplementary Table 4).

DISCUSSION

Using a population-based cohort representative of Ontarian adults, we found that poorer life satisfaction is associated with increased mental health service use in both emergency and outpatient settings. Following adjustment for sociodemographic measures, mental health visit history, and health behaviours, point estimates were attenuated but still present. A dose-response relationship between life satisfaction and mental health visits was observed, and notably less pronounced in the outpatient setting for count and binary models. The findings of our joint-effects models showed that low household income substantially increased the magnitude of the rate ratio of hospital/ED visits for those least satisfied with life, which was not the case for this group in the outpatient setting.

Potential biological, behavioural, and socio-ecological pathways could explain the association between life satisfaction and mental health service use. In terms of biological plausibility, previous studies have shown that reported life satisfaction is associated with elevated cortisol levels and decreased serum antioxidants which could impact mental health, though the impact was attenuated

once sociodemographic characteristics were adjusted for.[19 20] Regarding health behaviours, longitudinal studies have shown subjective wellbeing measures to be predictive of physical activity levels, diet, smoking, and alcohol consumption, which are also influential of mental wellbeing and health service use.[21 22] These findings further support the idea that people who are of lower socioeconomic status experience barriers to long-term and sustained mental health care. This may suggest that those with the poorest life satisfaction face both internal and external barriers to accessing continued, long-term mental health care, such as in the outpatient setting studied. Indeed, studies have shown that individuals reporting emotional distress and unmet mental health needs are more likely to experience affordability, medication, and trust-related barriers, as well as increased likelihood of not wanting to see a professional.[23] A similar pattern was observed in an evaluation of the impact of life satisfaction on ambulatory care sensitive conditions, wherein the joint-effects of income substantially increased the magnitude of effect.[9]

Repeated hospital/ED visits point to access challenges and gaps in long-term health care, and cyclically, this further contributes to the overcrowding of EDs observed across Canada. However, shifting the hospital/ED burden strictly to the clinical outpatient setting is not sustainable for Canada's growing mental health burden, nor is it in the patient's best interest. There are currently known delays in wait times for counselling and therapy of six months to one year, too long for effective care.[24 25] The majority (80%) of Canadians already seek care from their primary care physician, of whom only 23% report feeling prepared for severe mental health problems.[25] There exists a comprehensive need for accessible mental health care, which is only deepening with time. A preventative framework that considers life contexts outside of the health system may help quell the current overwhelming demand for services through the development and employment of community interventions. Previous studies have demonstrated that enrichment of life satisfaction can enhance psychological wellbeing, which in

turn could prevent future mental health issues.[26] In this way, expanding community capacities and optimizing built environments to improve quality of life, such as through improvements to food availability, public transport accessibility, neighbourhood walkability, and opportunities for social and civic engagement, are potential avenues to improve both life satisfaction and mental health.

Limitations

Our study has a number of limitations that should be considered when interpreting the findings. It is possible that the associations observed heavily reflect the negative influence of baseline poor mental health on life satisfaction. In fact, other studies have found that mental illness and negative affect are key determinants of individual perceptions of life satisfaction.[3 27] However, the cohort study design (which is a key advantage over previous studies) and the results of our sensitivity analysis (wherein participants with any mental health visit in the three years prior to interview or in the first year following the interview were excluded) showed that prospective associations remained robust. Still, we could not account for mental illness or negative affect uncaptured by the mental health service system, which could confound reported life satisfaction and subsequent service use.[2] Another limitation to consider is that life satisfaction measures were only measured once at baseline. This means that changes in life satisfaction that may influence the outcome are not captured. While changes in life satisfaction over the five-year follow-up window pose less of a threat due to this measurement's stability over time[28 29], health behaviours such as smoking and drinking could have changed more substantially. The potential misclassification of health behaviours may affect the confounding control of our model's health behaviours, which we note were important. We were also unable to distinguish between different types of mental health visits, given that billing codes for conditions are not validated for any mental health conditions other than schizophrenia.[30] Therefore, they represent health service use for mental health and should not be interpreted as a diagnosis for a particular mental health

condition. Lastly, our findings are not directly applicable to sub-populations not in the sampling frame for the CCHS. Unrepresented populations include Indigenous populations living on reserve, individuals in the military, and those living in institutions.

Conclusion

Our study contributes to a growing body of evidence that highlights the relevance of broader indicators of wellbeing and their influence on health system outcomes. The findings of this study support the incorporation of health indicators that consider socio-ecological perspectives on mental health (and health in general). Socio-ecological perspectives recognize the influence of broader life contexts and perceptions of wellbeing on our health, underscoring the need for a preventive framework which becomes especially relevant in light of the growing burden of mental illness in Canada. Future research that supports how life satisfaction can be modified through population- and community-based interventions and social programs is warranted.

Figure captions:

Figure 1. Flow chart of study population from pooled Ontario components of Statistics Canada's Canadian Community Health Surveys (CCHS, 2005-2014) linked to health administrative data through the Registered Persons Database (RPDB).

REQUIRED STATEMENTS

Author contributions: CAM contributed to the design, analysis, and interpretation of data, and drafted the article; LMD contributed to the design and interpretation of data, and critically revised the article; MH contributed to the analysis of data, and critically revised the article; VG contributed to the design and interpretation of the study, and critically revised the article; LCR contributed to the conception, design, and interpretation of data, and critically revised the article. All authors have given final approval of the version to be published, and LCR has agreed to act as the guarantor of the work.

Competing interests: None declared.

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Data sharing: The dataset from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS. The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

Ethical approval: The study design received ethics approval from the University of Toronto's ethics board (protocol #00039444).

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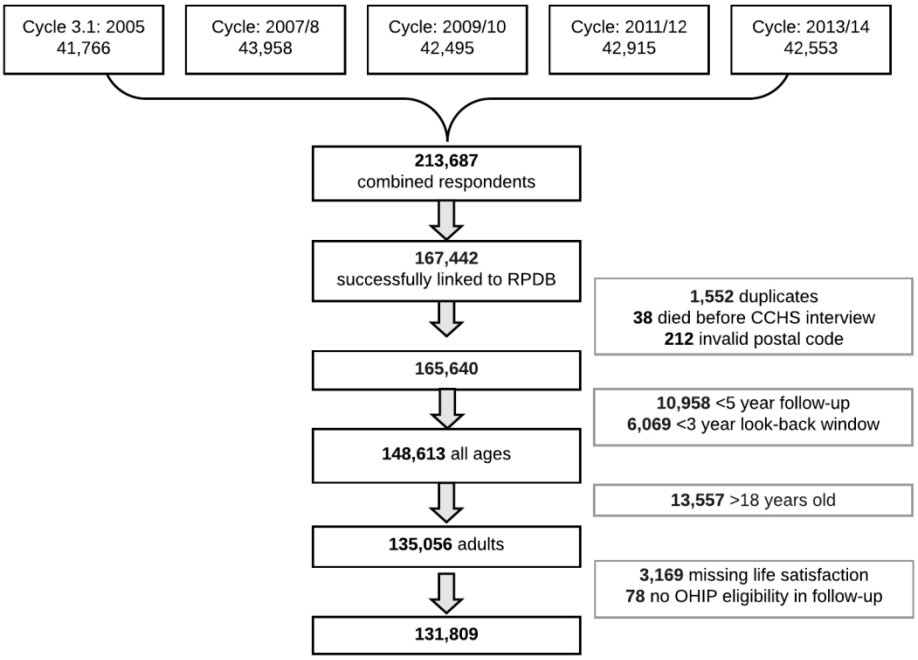

Figure 1. Flow chart of study population from pooled Ontario components of Statistics Canada's Canadian Community Health Surveys (CCHS, 2005-2014) linked to health administrative data through the Registered Persons Database (RPDB).

Supplementary Table 1: Source databases and corresponding ICD-9 or -10 codes defining mental health visits in each respective study setting.

Hospitalization/emergency department visit for any mental health condition	
ICD-9 codes (OMHRS - DSM IV)	Any OMHRS (including missing, excluding 290.x, 294.x in primary diagnosis) Exclude if Dxcode missing and provisional=2
ICD-10 codes (NACRS/DAD)	DX10CODE1= F09-F99 DX10CODE2-25 = X60-X84, Y10-Y19, Y28 when DX10CODE1 ne F06-F99
Outpatient (primary care/psychiatrist/pediatrician) visit for any mental health condition	
ICD-9 codes (OHIP)	291-293, 295-319 Psychiatrist [SPEC=19] and outpatient (LOCATION: O, L, H) and non-lab service [substr(FEECODE,1,1) ne 'G'], *OR* FP/GP [SPEC=00] and MHA diagnosis code [DXCODE] and outpatient (LOCATION: O, L, H) and non-lab service [substr(FEECODE,1,1) ne 'G'], *OR* Paediatrician [SPEC=26] and undefined location (LOCATION =U) and MHA diagnosis code [DXCODE] and fee code (FEECODE=K122 or K123 or K704). Paediatrician fee code description: K122 Developmental and/or behavioural care - individual developmental and/or behavioural care K123 Developmental and/or behavioural care - family developmental and/or behavioural care K704 Paediatric out-patient case conference

Abbreviations: ICD International Classification of Disease; DSM Diagnostic and Statistical Manual of Mental Disorders; OMHRS Ontario Mental Health Reporting System; NACRS National Ambulatory Care Reporting System; DAD Distract Abstract Database; OHIP Ontario Health Insurance Plan; FP Family physician; GP General practitioner; Dxcode Diagnosis code

Supplementary Table 2: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, excluding participants had any mental health visit three years prior to or 1 year following interview (N=84,528). Source: Canadian Community Health Survey, Ontario, Canada.

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.51 (0.74, 3.08)
Dissatisfied	2.23 (1.27, 3.89)
Very dissatisfied	3.97 (0.40, 40.54)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.19 (0.97, 1.46)
Dissatisfied	1.72 (1.06, 2.79)
Very dissatisfied	2.15 (1.21, 3.83)

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview..

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Supplementary Table 3: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, excluding participants who lost OHIP eligibility for more than 1 consecutive year (N=125,304). Source: Canadian Community Health Survey, Ontario, Canada.

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.90 (1.30, 2.78)
Dissatisfied	2.23 (1.70, 2.92)
Very dissatisfied	3.82 (2.16, 6.73)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.64 (1.44, 1.86)
Dissatisfied	2.22 (1.89, 2.61)
Very dissatisfied	1.85 (1.42, 2.41)

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview..

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Supplementary Table 4: Fully adjusted rate ratios and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, with missing income observations categorized as a separate category (N=131,809). Source: pooled participants surveyed from 2005 to 2014 (N=131,809), Canadian Community Health Survey, Ontario, Canada.

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.87 (1.29, 2.72)
Dissatisfied	2.28 (1.77, 2.94)
Very dissatisfied	3.67 (2.12, 6.38)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.61 (1.42, 1.83)
Dissatisfied	2.19 (1.87, 2.56)
Very dissatisfied	1.82 (1.41, 2.35)

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview..

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5-6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	7-8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, explain how loss to follow-up was addressed	7, death (offset)
		(*e*) Describe any sensitivity analyses	8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9 (Table 1)
		(b) Indicate number of participants with missing data for each variable of interest	8 (max reported)
		(c) Summarise follow-up time (eg, average and total amount)	5 (5y, 3y lookback)
Outcome data	15*	Report numbers of outcome events or summary measures over time	9 (Table 1)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11, 12 (Tables 2,3)
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Is life satisfaction associated with future mental health service use? An observational population-based cohort study

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Is life satisfaction associated with future mental health service use? An observational population-based cohort study

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Main body word count: 3,584 (from Introduction to Conclusion, excluding tables and figures)

ABSTRACT

Objective: To investigate the prospective association between life satisfaction and future mental health service use in: (i) hospital/emergency department (ED), and (ii) outpatient settings.

Design and setting: Population-based cohort study of adults from Ontario, Canada. Baseline data were captured through pooled cycles of the Canadian Community Health Survey (CCHS 2005-2014) and linked to health administrative data for up to five years of follow-up.

Participants: 131,809 Ontarians aged 18 years and older.

Main outcome measure: The number of mental health-related visits in (1) hospitals/emergency department and (2) outpatient settings within five-years of follow-up.

Results: Poisson regression models were used to estimate rate ratios in each setting, adjusting for sociodemographic measures, history of mental health-related visits, and health behaviours. In the hospital/emergency setting, compared to those most satisfied with life, those with the poorest satisfaction exhibited a rate ratio of 3.71 (95% confidence interval (CI): 2.14, 6.45) for future visits. In the outpatient setting, this same comparison group exhibited a rate ratio of 1.83 (95% CI: 1.42, 2.37). When the joint effects of household income were considered, compared to the highest income and most satisfied individuals, the least satisfied and lowest income individuals exhibited the highest rate ratio in the hospital/emergency setting at 11.25 (95% CI: 5.32, 23.80) whereas in the outpatient setting, the least satisfied and highest income individuals exhibited the highest rate ratio at 3.33 (95% CI: 1.65, 6.70).

Conclusion: The findings suggest that life satisfaction is a risk factor for future mental health visits. This study contributes to an evidence base connecting positive wellbeing with health system outcomes.

Abstract word count: 259

Keywords: mental health; health service use; epidemiology; public health; life satisfaction; wellbeing

ARTICLE SUMMARY

Strengths and Limitations

- This large provincially representative study links multiple cycles of the Canadian Community Health Survey with health administrative databases to evaluate the association between life satisfaction and mental health service use in two care settings.
- Insight into participants' history of mental health-related visits prior to survey interview allowed for more robust analyses that considered baseline mental health status and therefore decreased concern for reverse causation.
- Mental health-related visits with types of care providers that are not captured by the administrative databases could not be accounted for during follow-up, which could confound the reported association.
- Life satisfaction and health behaviours were only measured once at baseline, increasing the potential for misclassification bias.

INTRODUCTION

Mental and substance use disorders account for approximately 7.4% of all disability-adjusted life-years worldwide, and in Canada, 1 in 5 people live with a mental health problem or illness.[1 2] Mental illness is often accompanied by workforce participation barriers, excess comorbidity, high health care utilization, and shortened life expectancy.[3 4] In Canada's most populous province of Ontario, the burden of mental illness and addictions (in terms of health-adjusted life years) is estimated to exceed 1.5 times the burden of all cancers, and seven times the burden of all infectious diseases.[5]

Further, the demand for mental health services is increasing. In Ontario specifically, there are common delays in wait times for counselling and therapy that are often too long for effective care and result in unmet health needs.[6 7] In a cross-sectional study examining self-reported mental health service use among Ontario residents, service use increased from 7.2% in 2003–2005 to 12.8% in 2011–2014.[8] Among the subgroup reporting a past-year major depressive episode, the proportion of individuals not using mental health services was 48.8% in 2002, and decreased to 35.6% in 2012.[8] This increase in demand for health services can effectively strain health system capacity, reducing the quality of services received. A study conducted in south-eastern Ontario found that only 30% of clients seeking community-based care received an intensity of service that matched their psychosocial needs.[9] The majority (80%) of Canadians seek care from their primary care physician, of whom only 23% report feeling prepared to care for patients with severe mental health problems.[10] Evidently, there exists a comprehensive demand for accessible mental health care, which is deepening with time.

Epidemiologic research has historically been overwhelmingly oriented towards health deficits and risk factors, but in recent years, the idea that promoting positive aspects of health can have a widespread impact on health system outcomes has gained traction. A growing body of evidence points to a variety of positive social, psychological, and environmental factors that influence health and wellbeing outcomes to a comparable degree as what is observed in the larger risk factor-focused body

of research.[11] With regards to mental health, a promotion and protection framework describes a dual continuum wherein mental health is conceptualized as more than just the absence of illness, extending beyond deficits, beyond neutrality, and into a positive spectrum of wellbeing.[12] The World Health Organization adopts this framework in its description of mental health as a state of well-being in which an individual recognizes their abilities and is able to work productively, cope with life stressors, and make contributions to their community.[13] In other words, mental illness and positive mental wellbeing are two distinct but related concepts: people can have a mental illness yet cope well with it and be happily satisfied with their life, whilst others can be free from mental illness yet exhibit high levels of mental dysfunction and dissatisfaction with their life.[12 14 15] Critical to this framework lies the hypothesis that that gains in positive mental wellbeing can decrease the risk for future mental illness and health deficits.[14] Effectively, this premise extends understandings of health determinants and extends opportunities to integrate promotional and wellbeing-oriented supports. Expanding understandings of not only negative but also positive factors associated with health care utilization encourages the development of innovative and sustainable approaches to improving health system capacity, which is especially pertinent under the context of a growing demand for mental health care.

Previous studies have shown associations between positive mental wellbeing and a variety of health outcomes.[14 16-18] One wellbeing measure in particular, life satisfaction, has been shown to be associated with multiple health outcomes, such as health behaviours, chronic disease, death, preventable hospitalizations, general health care use, and mental health symptom development.[19-23] Life satisfaction is concerned with a subjective global evaluation of one's life, and previous studies support this measure as encompassing mental, physical, and social facets of wellbeing.[22 24 25] However, to the authors' knowledge, no studies have examined prospective and population-wide associations with subsequent mental health service use in Ontario**.** Using a large, representative population-based cohort,

we aim to investigate the prospective association between life satisfaction and future mental health service use in: (i) hospital/emergency department (ED), and (ii) outpatient settings.

METHODS

Study population

Data from five pooled cycles of Statistics Canada's Canadian Community Health Survey (CCHS, cycles 2005, 2007/08, 2009/10, 2011/12, 2013/14) were linked with population-based health administrative databases in Ontario, Canada. Datasets were linked using unique encoded identifiers and analysed at ICES, which is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse health care and demographic data, without consent, for health system evaluation and improvement.

Developed and administered by Statistics Canada, the CCHS is a cross-sectional survey that uses a multi-stage sample allocation strategy to gather data concerning health determinants, use, and outcomes across Canada. Response rates range from 66% to 79%, and the sample is representative of 98% of the Canadian population aged 12 years or older living in private dwellings. Statistics Canada asks CCHS participants for consent to share their survey responses with provincial ministries of health and link responses to administrative databases. Detailed survey methodology is available elsewhere.[26]

Respondents from Ontario who consented to share their survey data were linked to the Registered Persons Database (RPDB), which contains information on persons registered under the Ontario Health Insurance Plan (OHIP). Canada has a universal health care system controlled by each province or territory, and in Ontario all permanent residents are covered by a single-payer insurance system known as OHIP where all related health care encounters are recorded in health administrative

databases. Using the CCHS interview as the index date, each participant had up to five years of follow-up and a three-year lookback window in the administrative data. Mental health care utilization was documented in two settings: hospital or ED visits, and outpatient visits.

Pooling the Ontario component of the five selected CCHS cycles (N=213,687), 167,442 participants were successfully linked to the RPDB. After removing duplicate records, those with invalid death dates or postal codes, those under 18 years of age, those missing life satisfaction measures, and those who were never eligible for OHIP during follow-up, 131,809 respondents were included (Figure 1).

Measures

Exposure: The focal exposure was a single-item measure of life satisfaction. All CCHS respondents were prompted with the question: *How satisfied are you with your life in general?* For cycles 2005 and 2007/08, CCHS respondents were directly given five response options: *very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, or very dissatisfied.* For cycles 2009/10, 2011/12, 2013/14, the response option was an 11-point scale (from 0 labelled *very dissatisfied* to 10 labelled *very satisfied*), which was then converted to the same 5-point scale by Statistics Canada. For the purposes of this study, *very satisfied* and *satisfied* response levels were collapsed due to perceived similarity with respect to mental health service use outcomes. As mentioned, this single-item measure has been shown to be reliable and valid, as well as a moderately stable measure over time.[27-29] Compared to multi-item measures, this single-item measure has been shown to capture information very similarly to its multidimensional counterparts.[30]

Outcome: The primary outcome was a count of the number of mental health visits in each of the two settings in the five years following CCHS interview date. Secondary analyses were conducted to

examine binary measures of having ever had a mental health visit in the five years of follow-up. Hospital admissions were identified from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) (2002–2019) and the Ontario Mental Health Reporting System (OMHRS) (2005–2019). ED visits were obtained through the National Ambulatory Care Reporting System (NACRS) (2002–2019). Outpatient visits (defined as a visit to a primary care physician for any mental health condition or to a psychiatrist for any reason) were determined from the OHIP billings database between 2002 and 2019 (Supplementary Table 1A).

Covariates: Having had any prior mental health-related service use (in either of the two defined settings) was estimated from administrative data captured in the three years before the baseline interview for each participant. Age and sex were collected from the RPDB. Unfortunately, a measure for gender identity was not available. All other covariates were captured in the CCHS and included survey interview year, immigrant status, household income, smoking behaviour, alcohol consumption, physical activity level, and body mass index (BMI) (see Supplementary Table 1B for added detail on CCHS-derived covariate categorizations). These variables were chosen as they have been shown to be important confounders in the relationship between life satisfaction and health system and population health outcomes in previous studies.[19-21]

Statistical Analyses

The distributions of mental health care service use and selected covariates were estimated according to the four defined categorizations of life satisfaction. Poisson regression models were used to estimate rate ratios of mental health visits in hospital/ED or outpatient settings with a person-days offset. In addition, we estimated risk ratios for the binary outcome of ever/never having had a subsequent visit in each setting using modified Poisson regression models. Estimates from four

sequentially adjusted models were reported to transparently demonstrate the impact of the various adjustments: (i) unadjusted; (ii) age-, sex-, and survey cycle-adjusted; (iii) minimally adjusted; and (iv) fully adjusted. Minimally adjusted models included age, sex, survey cycle, immigrant status, and household income quintile. Fully adjusted models additionally adjusted for having had any mental health visit three years prior to the baseline interview, smoking behaviour, alcohol consumption, physical activity level, and BMI. To examine whether the association between life satisfaction and counts of mental health visits varied by socioeconomic status, fully adjusted joint-effects models were conducted which included a 12-category joint-effects variable combining life satisfaction with a collapsed measure of household income (where *low income*=quintile 1, *mid income*=quintiles 2 and 3, and *high income*=quintiles 4 and 5).

Median values were imputed for all missing observations. Income had the highest proportion of missing observations at 6.3% and we conducted a separate sensitivity analysis coding missing observations as a separate category. To decrease concern for reverse causation and attempt to capture any baseline mental illness that may have influenced life satisfaction, we conducted two sensitivity analyses by estimating models wherein (i) participants with any documented mental health visit within their three-year lookback window or one year following their interview day were excluded and (ii) self-rated mental health was additionally adjusted for in the original fully adjusted models. Another sensitivity analysis excluded participants who lost OHIP eligibility for one year or more, and the last sensitivity analysis stratified by age group (18-59 years versus 60 years and over) to examine whether life stage substantially impacted point estimates.

Pooled survey weights were used to adjust for the complex survey design of the CCHS and provide provincially representative estimates. Bootstrap weights were applied using balanced repeated replication to estimate variance.[31] Statistical analyses were performed in 2020 using SAS Enterprise

version 7.1 and Stata version 15.1.

Patient and Public Involvement

No patients involved.

Ethics Approval

The study design received ethics approval by the Research Ethics Board at the University of Toronto (protocol #39444).

RESULTS

Of the study cohort, 90.9% reported being very satisfied or satisfied with life, 5.8% reported being neither satisfied nor dissatisfied, 2.7% reported being dissatisfied, and 0.6% reported being very dissatisfied. Compared to those most satisfied with life, those who reported being very dissatisfied with life were older (with a mean age of 51.8 years compared to 45.7), more likely to be in the lowest household income quintile (48.8% versus 15.3%), current smokers (41.7% versus 18.6%), non-drinkers (35.3% versus 19.9%), physically inactive (70.2% versus 46.8%), underweight or very obese, and have had a mental health visit in both the lookback and follow-up windows (Table 1). The mean follow-up time (censored by death date) was 4.93 years.

Restricting to those that had at least one hospital/ED visit during follow-up (N=5,507), the mean number of hospital/ED visits was 2.0 (95% CI: 1.8, 2.1). Stratifying this group by level of life satisfaction, the most satisfied group exhibited the lowest mean at 1.8 (95% CI: 1.7, 1.9), which increased per lower level of satisfaction to reach a mean of 3.4 (95% CI: 1.9, 4.9) hospital/ED visits among those most dissatisfied. Further restricting to those with repeat hospital/ED visits (i.e., >1 visit)

during follow-up (N=1,757), the mean number of visits was 4.0 (95% CI: 3.6, 4.3) and estimates followed the same sequential trend when stratified by life satisfaction.

Among those that had at least one outpatient visit during follow-up (N=49,450), the mean number of outpatient visits was 7.5 (95% CI: 7.2, 7.8). The most satisfied group had the lowest mean at 6.8 (95% CI: 6.5, 7.1) and the dissatisfied group had the highest mean at 15.1 (95% CI: 12.9, 17.4) visits, followed by the very dissatisfied group at 12.8 (9.5, 16.1) outpatient visits. Further restricting to those with repeat outpatient visits (N=31,311), the mean number of visits was 11.2 (95% CI: 10.8, 11.7). Again, the dissatisfied group had the highest mean number of visits at 19.0 (95% CI: 16.1, 21.9), following the same sequential trend when stratified by life satisfaction.

Table 1: Proportion (%) and mean[a] characteristics for the study sample (N=131,809).

		Life Satisfaction			
	Overall (N=131,809)	**Satisfied** (N=119,543)	**Neither** (N=7,541)	**Dissatisfied** (N=3,745)	**Very dissatisfied** (N=980)
	Mean[a]				
Age	46.0	45.7	48.4	48.9	51.8
Total # hospital/ED visits	0.07	0.06	0.16	0.28	0.53
Total # outpatient visits	2.9	2.5	5.4	9.4	8.6
	%[a]				
Sex					
Female	**51.1**	51.0	54.0	50.1	51.7
Male	**48.9**	49.0	46.0	49.3	48.3
CCHS Cycle					
2005/06	**16.2**	16.2	16.0	17.1	13.4
2007/09	**22.3**	22.1	23.8	24.1	21.0
2009/10	**23.0**	23.0	23.4	22.4	20.3
2011/12	**23.3**	23.5	21.3	22.9	25.1
2013/14	**15.1**	15.1	15.5	13.6	20.2
Immigrant					
No	**67.3**	68.1	56.4	64.7	69.3
Yes	**32.7**	31.9	43.6	35.3	30.7
Household income					
Q1 (Lowest)	**16.9**	15.3	29.4	40.0	48.8
Q2	**17.4**	17.0	22.1	19.7	15.9
Q3	**26.0**	26.1	26.8	22.3	17.9
Q4	**19.2**	20.0	12.4	9.3	8.1

Q5 (Highest)	**20.5**	21.6	9.3	8.7	9.3
Smoking status					
Non-smoker	**58.3**	59.3	51.3	44.0	34.9
Former	**21.9**	22.1	19.4	20.9	21.5
Current	**19.8**	18.6	29.4	35.1	41.7
Alcohol consumption					
No past-year	**20.6**	19.9	27.0	28.1	35.3
Occasional	**16.3**	15.8	21.3	22.7	21.5
Regular	**28.3**	28.8	24.1	21.4	17.0
Regular & binge	**34.8**	35.5	27.6	27.8	26.2
Physical activity[b]					
Active	**26.4**	27.4	17.1	15.9	15.9
Moderate	**25.1**	25.7	19.1	18.8	13.9
Inactive	**48.5**	46.8	63.8	65.3	70.2
Body mass index					
Underweight (<18.5)	**2.6**	2.4	3.8	3.8	6.5
Normal (18.5-24.9)	**43.7**	44.3	39.4	35.4	33.7
Overweight (25-29.9)	**36.6**	36.7	36.6	34.7	35.6
Mod obese (30-34.9)	**12.1**	11.9	12.9	15.3	13.0
Very obese (≥35)	**5.0**	4.7	7.3	10.8	11.3
Hospital or emergency department visit (5-year follow-up)					
No	**96.3**	96.8	93.3	88.4	84.3
Yes	**3.7**	3.2	6.7	11.6	15.7
Outpatient visit (5-year follow-up)					
No	**62.1**	63.8	50.0	37.8	32.6
Yes	**37.9**	36.2	50.0	62.2	67.4
Any MH visit (3-year lookback)					
No	**69.9**	71.6	56.7	44.8	41.7
Yes	**30.1**	28.4	43.3	55.2	58.3

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.
[a] Survey sampling weights were used to produce population estimates.

Examining the association with future mental health-related hospital/ED visits, a dose-response was observed for decreasing levels of life satisfaction. Individuals most dissatisfied with their lives exhibited the highest rate (Table 2) and risk (Table 3) ratios compared to those most satisfied with their lives. This dose-response was less pronounced in the outpatient setting. Regarding our fully adjusted count outcome models, compared to those most satisfied with life, those who were most dissatisfied exhibited a fully adjusted rate ratio of 3.71 (95% CI: 2.14, 6.45) for future hospital/ED visits (Table 2).

In the outpatient setting, the same comparison group exhibited a fully adjusted rate ratio of 1.83 (95% CI: 1.42, 2.37). Covariate adjustments attenuated the magnitude of the life satisfaction effect (i.e., the unadjusted to fully adjusted rate ratios decreased from 9.48 to 3.71 in the hospital/ED setting and from 3.66 to 1.83 in the outpatient setting) (Table 2).

Table 2: Rate ratios[a] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition (N=131,809)

	Unadjusted	Age, sex, cycle-adjusted	Minimally adjusted[b]	Fully adjusted[c]
Hospital or emergency department visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.86 (1.92, 4.27)	3.08 (2.05, 4.62)	2.63 (1.77, 3.90)	1.89 (1.30, 2.73)
Dissatisfied	4.93 (3.91, 6.21)	5.40 (4.29, 6.80)	3.81 (2.96, 4.91)	2.29 (1.77, 2.96)
Very dissatisfied	9.48 (5.59, 16.08)	10.98 (6.49, 18.60)	7.00 (4.09, 11.99)	3.71 (2.14, 6.45)
Outpatient visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.24 (1.97, 2.56)	2.27 (1.99, 2.59)	2.24 (1.96, 2.56)	1.62 (1.42, 1.84)
Dissatisfied	3.92 (3.33, 4.62)	4.03 (3.42, 4.75)	3.67 (3.11, 4.33)	2.20 (1.88, 2.58)
Very dissatisfied	3.66 (2.85, 4.71)	3.84 (2.97, 4.95)	3.31 (2.56, 4.29)	1.83 (1.42, 2.37)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up for up to 5 years following interview.

[b] Minimally adjusted model includes age, sex, survey cycle, immigrant status, and household income.

[c] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Regarding our binary outcome models (i.e., having had at least one visit during follow-up versus none), the dose-response relationship was again less pronounced in the outpatient setting (Table 3). Still, those reporting the poorest level of life satisfaction exhibited the highest fully adjusted rate ratio of having at least one mental health-related visit in both the hospital/ED setting (rate ratio: 2.58, 95% CI: 1.92, 3.47), as well as the outpatient setting (rate ratio: 1.38, 95% CI: 1.28, 1.50), compared to those most satisfied with life (Table 3).

Table 3: Risk ratios[a] and 95% confidence intervals for risks of (i) hospitalization or emergency department visit, or (ii) outpatient visit for any mental health condition (N=131,809)

	Unadjusted	Age, sex, cycle-adjusted	Minimally adjusted[b]	Fully adjusted[c]
Hospital or emergency department visit				
Very satisfied or satisfied	Ref.	Ref.	Ref.	Ref.
Neither	2.12 (1.78, 2.53)	2.23 (1.87, 2.65)	2.02 (1.71, 2.40)	1.58 (1.33, 1.87)
Dissatisfied	3.73 (3.18, 4.38)	3.99 (3.40, 4.68)	3.16 (2.69, 3.71)	2.15 (1.84, 2.52)
Very dissatisfied	5.12 (3.84, 6.83)	5.77 (4.31, 7.72)	4.22 (3.14, 5.67)	2.58 (1.92, 3.47)
Outpatient visit				
Very satisfied or satisfied	Ref.	Ref	Ref.	Ref.
Neither	1.40 (1.34, 1.46)	1.38 (1.33, 1.44)	1.37 (1.32, 1.43)	1.18 (1.13, 1.23)
Dissatisfied	1.76 (1.68, 1.84)	1.76 (1.68, 1.84)	1.70 (1.62, 1.78)	1.33 (1.27, 1.38)
Very dissatisfied	1.93 (1.80, 2.07)	1.93 (1.79, 2.08)	1.84 (1.70, 1.98)	1.38 (1.28, 1.50)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted risk ratios from modified Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) comparing those who had at least one (i) hospitalization or emergency department visit, or (ii) outpatient visit for any mental health condition, per person-days of follow-up for up to 5 years following interview.

[b] Minimally adjusted model includes age, sex, survey cycle, immigrant status, and household income.

[c] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Examining the joint effects of life satisfaction with household income, compared to the most satisfied, high-income group, the most dissatisfied and low-income group exhibited a fully adjusted rate ratio of 11.25 (95% CI: 5.32, 23.80) visits in the hospital/ED setting, which differed substantially from the fully adjusted model that did not take the joint effects of income into account (rate ratio: 3.71, 95% CI: 2.14, 6.45). In the outpatient setting however, the most dissatisfied and high-income group exhibited the highest rate ratio of 3.33 (95% CI: 1.65, 6.70), exceeding that of the most dissatisfied, low-income group (rate ratios: 1.84, 95% CI: 1.29, 2.63) (Table 4).

Table 4: Joint-effects of life satisfaction and income[a,b] on counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition (N=131,809)

Hospital or emergency department visit	
Satisfied & high income	Ref.
Satisfied & mid income	1.37 (1.08, 1.73)
Satisfied & low income	2.93 (2.23, 3.84)
Neither & high income	0.96 (0.67, 1.39)
Neither & mid income	2.73 (1.71, 4.35)
Neither & low income	6.10 (3.20, 11.61)
Dissatisfied & high income	2.74 (1.54, 4.86)
Dissatisfied & mid income	4.39 (2.57, 7.50)
Dissatisfied & low income	5.33 (3.81, 7.45)
Very dissatisfied & high income	6.20 (3.62, 10.64)
Very dissatisfied & mid income	3.04 (1.70, 5.43)
Very dissatisfied & low income	11.25 (5.32, 23.80)
Outpatient visits	
Satisfied & high income	Ref.
Satisfied & mid income	0.89 (0.79, 1.00)
Satisfied & low income	1.13 (1.00, 1.28)
Neither & high income	1.73 (1.31, 2.27)
Neither & mid income	1.50 (1.23, 1.83)
Neither & low income	1.64 (1.32, 2.04)
Dissatisfied & high income	2.09 (1.55, 2.82)
Dissatisfied & mid income	1.94 (1.45, 2.60)
Dissatisfied & low income	2.51 (1.98, 3.18)
Very dissatisfied & high income	3.33 (1.65, 6.70)
Very dissatisfied & mid income	1.37 (1.03, 1.83)
Very dissatisfied & low income	1.84 (1.29, 2.63)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Fully adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up for up to 5 years following interview.

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit in the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Sensitivity analyses

In our count models that excluded participants with a history of a mental health visits or in the first year following their CCHS interview, the overall magnitude and direction of all rate ratios remained consistent. However, rate ratios for those reporting being neither satisfied nor dissatisfied became statistically insignificant in both settings and due to small cell counts, there was considerable uncertainty around the estimate for those reporting being very dissatisfied in the hospital/ED setting

(Supplementary Table 2A). Taking the original fully adjusted models and additionally adjusting for self-rated mental health, the direction of point estimates remained consistent but were attenuated. Specifically, the rate ratios for those reporting being very dissatisfied became statistically insignificant in the outpatient setting (Supplementary Table 2B). The rate ratios for those reporting being neither satisfied nor dissatisfied became statistically insignificant in the hospital/ED setting. In the sensitivity analysis excluding participants who lost OHIP eligibility for one consecutive year or more, the general magnitude and direction of all point estimates remained consistent (Supplementary Table 3). Categorizing missing income observations as a separate response category resulted in no meaningful differences (Supplementary Table 4). Lastly, the two age strata (18-59 years versus 60 years and over) exhibited similar point estimates and overlapping confidence intervals (Supplementary Table 5).

DISCUSSION

The current study investigated the prospective association between life satisfaction and mental health-related visits in a provincially representative sample of Ontarian adults. We found that poorer life satisfaction is associated with increased mental health service use in both hospital/ED and outpatient settings. Following adjustment for sociodemographic measures, mental health-related visit history, and health behaviours, point estimates were attenuated but continued to indicate higher rate and risk ratios for lower levels of life satisfaction. The findings of our joint-effects models showed that among those most dissatisfied with life, low household income substantially increased the magnitude of the rate ratio for hospital/ED visits, which was not the case in the outpatient setting.

Multiple mechanisms could explain the association between life satisfaction and mental health-related service use seeing as a variety of broader life contexts and resources that influence health trajectories have been shown to be associated with life satisfaction. For instance, adults with higher life satisfaction are more likely to report positive psychological, behavioural, and social resources including

higher optimism, social integration, and wealth.[22 23] Regarding psychological resources for instance, Kim and colleagues (2014) proposed that higher health service utilization may be additionally explained not only by objectively poorer health, but also by excessive worrying about health status, resulting in overtreatment.[23] Our study sample largely reflected these findings, wherein more satisfied individuals did indeed report higher household income levels and exhibited higher instances of health promoting behaviours.

Our findings also showed that low household income exacerbates the observed association between life satisfaction and mental health-related service use in the hospital/ED setting. The most dissatisfied low-income group exhibited a substantially higher rate ratio of hospital/ED visits compared to their higher income counterparts. Yet in the outpatient setting, compared to their most dissatisfied counterparts, the low-income group exhibited the lowest rate ratio of mental health-related visits. Given that emergency health care settings are less porous to affordability-related barriers, this finding points to socioeconomic-related barriers to accessing long-term mental health care. Indeed, studies have shown that affordability issues (as well as medication, stigma, and trust-related barriers) are associated with a higher likelihood of experiencing unmet health needs and a lower likelihood of seeking help.[32 33] In this way, our joint-effects models demonstrated that improving access to long-term mental health-related care is particularly pertinent for the most dissatisfied and low-income individuals.

As established, however, an overburdened health system is not a well-equipped support to sufficiently meet population mental health needs in a timely manner. Identifying modifiable positive subjective wellbeing factors associated with improved mental health (and reduced service use) lays precedence for the development of sustainable approaches to promoting mental wellbeing. Positive psychology interventions, which encapsulate intentional activities aimed at fostering positive emotions, cognitions, and behaviours, provide one potential approach to modifying life satisfaction and generally maintaining or improving psychological wellbeing. Two meta-analyses explored the effectiveness of

positive psychology interventions and found that they can increase levels of subjective wellbeing in both younger and older adult populations.[34-36] However the applicability of larger-scale applications of positive psychology interventions does require further study.

Limitations

Our study has a number of limitations that should be considered when interpreting the findings. It is possible that the associations observed reflect the negative influence of baseline poor mental health on life satisfaction. In fact, other studies have found that mental illness and negative affect are key determinants of individual perceptions of life satisfaction.[22 37] However, the cohort study design (which is a key advantage over previous studies) and the results of our sensitivity analyses (which considered previous mental health-related visits with a one year wash-out period, and considered an adjustment for self-rated mental health) showed that prospective associations remained robust. Still, we could not entirely account for negative affect uncaptured by the mental health service system or self-rated mental health, which could confound reported life satisfaction and subsequent service use. Another limitation to consider is that life satisfaction was only measured once at baseline meaning that any changes that may influence the outcome were not captured. Similarly, health behaviours such as smoking and drinking could have changed over the follow-up period, and this potential misclassification could affect the confounding control of our model's health behaviours, which we note were important. We were also unable to distinguish between different types of mental health visits, given that billing codes for conditions are not validated for any mental health conditions other than schizophrenia.[38 39] The outcomes examined represent health service use for mental health and should not be interpreted as a diagnosis for a particular mental health condition. Lastly, our findings are not directly applicable to sub-populations excluded from the CCHS sampling frame. Unrepresented populations include Indigenous populations living on reserve, individuals in the military, and those living in institutions.

Conclusion

Conceptualizing positive mental wellbeing and health deficits on a dual continuum, our study contributes to a growing body of evidence that connects positive wellbeing with meaningful health system outcomes. The findings of this study emphasize the value in identifying positive wellbeing factors associated with subsequent mental health-related service use, strengthening an evidence base that supports the development of innovative and sustainable mental health interventions.

Figure captions:

Figure 1. Flow chart of study population from pooled Ontario components of Statistics Canada's Canadian Community Health Surveys (CCHS, 2005-2014) linked to health administrative data through the Registered Persons Database (RPDB).

REQUIRED STATEMENTS

Author contributions: CAM contributed to the design, analysis, and interpretation of data, and drafted the article; LMD contributed to the design and interpretation of data, and critically revised the article; MH contributed to the analysis of data, and critically revised the article; VG contributed to the design and interpretation of the study, and critically revised the article; LCR contributed to the conception, design, and interpretation of data, and critically revised the article. All authors have given final approval of the version to be published, and LCR has agreed to act as the guarantor of the work.

Competing interests: None declared.

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Data sharing: The dataset from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS. The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

Ethical approval: The study design received ethics approval from the University of Toronto's ethics board (protocol #39444).

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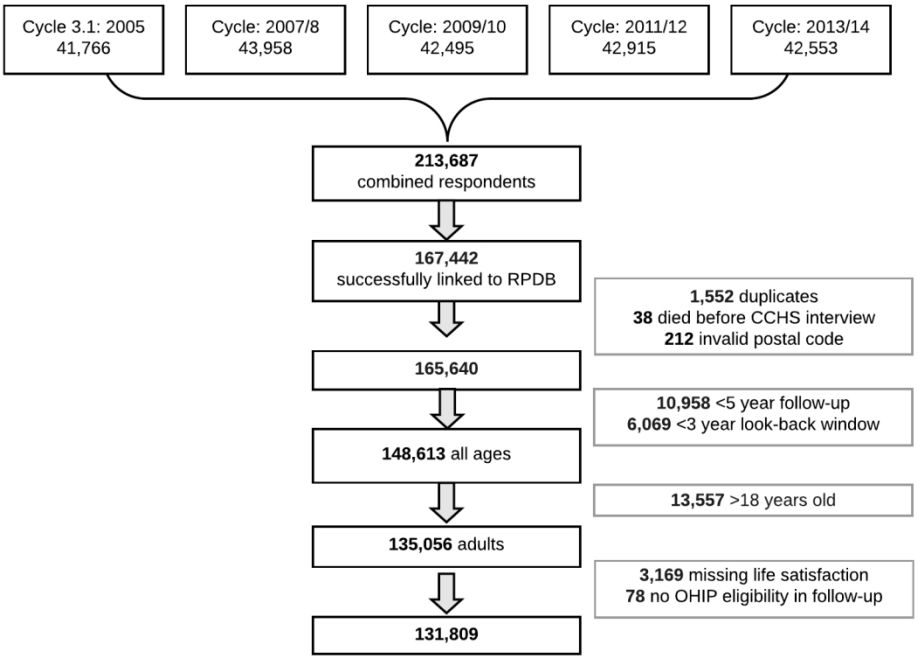

Figure 1. Flow chart of study population from pooled Ontario components of Statistics Canada's Canadian Community Health Surveys (CCHS, 2005-2014) linked to health administrative data through the Registered Persons Database (RPDB).

Supplementary Table 1A: Source databases and corresponding ICD-9 or -10 codes defining mental health visits in each respective study setting.

Hospitalization/emergency department visit for any mental health condition	
ICD-9 codes (OMHRS - DSM IV)	Any OMHRS (including missing, excluding 290.x, 294.x in primary diagnosis) Exclude if Dxcode missing and provisional=2
ICD-10 codes (NACRS/DAD)	DX10CODE1= F09-F99 DX10CODE2-25 = X60-X84, Y10-Y19, Y28 when DX10CODE1 ne F06-F99
Outpatient (primary care/psychiatrist/pediatrician) visit for any mental health condition	
ICD-9 codes (OHIP)	291-293, 295-319 Psychiatrist [SPEC=19] and outpatient (LOCATION: O, L, H) and non-lab service [substr(FEECODE,1,1) ne 'G'], *OR* FP/GP [SPEC=00] and MHA diagnosis code [DXCODE] and outpatient (LOCATION: O, L, H) and non-lab service [substr(FEECODE,1,1) ne 'G'], *OR* Paediatrician [SPEC=26] and undefined location (LOCATION =U) and MHA diagnosis code [DXCODE] and fee code (FEECODE=K122 or K123 or K704). Paediatrician fee code description: K122 Developmental and/or behavioural care - individual developmental and/or behavioural care K123 Developmental and/or behavioural care - family developmental and/or behavioural care K704 Paediatric out-patient case conference

Abbreviations: ICD International Classification of Disease; DSM Diagnostic and Statistical Manual of Mental Disorders; OMHRS Ontario Mental Health Reporting System; NACRS National Ambulatory Care Reporting System; DAD Distract Abstract Database; OHIP Ontario Health Insurance Plan; FP Family physician; GP General practitioner; Dxcode Diagnosis code

Supplementary Table 1B: Detailed breakdown of CCHS-derived covariate categorizations used in regression models.

Focal Exposure	**Source and classification details**
Life satisfaction	**Source:** CCHS **Question:** Using a scale of 0 to 10, where 0 means "Very dissatisfied" and 10 means "Very satisfied", how do you feel about your life as a whole right now? (Response options: *0-10)* **Analytic classification:** *(1) Very satisfied/satisfied (6,7,8/9,10)* *(2) Neither (5)* *(3) Dissatisfied (2,3,4)* *(4) Very dissatisfied (0,1)*
Covariates	
Age	**Source:** Registered Persons Database (contains information on persons registered under the Ontario Health Insurance Plan (OHIP)) **Analytic classification:** *continuous, 18 and over*
Sex	**Source:** Registered Persons Database **Analytic classification:** *(1) Male* *(2) Female*
Immigrant status	**Source:** CCHS **Question:** Were you born a Canadian citizen? (Response options: Yes/No) **Analytic classification:** *(1) Immigrant* (No) *(2) Canadian-born* (Yes)
Household income	**Source:** CCHS **Question:** Thinking about the total income for all household members, from which of the following sources did your household receive any income in the past 12 months? **Analytic classification:** Income deciles are determined by Statistics Canada, which are grouped by the distribution of an adjusted ratio of their total reported household income to the low income cut-off corresponding to their household and community size. It provides, for each respondent, a relative measure of their household income to the household incomes of all other respondent. We collapsed 10 categories into 5. *(1) Lowest income quintile (quintile 1, 2)* *(2) Quintile 3, 4* *(3) Quintile 5, 6* *(4) Quintile 7, 8* *(5) Highest income quintile (quintile 9, 10).*
Smoking status	**Source:** CCHS **Question:** Several variables examining the number of cigarettes smoked per day currently and formerly, a binary measure of having ever smoked 100 or more cigarettes **Analytic classification:** *(1) Current smoker*: smokes daily (smoked at least 100 lifetime cigarettes) *(2) Former smoker:* smoked regularly or occasionally in the past and no longer does (including smoked at least 100 lifetime cigarettes) *(3) Never smoker*: has indicated no current or former smoking habits, or has smoked less than 100 lifetime cigarettes

Alcohol consumption	**Source:** CCHS **Question:** Several variables examining frequency and amount of alcohol consumption **Analytic classification:** *(1) Regular and binge drinker*: has consumed alcohol in the past year with a frequency ranging from once a month to daily, and has engaged in binge drinking (defined as 4 drinks for females and 5 drinks for males in one sitting) at any frequency *(2) Regular drinker:* has consumed alcohol in the past year with a frequency ranging from once a month to daily, and has never engaged in binge drinking *(3) Occasional:* has consumed alcohol in the past year with a frequency of less than once per month *(4) Non-drinker:* no alcohol consumption in the past year
Physical activity level	**Source:** CCHS **Question:** This variable is based on the participants' leisure time total daily Energy Expenditure values (kcal/kg/day). *Energy Expenditure for each activity = (N X D X METvalue) / 365* N=number of times a respondent engaged in an activity over a 12 month period D= average duration in hours of the activity MET value=the energy cost of the activity expressed as kilocalories expended per kilogram of body weight per hour of activity (kcal/kg per hour)/365 (to convert yearly data into daily data); the low-intensity MET value was used for calculations. **Analytic classification:** *(1) Active* ($EE \geq 3$) *(2) Moderately active* ($1.5 \leq EE < 3$) *(3) Inactive* ($0 \leq EE < 1.5$)
Body mass index (BMI)	**Source:** CCHS **Question:** Self-reported height and weight **Analytic classification: I**nternational standard of BMI classification (kg/m^2) for adults aged 18 and over *(1) Underweight* (<18.5) *(2) Normal (*18.5-24.9) *(3) Overweight* (25-29.9) *(4) Moderately obese* (30-34.9) *(5) Very obese* (≥35)

Supplementary Table 2A: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, excluding participants had any mental health visit three years prior to or 1 year following interview (N=84,528)

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.51 (0.74, 3.08)
Dissatisfied	2.23 (1.27, 3.89)
Very dissatisfied	3.97 (0.40, 40.54)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.19 (0.97, 1.46)
Dissatisfied	1.72 (1.06, 2.79)
Very dissatisfied	2.15 (1.21, 3.83)

Supplementary Table 2B: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, additionally adjusting for self-rated mental health (N=131,809)

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.45 (0.93, 2.24)
Dissatisfied	1.46 (1.10, 1.95)
Very dissatisfied	2.23 (1.28, 3.86)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.16 (1.02, 1.32)
Dissatisfied	1.31 (1.11, 1.55)
Very dissatisfied	1.04 (0.80, 1.34)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview.

[b] Fully adjusted model includes self-rated mental health, age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index with an additional adjustment for self-rated mental health.

Supplementary Table 3: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, excluding participants who lost OHIP eligibility for more than 1 consecutive year (N=125,304).

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.90 (1.30, 2.78)
Dissatisfied	2.23 (1.70, 2.92)
Very dissatisfied	3.82 (2.16, 6.73)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.64 (1.44, 1.86)
Dissatisfied	2.22 (1.89, 2.61)
Very dissatisfied	1.85 (1.42, 2.41)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview.

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Supplementary Table 4: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, with missing income observations categorized as a separate category (N=131,809).

Hospital or emergency department visit	
Very satisfied or satisfied	Ref.
Neither	1.87 (1.29, 2.72)
Dissatisfied	2.28 (1.77, 2.94)
Very dissatisfied	3.67 (2.12, 6.38)
Outpatient visit	
Very satisfied or satisfied	Ref.
Neither	1.61 (1.42, 1.83)
Dissatisfied	2.19 (1.87, 2.56)
Very dissatisfied	1.82 (1.41, 2.35)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview.

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

Supplementary Table 5: Fully adjusted rate ratios[a,b] and 95% confidence intervals for counts of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, stratified by age group (18-59 years/60 years and over; N=131,809).

Hospital or emergency department visit	**18-59 years** (N=83,851)	**60 years and over** (N=47,958)
Very satisfied or satisfied	Ref.	Ref.
Neither	1.96 (1.33, 2.94)	1.31 (0.95, 1.80)
Dissatisfied	2.29 (1.72, 3.04)	2.53 (1.72, 3.72)
Very dissatisfied	3.69 (1.98, 6.89)	3.81 (1.86, 7.83)
Outpatient visit		
Very satisfied or satisfied	Ref.	Ref.
Neither	1.68 (1.45, 1.96)	1.33 (1.08, 1.65)
Dissatisfied	2.26 (1.91, 2.69)	1.44 (1.17, 1.77)
Very dissatisfied	1.77 (1.30, 2.41)	1.65 (1.25, 2.19)

Source: pooled participants of the Canadian Community Health Survey surveyed from 2005 to 2014, linked to the Registered Persons Database, Canadian Institute for Health Information Discharge Abstract Database, the Ontario Mental Health Reporting System, the National Ambulatory Care Reporting System, and the Ontario Health Insurance Plan billings databases.

[a] Multivariable adjusted rate ratios from Poisson regressions (with balanced repeated replication to produce 95% confidence intervals) for a count of the number of (i) hospitalization or emergency department visits, or (ii) outpatient visits for any mental health condition, per person-days of follow-up, within 5 years following Canadian Community Health Survey interview.

[b] Fully adjusted model includes age, sex, survey cycle, immigrant status, household income, having had any mental health visit In the three years prior to survey interview, smoking status, alcohol consumption, physical activity level, and body mass index.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8 (Supplement 1B)
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	7 (Figure 1)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8 (Supplement 1B)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9-10
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, explain how loss to follow-up was addressed	10, death (offset)
		(*e*) Describe any sensitivity analyses	9

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7 (Figure 1)
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11, 12 (Table 1)
		(b) Indicate number of participants with missing data for each variable of interest	9 (max missingness reported)
		(c) Summarise follow-up time (eg, average and total amount)	10
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12 (Table 1)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13, 14 (Tables 2,3)
		(*b*) Report category boundaries when continuous variables were categorized	11, 12 Table 1 BMI
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.