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# Editorial

# Post-COVID: Together, we will do better

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The COVID-19 pandemic has affected everyone, and none more than the families and friends of those who have passed away. Many of its effects will be felt long after the pandemic is over, prompting the question, how can we do better next time? *The Canadian Pandemic Influenza Plan for the Health Sector*[1] is a comprehensive document containing over 500 pages of detailed guidelines, tools and planning checklists. This document was updated in 2018 based on lessons learned from the 2009 H1N1 pandemic.[2] A similar report will undoubtedly follow when COVID-19 has ended, to serve as a guide to how we can better prepare for the next pandemic, whether it be a return of COVID-19 or something else.

Because a pandemic is by definition a global health threat, our view is that a concerted global response is required. To this point, however, the response to date has differed from country to country. Sweden's decision to keep the country open[3] is in stark contrast to countries that closed their borders early.[4] More troubling was the emergence of competing national responses to mitigation. We saw unprecedented competition among countries, amounting at times to frenzy, to acquire personal protective equipment and medical supplies. Some governments are even now offering huge sums in a race to secure an "inside track" on access to candidate vaccines. Declaring COVID-19 a pandemic was intended to highlight the need for greater unity and global collaboration to study and contain the virus. We need more global collaboration, not less.

Thirty-five years ago, Geoffrey Rose published a landmark paper.[5] "Sick Individuals and Sick Populations" challenged traditional public health views. Rose argued that only small benefits were gained by treating high-risk individuals, whereas large potential gains would follow "treating" populations. Rose called this approach "radical" but in the context of COVID-19 his reasoning does not seem at all radical. From his perspective, focussing *only* on those first thought to be at high risk would have been flawed, yet in some respects this is what happened in parts of Canada. This initial approach has gradually given way to a population approach for disease prevention, which we believe should remain at the heart of strategies intended to prevent or better manage future pandemics. We urge, however, that the world take a further step: expanding Rose's view of sick populations to include a "sick world." This expanded view would entail extending current surveillance systems and countermeasure strategies to include animal, environmental and human health. To do this, it is important to work effectively across disciplines, which requires shifting our practices to adopt the "One World, One Health" paradigm.[6]

We would also need to make greater use of modern predictive analytics and to extract key information from a variety of data sources beyond the health realm. Advanced tagging algorithms allow for signal detection across digital operations that can provide clues in identifying emerging health threats. This is not much different from the approach currently used to obtain global epidemiological updates using data collated from other publicly available websites.[7] For the opioid crisis in Canada, for example, the Public Health Agency of Canada (PHAC) explored non-traditional data sources to gain insight into the increase in overdoses and deaths. One source was social media data,[8] wherein changes in sentiments towards the use of opioids and their perceived dangers were identified. In a second paper, PHAC used paramedic data to detect spikes in opioid overdose cases before patients made contact with the health care system.[9] In another example, Health Canada used syndromic surveillance to identify the first vaping-associated lung illness in Canada in the Consumer and Hazardous Products Safety Directorate database.[10,11] While this database was initially designed to support regulatory functions, it was re-tooled to permit surveillance of vaping injuries.[11] If we succeed in adapting Rose's view to the idea of a "sick world," advanced analytics could provide much of the knowledge needed to prevent or control future outbreaks.

As with any challenge, the current pandemic has presented many opportunities for improvement. Whether we extend Rose's views to the global level or to the use of new analytical methods to better detect signals of emerging health threats, we will still need far more fresh thinking. We will need to foster more dialogue and strengthen links across disciplines to fully achieve an effective interdisciplinary and multidisciplinary approach to managing pandemics. Early in the COVID-19 pandemic, world leaders responded quickly with fiscal interventions on a massive scale. It is time for the many disciplines within the scientific community to open their toolboxes, but to use the tools properly, continued support will be essential. The next pandemic could be worse. We must then act quickly and together; we will need to synthesize the information then available into actionable intelligence.

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Above all, we will need to work—not as individuals, but as a team—thinking "radically" and with a clear sense of direction.

## Conflicts of interest and statement

None.

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# Original quantitative research

# Determinants of psychological and social well-being among youth in Canada: investigating associations with sociodemographic factors, psychosocial context and substance use

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This article has been peer reviewed.



## Abstract

**Introduction:** Positive mental health is an essential part of youth's healthy development. For instance, positive mental health is associated with greater self-reported physical health, closer relationships and fewer conduct problems in youth. As positive mental health promotion is a public health priority, examining its potential determinants is important.

**Methods:** We analyzed data from students in Grades 7–12 (secondary I–V in Quebec), from nine Canadian provinces, who participated in the 2016/2017 Canadian Student Tobacco, Alcohol and Drugs Survey. Psychological and social well-being (PSWB) was assessed using the Children's Intrinsic Needs Satisfaction Scale (CINSS). We conducted linear regression analyses to determine associations of sociodemographic, psychosocial and substance use variables with overall CINSS scores (n = 37 897).

**Results:** In general, youth in Canada reported fairly high PSWB. After adjusting for all included variables, being in a higher grade, being bullied, bullying others, reporting more behavioural problems and using cigarettes, e-cigarettes or cannabis at least once in the past 30 days were associated with lower overall CINSS scores for both male and female students. Reporting more prosocial behaviours was associated with higher overall scores for both sexes.

**Conclusion:** A number of sociodemographic, psychosocial and substance use factors are associated with PSWB among youth in Canada. Prospective longitudinal and intervention studies could examine whether changes in these potential risk/protective factors are accompanied by changes in positive mental health.

***Keywords:*** *psychological well-being, social well-being, eudaimonic well-being, positive mental health, youth, substance use, bullying, demographic factors*

### *Highlights*

- This study examined correlates of psychological and social well-being (PSWB) among youth in Grades 7–12/secondary I–V in Canada.
- PSWB was lower for students in higher grades.
- Behavioural problems, being bullied and bullying others were associated with lower PSWB, while prosocial behaviours (e.g. helping, sharing) were associated with higher PSWB.
- Recent cigarette, e-cigarette and cannabis use were associated with lower PSWB.

## Introduction

The prevention of mental illness and the promotion of positive mental health have been identified as key priorities in Canada and worldwide.[1,2] The Public Health Agency of Canada defines positive mental health as "the capacity of each and all of us to feel, think, and act in ways that enhance our ability to enjoy life and deal with the challenges we face."[3] Positive mental health can decrease the likelihood of experiencing mental illness and can help in the recovery of those with mental disorders.[4-7] In addition, positive mental health appears to be a protective factor against the onset and progression of some physical illnesses/diseases and mortality.[8,9] Among youth in the United States, positive mental health outcomes have been found to be associated with a more positive self-concept, closer interpersonal relationships, stronger sense of school connectedness, higher self-reported physical health and fewer conduct problems (e.g. substance use, truancy, being arrested).[10,11]

A variety of conceptualizations and operationalizations of positive mental health and well-being abound, but one distinction that is commonly made is between hedonic well-being and eudaimonic well-being.[12] Hedonic well-being is often construed and measured as the *experience* of positive emotions and satisfaction with life.[12] Eudaimonic well-being, in contrast, is frequently construed and measured as positive psychological *functioning* (psychological well-being) and includes constructs such as personal growth, purpose/meaning in life, autonomy and environmental

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mastery/competence, as well as aspects of positive social functioning (social well-being) such as positive relations with others, relatedness, social integration, social acceptance, social contribution, social actualization and social coherence.[12-14]

In this paper, we focus on the eudaimonic conceptualization of well-being and examine the psychological and social well-being (PSWB) of youth in Canada from the perspective of self-determination theory, as measured by the Children's Intrinsic Needs Satisfaction Scale (CINSS).[15]

Self-determination theory posits the existence of three basic psychological needs: the need for autonomy (to feel like one has free will and choice); the need for competence (to feel effective and capable); and the need for relatedness (to feel supported, cared about and connected to others).[16,17] The satisfaction of these basic needs can be considered an indicator of PSWB.[12,16,17]

In this paper, we follow the approach taken in the Positive Mental Health Surveillance Indicator Framework (PMHSIF) for youth[18] by considering autonomy and competence as indicators of psychological well-being and relatedness as an indicator of social well-being.

Previous research with children and youth from Montréal found that those who reported greater satisfaction of basic psychological needs (i.e. higher PSWB) reported fewer depressive symptoms and negative emotions, and more positive emotions concurrently and six weeks later.[15] Similar to research investigating other positive mental health outcomes,[19-21] the Montréal study also found that PSWB tended to be lower among older students.

In a large representative sample, recent involvement in bullying (i.e. being bullied or bullying others) and other problematic behaviour were associated with lower PSWB in youth in Canada, while engagement in prosocial behaviours was associated with higher PSWB.[22] The study did not find large differences in PSWB between male and female youth.[22]

While these studies document how a few sociodemographic and psychosocial factors may be related to PSWB, they do not consider numerous potential determinants of PSWB simultaneously. Other recent research has examined how measures of eudaimonic well-being are associated with substance use in youth, but the samples are non-representative and/or the analyses only include well-being as an explanatory variable.[23-25]

Our aim was to examine whether a variety of sociodemographic, psychosocial and substance use–related factors are associated with PSWB in a representative sample of youth. Along with contributing to the literature on the correlates of PSWB, our research could also increase understanding of the distribution of PSWB across numerous characteristics and behaviours and allow for the better identification of youth subpopulations (e.g. those attending school in rural vs. urban areas) who might benefit from targeted interventions.[26,27]

## Methods

### *Data and participants*

We analyzed data from the 2016/2017 cycle of the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS). A sample of 52 103 students in Grades 7–12 (or secondary I-V in Quebec) in 699 public, private and Catholic schools from 117 school boards in nine Canadian provinces participated in the cycle. (New Brunswick declined to participate.) Data were not collected from students attending other types of schools (e.g. on First Nations reserves and military bases, virtual and international schools, special needs schools, schools for the visually and hearing impaired), schools in the three Canadian territories or schools with fewer than 20 students in an eligible grade.

The school response rate was 78% and the student response rate was 76%. Student non-responses were due to parents/guardians refusing to give their permission or students declining to participate or being absent on the day the survey was given in their school.

Students voluntarily completed paper surveys during a class period. The surveys took 40 minutes or less to complete. The CSTADS received ethical approval from the Health Canada Research Ethics Board, the ethics review boards in affiliated provincial institutions, school board ethics review committees and the Office of Research Ethics at the University of Waterloo.[28]

### *Measures*

#### Psychological and social well-being

The 18-item Children's Intrinsic Needs Satisfaction Scale (CINSS)[15] was used as a measure of positive psychological and social functioning. Students responded on a 4-point scale that ranged from 1 ("really false for me") to 4 ("really true for me") to indicate how well each statement from the CINSS applied to them.

Six items assessed autonomy (e.g. "I feel free to express myself at home"), six items assessed competence (e.g. "I feel I do things well at school") and six items assessed relatedness (e.g. "My friends like me and care about me") across three domains (at home, at school and with peers). Although previous research has validated the three-factor structure of the CINSS among youth in Canada, the autonomy, competence and relatedness subscales all load onto a higher-order factor[22] and were highly correlated with one another in the current cycle ($rs \geq 0.78$). Thus, we calculated overall scores of PSWB for each student by summing their responses to all 18 items from the CINSS (Cronbach's $\alpha = 0.93$).

#### Potential determinants

Potential determinants of PSWB were identified from the CSTADS and grouped into three broad categories. The first category—sociodemographic factors—included the student's sex (male/female); grade (7–12); and the urban or rural status of the area where the student's school was located. The area was determined based on the school's postal code. For students in Quebec, secondary I-V was recoded to Grades 7–11.

The CSTADS also measured self-reported ethnicity, but we were unable to analyze this variable as we did not have access to the restricted version of the data.

The second category included variables that assessed aspects of the student's psychosocial context and behaviour. This included self-reports of being the target of bullying (being bullied at least once in the last 30 days/not being bullied); perpetrating bullying (bullying others at least once in the last 30 days/not bullying others); prosocial behaviour; and behavioural problems.

Prosocial behaviour was measured using five items that asked students about their

willingness to help, be generous and show interest in others (e.g. "I often help people without being asked").

Behavioural problems were measured using seven items that asked students about their respect for social boundaries, routines and rules (e.g. "I cut classes or skip school").

For both the prosocial behaviour and behavioural problems items, students indicated how well each statement described them on 6-point scale from 1 ("definitely not like me") to 6 ("definitely like me"). Overall scores for prosocial behaviour ($\alpha$ = 0.91) and behavioural problems ($\alpha$ = 0.85) were obtained by summing their respective items. The prosocial behaviour and behavioural problems items were first developed and validated for use in the Health Behaviour in School-aged Children (HBSC) survey.[22,29,30]

The third category included substance use–related variables: self-reported cigarette use (smoked a cigarette at least once in the past 30 days/did not smoke a cigarette); e-cigarette use (smoked an e-cigarette at least once in the past 30 days/did not smoke an e-cigarette); alcohol use (drank alcohol at least once in the past 30 days/did not drink alcohol); and cannabis use (used cannabis at least once in the past 30 days/did not use cannabis). We focussed on reported use of each of these substances over the past 30 days because we assumed that recent substance use would be more strongly associated with current levels of PSWB and would be more accurately remembered. This approach also allowed us to examine the association of PSWB with experiences of substance use and experiences of bullying over the same time span.

### *Analysis*

We conducted linear regression analyses to examine the association between PSWB and the sociodemographic, psychosocial and substance use variables in the overall sample and separately for female and male students.

The first set of regression analyses examined each potential determinant on its own (unadjusted results), while the second analysis examined all potential determinants together (fully adjusted results). In both sets of regression analyses, we used sampling weights to adjust for the CSTADS sampling method and to make the results representative of youth from the target population.[28] Variance was estimated using the bootstrap resampling method with 500 replications to account for the complex sampling design. Analyses were conducted using statistical package SAS Enterprise Guide version 7.1 (SAS Institute, Cary, NC, USA).

To make the sample composition constant across the unadjusted and adjusted analyses, we excluded from the linear regression analyses individuals with missing responses on any of the relevant questions. In the adjusted models, there was no evidence of heteroscedasticity, multicollinearity or extreme skewness in the distribution of residuals.

## Results

For sample characteristics on sociodemographic, psychosocial and substance use–related factors, see Table 1.

In general, the distribution of PSWB was negatively skewed as youth in Canada reported fairly high PSWB with an average score of 59.09 on the CINSS (scale range: 18–72; higher scores indicate greater well-being).

### *Unadjusted results*

In the overall sample, all of the variables were significantly associated with PSWB when separate linear regression analyses were conducted (see the "Unadjusted" column of results for both sexes in Table 2). Being female, attending a school located in an urban area and reporting more prosocial behaviours were significantly related to higher PSWB. Being in a higher grade, being bullied, bullying others, reporting more behavioural problems and using a cigarette, an e-cigarette, alcohol or cannabis at least once in the past 30 days were significantly associated with lower PSWB.

The direction and significance of these associations were the same when results were stratified by sex, albeit with one exception: attending a school in an urban versus rural area was not significantly associated with PSWB for female students (see the "Unadjusted" columns of results for males and females in Table 2).

### *Adjusted results*

In all three fully adjusted models, being in a higher grade, being bullied, bullying others, reporting more behavioural problems and using a cigarette, an e-cigarette or cannabis at least once in the past 30 days were all significantly associated with lower PSWB, while reporting more prosocial behaviours was significantly associated with higher PSWB (see the "Adjusted" columns of results in Table 2).

Attending school in an urban area was significantly associated with lower PSWB in the overall sample and for female students, but not significantly associated with PSWB for male students.

Recent alcohol use was not significantly associated with PSWB in the overall sample, but a significant negative association between recent alcohol use and PSWB was found for male students and a significant positive association between these variables was found for female students.

Lastly, being female was significantly associated with lower PSWB in the overall sample. Collectively, the set of variables in the fully adjusted models explained one-fifth of the variance in PSWB (adjusted $R^2$s = 0.20).

## Discussion

The goal of this research was to examine how sociodemographic, psychosocial and substance use variables are associated with PSWB in youth in Canada. The results revealed that most of these factors were significantly associated with PSWB when examined individually and after adjustment.

In terms of the psychosocial context of both male and female youth in Canada, behavioural problems, being bullied and bullying others were associated with lower PSWB, while prosocial behaviour was associated with higher PSWB. These variables remained significantly associated with PSWB in the adjusted models. This expands on Orpana et al.'s study, which used an earlier cycle of the CSTADS and did not control for other potential determinants.[22]

The positive association between prosocial behaviour and PSWB we observed in the current study extends previous findings of fairly consistent cross-cultural support for higher hedonic well-being in people (aged 15 years and older) who engage in prosocial behaviour (i.e. volunteering or

**TABLE 1**
**Sample characteristics and descriptive statistics of CINSS, prosocial behaviour scale and behavioural problems scale, CSTADS, 2016/2017**

| Variables | % (95% CI), weighted |
|---|---|
| Sex (n = 52 103) | |
| Male | 51.33 (51.33, 51.33) |
| Female | 48.67 (48.67, 48.67) |
| Grade (n = 52 103) | |
| Grade 7 | 16.37 (16.37, 16.37) |
| Grade 8 | 16.26 (16.25, 16.26) |
| Grade 9 | 17.11 (17.11, 17.11) |
| Grade 10 | 17.08 (17.08, 17.08) |
| Grade 11 | 17.01 (17.00, 17.01) |
| Grade 12 | 16.18 (16.18, 16.18) |
| Area (n = 52 103) | |
| Rural | 16.00 (14.26, 17.74) |
| Urban | 84.00 (82.26, 85.74) |
| Bullied by others (n = 49 543) | |
| No | 76.53 (76.18, 76.87) |
| Yes | 23.47 (23.13, 23.82) |
| Bullied others (n = 49 781) | |
| No | 86.79 (86.51, 87.07) |
| Yes | 13.21 (12.93, 13.49) |
| Cigarette use (n = 52 031) | |
| No | 93.82 (93.54, 94.09) |
| Yes | 6.18 (5.91, 6.46) |
| E-cigarette use (n = 51 719) | |
| No | 89.02 (88.74, 89.29) |
| Yes | 10.98 (10.71, 11.26) |
| Alcohol use (n = 49 336) | |
| No | 72.87 (72.39, 73.35) |
| Yes | 27.13 (26.65, 27.62) |
| Cannabis use (n = 50 867) | |
| No | 89.11 (88.74, 89.48) |
| Yes | 10.89 (10.52, 11.26) |
| **Variables** | **Mean (95% CI), weighted** |
| Prosocial behaviour (n = 49 016) | 19.49 (19.46, 19.53) |
| Behavioural problems (n = 49 537) | 10.75 (10.71, 10.78) |
| CINSS (n = 45 130) | 59.09 (59.02, 59.15) |

**Abbreviations:** CINSS, Children's Intrinsic Needs Satisfaction Scale; CSTADS, Canadian Student Tobacco, Alcohol and Drugs Survey.

donating to charity).[31] The current study also extends research with American adults that found positive relationships between prosocial behaviour and more eudaimonic aspects of well-being, such as meaning in life.[32,33]

Behavioural problems were also robustly associated with PSWB. This result may not be surprising as externalizing behaviours (e.g. aggression, rule-breaking) are common to a number of mental disorders in childhood and adolescence.[34]

The current results also build upon a large international body of research showing a link between being bullied/bullying others and negative mental health outcomes (e.g. suicidal ideation).[35-37] This suggests that aspects of positive psychological and social functioning may be also negatively affected by being bullied/bullying others. Future research could examine whether interventions that are effective at decreasing bullying perpetration and victimization[38] or other behavioural problems[39] are accompanied by increases in PSWB.

However, given the cross-sectional nature of the CSTADS data and that some protective factors against bullying overlap with aspects of PSWB,[40] it is important to acknowledge that the current research cannot establish causality and that the link between bullying and PSWB is likely bidirectional. A similar caveat applies to PSWB's relationship with prosocial behaviour and behavioural problems.

Beyond the psychosocial context, PSWB tended to be lower in youth who recently engaged in substance use. We found this pattern for cigarette, e-cigarette and cannabis use in the overall and sex-stratified unadjusted and adjusted models. In other words, use of each of these substances in the past 30 days was uniquely related to lower PSWB in Canadian youth. As brain development is ongoing during adolescence and can be disturbed by substance use during this sensitive time,[41] it is not surprising that psychological/social functioning might also be negatively affected.

The negative association between cigarette use and PSWB extends findings from the HBSC survey.[29] The HBSC survey found that youth in Canada who indicated that they never smoke were less likely to report emotional problems and more likely to report high emotional well-being.[29] The lower PSWB observed among Canadian youth who recently used cannabis replicates previous (non-representative) findings in high school students in Ontario and British Columbia: Butler et al.[23] found that the likelihood of ever using cannabis or using cannabis more frequently was higher among students who reported lower levels of flourishing.

The link between e-cigarette use and lower PSWB is of particular importance given evidence of increasing rates of e-cigarette use by Canadian adolescents,[42-44] and cases of vaping-associated lung illnesses in Canada and the United States.[45] The unique association between PSWB and e-cigarette use in this current research

**TABLE 2**
**Linear regression models examining how overall CINSS scores are associated with sociodemographic, psychosocial and substance use variables, CSTADS, 2016/2017**

| Variables | Both sexes ($N$ = 37 897) | | Males ($N$ = 18 302) | | Females ($N$ = 19 595) | |
|---|---|---|---|---|---|---|
| | Unadjusted | Adjusted | Unadjusted | Adjusted | Unadjusted | Adjusted |
| | $B^a$ (95% CI) | $B^a$ (95% CI) | $B^a$ (95% CI) | $B^a$ (95% CI) | $B^a$ (95% CI) | $B^a$ (95% CI) |
| Sex | | | | | | |
| Male | (Ref.) | (Ref.) | – | – | – | – |
| Female | 0.73*** (0.64, 0.82) | −0.11** (−0.19, −0.03) | – | – | – | – |
| Grade | −0.56*** (−0.60, −0.53) | −0.30*** (−0.33, −0.28) | −0.59*** (−0.64, −0.55) | −0.26*** (−0.29, −0.23) | −0.52*** (−0.57, −0.47) | −0.36*** (−0.41, −0.31) |
| School area | | | | | | |
| Rural | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Urban | 0.25** (0.09, 0.41) | −0.33*** (−0.43, −0.23) | 0.55*** (0.33, 0.76) | −0.14 (−0.28, 0.002) | −0.03 (−0.24, 0.19) | −0.55*** (−0.73, −0.37) |
| Bullied by others | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −4.75*** (−4.90, −4.59) | −4.20*** (−4.34, −4.05) | −4.54*** (−4.80, −4.28) | −3.75*** (−3.98, −3.51) | −5.15*** (−5.30, −4.99) | −4.54*** (−4.71, −4.38) |
| Bullied others | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −4.88*** (−5.04, −4.72) | −0.68*** (−0.88, −0.49) | −4.83*** (−5.13, −4.53) | −0.94*** (−1.25, −0.63) | −4.90*** (−5.11, −4.69) | −0.49*** (−0.72, −0.27) |
| Prosocial behaviour | 0.34*** (0.34, 0.35) | 0.35*** (0.34, 0.35) | 0.36*** (0.35, 0.38) | 0.37*** (0.36, 0.38) | 0.33*** (0.32, 0.34) | 0.31*** (0.30, 0.32) |
| Behavioural problems | −0.59*** (−0.61, −0.58) | −0.43*** (−0.45, −0.42) | −0.57*** (−0.60, −0.53) | −0.43*** (−0.45, 0.40) | −0.62*** (−0.64, −0.60) | −0.45*** (−0.47, −0.43) |
| Cigarette use | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −6.17*** (−6.45, −5.90) | −1.95*** (−2.14, −1.75) | −5.78*** (−6.18, −5.39) | −1.27*** (−1.51, −1.03) | −6.59*** (−6.88, −6.30) | −2.84*** (−3.15, −2.54) |
| E-cigarette use | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −3.91*** (−4.11, −3.71) | −0.41*** (−0.58, −0.24) | −3.76*** (−4.06, −3.47) | −0.25* (−0.50, −0.01) | −3.96*** (−4.15, −3.77) | −0.57*** (−0.76, −0.38) |
| Alcohol use | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −2.46*** (−2.57, −2.35) | −0.04 (−0.16, 0.08) | −2.79*** (−3.00, −2.59) | −0.48*** (−0.64, −0.31) | −2.12*** (−2.30, −1.95) | 0.43*** (0.26, 0.60) |
| Cannabis use | | | | | | |
| No | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Yes | −4.80*** (−5.02, −4.59) | −1.39*** (−1.60, −1.19) | −4.80*** (−5.09, −4.51) | −1.52*** (−1.80, −1.24) | −4.71*** (−4.92, −4.50) | −1.22*** (−1.45, −0.98) |

**Abbreviations:** CINSS, Children's Intrinsic Needs Satisfaction Scale; CSTADS, Canadian Student Tobacco, Alcohol and Drugs Survey; Ref., reference group.
**Note:** Dummy coding was used to create the reference groups for the categorical variables.
[a] $B$ is the unstandardized regression coefficient.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

suggests that the negative effect of e-cigarette use may not be limited to physical health.

Caution is warranted in inferring causality from the current cross-sectional data, however, especially considering that pre-existing mental health problems have been identified as a risk factor for substance use and dependence.[41,46] While abstaining or minimizing substance use during adolescence may promote higher psychological/social functioning, it is also plausible that intrinsic need satisfaction may act as a protective factor against using substances during this developmental period. Using data from 2014/2015 cycle of the CSTADS, Enns and Orpana[25] found that alcohol and cannabis use tends to be less common among youth who report higher levels of competence and relatedness. We decided to include substance use variables as explanatory variables in our analyses because substance use is included as a determinant of positive mental health outcomes in the PMHSIF for youth.[18] Future prospective longitudinal research could examine the potentially bidirectional relationship between substance use and PSWB.

In terms of alcohol use, drinking alcohol in the past 30 days was also associated with lower PSWB in the unadjusted results, but was inconsistently associated with PSWB in the adjusted results. Recent Canadian research also provides inconsistent results. For instance, Butler et al.[24] found that positive and negative mental health outcomes were not significantly associated with binge drinking among high school students in Ontario and British Columbia. Enns & Orpana,[25] analyzing a previous cycle of the CSTADS, found that the association between PSWB and alcohol use depended on the subscale of the CINSS and the inclusion/exclusion of covariates. It might be beneficial for future research on this topic to take a cognitive rather than a behavioural approach and examine associations between the motives underlying drinking behaviours and PSWB in youth.[47]

With regard to sociodemographic factors, being female was associated with higher PSWB in the unadjusted model, but with lower PSWB after adjustment. The unadjusted result is somewhat consistent with an analysis of an earlier cycle of the CSTADS that found that satisfaction of relatedness needs was significantly higher among female students.[22] Nevertheless, sex did not explain a lot of variance in PSWB in the unadjusted model in the current study ($R^2$ = 0.002), suggesting that differences in the psychological and social functioning of male and female students in Canada are fairly trivial in magnitude. The reversal of the association between sex and PSWB in the adjusted model may have been due to controlling for variables (e.g. externalizing behavioural problems) that tend to be more prevalent among male youth in Canada, and not controlling for internalizing problems (e.g. sadness/hopelessness) that tend to be more prevalent among female youth in Canada.[29,48] When possible, future research should examine both internalizing and externalizing problems simultaneously.[49]

Another inconsistent sociodemographic factor was the urban/rural setting of the student's school. Specifically, students who attended school in an urban area tended to report higher PSWB than students attending school in a rural area in the unadjusted model, with the opposite pattern found after adjustment. Given that previous Canadian research has found mixed evidence for differences in positive mental health outcomes in urban versus rural areas[50-52] and that associations between rural/urban school setting and psychological/social functioning were not consistently found across the sex-stratified analyses, we hesitate to consider school area to be a potentially important determinant of PSWB in Canadian youth.

In contrast to sex and school area, the results for the third sociodemographic factor—grade level—were consistent across both unadjusted and adjusted analyses. Specifically, PSWB was lower for male and female students in higher grades. This extends previous research based on data from the HBSC survey that found lower life satisfaction and higher subjective health complaints among older youth on average across Europe and Canada.[19-21] To boost the positive mental health of Canadian youth, interventions may want to target students in higher grades as well-being appears to be lower in high school than in middle school (although prospective longitudinal research is needed to provide stronger evidence for within-person changes in positive mental health).

### *Strengths and limitations*

As previously mentioned, due to the cross-sectional nature of the CSTADS data, we cannot establish causality. Another limitation is the use of self-report questions to measure the constructs of interest; social desirability and recall biases cannot be ruled out (e.g. students may purposefully or unintentionally misreport the frequency of their substance use or their engagement in bullying).

Although we were able to control for many variables, our investigation of potential determinants was not exhaustive and was limited by the availability of constructs measured in the CSTADS, especially the dearth of sociodemographic variables. There could be other confounding or important variables that we were not able to account for (or interaction effects) that could have changed the results (e.g. household income, ethnicity, immigration status, sexual orientation, internalizing problems, sleep, physical activity, screen time).[49,53-55] More comprehensive analyses could be conducted using recently released data from the Canadian Health Survey on Children and Youth.

As we only examined overall results across nine provinces, it is unclear whether all of the observed associations replicate in every province, the territories or other countries. While self-determination theory construes autonomy, competence and relatedness as universal needs, it acknowledges that the pathways to satisfy these needs can be shaped by context.[16] Thus, future research could investigate similarities and differences in the determinants of youth PSWB across provinces/territories and countries.

Lastly, we referred to the male/female variable as "sex" to be consistent with CSTADS data labelling and previous research,[22,25,28] but this variable could be construed as measuring "gender" as respondents were simply asked "Are you female or male?".

While recognizing these limitations, the large representative sample, high statistical power, examination of different types of substance use and inclusion of validated measures of youth functioning (e.g. the CINSS) are major strengths of the CSTADS and the current research.

## Conclusion

The current study reveals that a variety of sociodemographic, psychosocial and

substance use–related factors are associated with PSWB in Canadian youth. Lower PSWB was found among male and female students who were in higher grades; who were targets of bullying or who bullied others; who reported more behavioural problems; and who used cigarettes, e-cigarettes or cannabis at least once in the past 30 days. Male and female students who reported more prosocial behaviours tended to have higher PSWB.

The identification of these potential determinants of PSWB in Canadian youth is an important contribution to the existing literature and could be useful for informing public health policies and interventions.

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## Conflicts of interest

The authors have no conflicts of interest.

## Authors' contributions and statement

MV conceived the project. CC, MV and RD decided on the analytic approach. MV and CC conducted the statistical analyses. CC, MV and RD interpreted the results. CC drafted and revised the manuscript in response to feedback provided from MV and RD.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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# Original quantitative research

# Examining the municipal-level representativeness of the Canadian Longitudinal Study on Aging (CLSA) cohort: an analysis using Calgary participant baseline data

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This article has been peer reviewed.



## Abstract

**Introduction:** The Canadian Longitudinal Study on Aging (CLSA) is a rich, nationally representative population-based resource that can be used for multiple purposes. Although municipalities may wish to use CLSA data to address local policy needs, how well localized CLSA cohorts reflect municipal populations is unknown. Because Calgary, Alberta, is home to one of 11 CLSA data collection sites, our objective was to explore how well the Calgary CLSA sample represented the general Calgary population on select sociodemographic variables.

**Methods:** Baseline characteristics (i.e. sex, marital status, ethnicity, education, retirement status, income, immigration, internal migration) of CLSA participants who visited the Calgary data collection site between 2011 and 2015 were compared to analogous profiles derived from the 2011 National Household Survey (NHS) and 2016 Census datasets, which spanned the years when data were collected on the CLSA participants.

**Results:** Calgary CLSA participants were representative of the Calgary population for age, sex and Indigenous identity. Discrepancies of over 5% with the NHS and/or 2016 Census were found for marital status, measures of ethnic diversity (i.e. immigrant status, place of birth, non-official language spoken at home), internal migration, income, retirement status and education.

**Conclusion:** Voluntary studies face challenges in recruiting fully representative cohorts. Communities opting to use CLSA data at a municipal level, including the 10 other CLSA data collection sites, should exercise caution when interpreting the results of these analyses, as CLSA participants may not be fully representative of the local population on select characteristics of interest.

***Keywords:*** *demographics, Calgary, cities, longitudinal studies, census, Canadian Longitudinal Study on Aging, CLSA*

### *Highlights*

- The Canadian Longitudinal Study on Aging (CLSA) is designed to be nationally and provincially representative for age and sex.
- Municipal representativeness of CLSA data is unknown.
- We compared baseline sociodemographic characteristics of Calgary CLSA participants in the comprehensive cohort with those derived from the 2011 National Household Survey and 2016 Canadian Census.
- Calgary's CLSA sample was representative for age, sex and Indigenous identity but was not fully representative for ethnic diversity, internal migration, education and income when compared to the true population.
- Researchers, planners, policy makers and others using municipal-level CLSA data should consider representativeness of their CLSA sample when interpreting findings.

## Introduction

Like many other municipalities in Canada and around the world, the City of Calgary, Alberta, implemented an age-friendly strategy in 2015. Based on the World Health Organization's *Global Age-friendly Cities* guide,[1-3] the strategy's vision states that "Calgary is an age-friendly city where all people have lifelong opportunities to thrive."[3,p.12] To achieve this vision, the City and other stakeholder groups identified short- and mid-range actions.[3] The Canadian Longitudinal Study on Aging (CLSA) was recommended as a data resource that could assist in both informing and evaluating the strategy by establishing baseline measures and tracking changes over time.[4]

The CLSA is a national research platform designed to advance our understanding of

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the complexities of aging. The overall aims of the CLSA are to examine aging as a dynamic process; investigate the interrelationship between intrinsic and extrinsic factors, from mid-life to older age; capture the transitions, trajectories and profiles of aging; and provide infrastructure and build capacity for sustained high-quality research on aging.[5] Many of the characteristics being tracked longitudinally were selected to both support population-based research and lead to evidence-informed government policies.[6]

Launched in 2011, the CLSA is a rich data source available to planners and policy makers at all levels of government and academic researchers. While participation is voluntary, the CLSA sampling framework was designed to achieve national and provincial representativeness for age and sex. The extent to which CLSA data are representative for these variables at the municipality level is not known. There are also concerns about its representativeness for other sociodemographic characteristics that may be of interest. These questions merit attention if municipalities use CLSA data to assess population-level needs, monitor sociodemographic changes and understand the impact of public policy implementation.

To understand the extent to which CLSA measures are generalizable to the true population, it was important to assess how closely the CLSA Calgary sample mirrored the sociodemographic profile of middle-aged and older residents of Calgary, Alberta. Other studies have examined the limitations of establishing study cohort representativeness through comparisons with census data.[7-11] Volunteer and selection bias that lead to underrepresentation of minorities and other vulnerable groups may be a possible threat to the generalizability of results derived from volunteer-based cohort studies.[7-11] Examining cohort representativeness can help those using these data to determine when other data sources or analytical approaches should be utilized.

Calgary hosts one of the 11 CLSA data collection sites located across Canada. Assessing the representativeness of Calgary's CLSA sample would inform the City of Calgary administration of the strengths and limitations of CLSA data in evaluating the characteristics and needs of the local older population and the effectiveness of age-friendly policy implementation. The objective of this current study was to evaluate the extent to which baseline CLSA Calgary municipal data were representative of the corresponding geographical level "true" population as captured by either the 2011 National Household Survey (NHS) or 2016 Census data. This examination would assess the utility of the CLSA as a prospective longitudinal data source for tracking age-friendly policy implementation. Although we focussed on Calgary data to explore representativeness, other cities with a CLSA data collection site could replicate our analysis to evaluate their age-friendly policy implementation.

## Methods

### *Data sources – baseline CLSA data*

The CLSA is a national voluntary study that consists of two cohorts.[5] The tracking cohort is made up of 21 241 randomly selected participants from across Canada who provide alphanumeric data via computer-assisted telephone interviews. The comprehensive cohort consists of 30 097 randomly selected participants living within a 25-km radius of one of 11 data collection sites spread across Canada. These participants provide alphanumeric data, undergo detailed in-person assessments and provide biological samples.

Study baseline data collection for both the tracking and comprehensive cohorts began in 2011 and was completed in 2015. The intent is to follow participants for 20 years or until death, whichever comes first.

Two different sampling designs were used to recruit the two study cohorts. A national sampling frame was used to ensure representativeness for age and sex. In the tracking cohort, people living in postal code areas with average lower education achievement were oversampled to adjust for bias toward recruiting participants with higher socioeconomic status and to ensure sufficient heterogeneity for analyses.[6] Individuals living within a 25-km radius of CLSA data collection sites were intentionally oversampled for inclusion in the comprehensive cohort to receive physical examinations and provide biological samples.[5] For a more detailed description, see Raina et al.[5]

For the tracking cohort, sampling was designed to provide results that would be generalizable at a national level and by province in relation to the overall age and sex distribution of the population. Three sampling frames were used: the Canadian Community Health Survey on Healthy Aging; provincial health registries (except in the provinces of Alberta and Quebec); and random-digit dialling to landlines (as distinguished from a mobile cellular line).[12] Participants in the comprehensive cohort were recruited using provincial health registries (as before, except for in Alberta and Quebec) and random-digit dialling sampling frames.

The overall response rate was 10% and the participation rate was 45%.[5] Individuals were excluded from participating in the CLSA if they could not speak or write in English or French, were living in an institution, were unable to provide informed consent at the time of enrolment, resided in any of the three Canadian territories, were living on federal First Nations reserves or were full-time members of the Canadian Armed Forces.

We initially examined baseline data of CLSA participants in both the tracking (n = 306) and comprehensive (n = 2956) cohorts who, at the time of recruitment, lived in Calgary. We examined data for participants aged 45 to 64 years and 65-plus years separately. After assessing the similarities and differences between the cohorts, we elected to utilize only the comprehensive cohort dataset, with its response rate of approximately 11%.[12]

Participants in the tracking cohort were ultimately excluded because some measures of interest to the municipality for evaluating its age-friendly strategy (e.g. life space index) were either not available or were collected in a manner that may have affected the responses (e.g. elder abuse, as tracking cohort participants underwent a telephone interview where other people may have been in hearing distance, whereas comprehensive cohort participants underwent a confidential face-to-face interview).

Finally, we excluded 109 comprehensive cohort participants (3.7% of the sample) whose residential address was outside of the City of Calgary legal jurisdiction.

Of those included in the final sample (n = 2847), 1640 were aged 45 to 64 years and 1207 were aged 65-plus years.

### *Data sources – 2011 NHS and 2016 Census data*

Because baseline CLSA data were collected between 2011 and 2015, we compared CLSA data with both 2011 NHS[13] and 2016 Census[14] data to determine the distribution of characteristics for the "true" population of Calgary.

In 2011, completion of the long-form questionnaire of the Canadian census was not mandatory. The 2011 NHS, collecting similar data to the long-form questionnaire, sampled 3 out of 10 households; participation was voluntary. The NHS included questions from previous iterations of the national census. The present study accessed 2011 NHS data through a public use microdata file released by Statistics Canada, reporting a 25% sample of the collected data. Our approach also reflects the CLSA's assessment of the national representativeness of the data, which also made comparisons to 2011 NHS data, as the best available representation of the true Canadian population.[5]

The 2016 Census long-form questionnaire sampled 25% of the Canadian population. Mandatory participation had been reinstituted in 2015. Due to the timing of our analysis, the 2016 Census public use microdata file for Calgary had not yet been released. Therefore, we accessed 2016 Census data through public aggregated tables reporting on a 25% sample of the collected data. The data tables were accessible using "Beyond 20/20," a platform that Statistics Canada uses to disseminate aggregate data.

Because the 2011 NHS public use microdata file and the 2016 Census aggregated table data are organized into 5-year age cohorts, we merged available data to create the 45- to 64-year and the 65-plus-year age group categories. From the 2011 NHS, we created a dataset describing the Calgary population aged 45 to 64 years (n = 8808) and 65-plus years (n = 2849). The datasets created from the 2016 Census described the Calgary population aged 45 to 64 years (n = 319 600) and 65-plus years (n = 127 880).

### *Characteristics*

We examined sex, marital status, immigration status, place of birth, Indigenous identity, language most often spoken at home, education, working status, total personal income and internal migration status (defined as a within-Canada household relocation that took place within the past 5 years).

Data for these variables were categorized and presented as percentages. For accurate comparisons between data sources, variable recoding was used to collapse 2011 NHS and 2016 Census response categories as needed. Across all data sources, education, working status and language most spoken at home variables were recoded for comparability. Additional recoding of marital status, country of birth, Indigenous identity and total personal income variables in the 2011 NHS and 2016 Census was done to allow for comparability with CLSA data. Since neither comparison dataset reported a retirement variable, we used the "not in the labour force" measure as a proxy for retirement status. Comparative internal migration variables were also derived from corresponding variables in the CLSA, 2011 NHS and 2016 Census datasets. Finally, we created a category for Canada as the country of birth in the 2011 NHS and 2016 Census datasets using the "non-immigrant" measure.

The CLSA dataset had 5.0% or less missing data (i.e. data coded as "refused," "required question was not answered," "at least one required question was not answered" and "don't know/no answer" responses combined) for the sociodemographic variables in this analysis. The exception was "personal income," with 7.3% missing data for the 45- to 64-year age group and 12.5% missing data for the 65-plus-year age group. The 2011 NHS variables contained 5% or less missing data for all sociodemographic variables assessed in this analysis. It is important to note that while we excluded observations with missing values from our CLSA sample, the NHS values for missing data were imputed using the nearest-neighbour method described in the *NHS User Guide*.[15] At a national level, response rates for education, income and work items in the NHS questionnaire were lower than for the other characteristics measured, and the values for these items were more likely to be imputed.[15]

### *Analysis*

Sociodemographic profiles were established for baseline CLSA (collected between 2011 and 2015), 2011 NHS and 2016 Census cohorts living within Calgary's jurisdictional boundaries, as defined using Forward Sortation Areas (i.e. the first three digits of participants' postal codes). We stratified our analysis separately for the 45- to 64-year and 65-plus-year age groups because people become eligible for policy-driven programs like pensions and subsidies and other age-friendly programs and activities upon reaching age 65. For CLSA data, descriptive variables were adjusted for sampling probabilities using the trimmed analytic weights provided by CLSA, which adjust for inclusion probability.[12] The 2016 Census sociodemographic frequencies were calculated using Microsoft Excel, as per the format of the released data. All other analyses were conducted using SPSS version 25.0.[16]

Rather than looking for statistical significance (trivial differences in proportions can be statistically significant in studies with a large number of participants), we were interested in the *practical importance* of any differences seen, that is, whether differences would have real and noticeable effects on the interpretation of the data. We decided a priori on a 10% difference in proportions between the CLSA sample and the true population as a threshold for practical importance to consider when interpreting findings. We also noted percentage differences of 5% to 9% as being of questionable importance when interpreting findings.

## Results

### *Baseline CLSA (2011–2015) and 2011 NHS comparisons*

Both sex and Indigenous identity distributions in the CLSA sample were representative across both age categories (see Table 1). In contrast, immigrants were underrepresented in the CLSA sample, as indicated by differences in place of birth (and Asia in particular) and language spoken at home, suggesting practical differences compared with 2011 NHS data.

In both age groups, but especially among those aged 65-plus years, lower-income Calgary residents were underrepresented in the CLSA sample. Marital status and educational achievement were representative for Calgary CLSA participants aged 65-plus years. For the 45- to 64-year age group, discrepancies in marital status were questionable, with married individuals overrepresented and divorced individuals

**TABLE 1**
**Comparison of baseline CLSA and 2011 NHS demographic characteristics by age group, Calgary data[a]**

| Characteristic | 45–64 years | | | ≥ 65 years | | |
|---|---|---|---|---|---|---|
| | CLSA | 2011 NHS | Difference | CLSA | 2011 NHS | Difference |
| Sample size (n)[b] | 1640 | 8808 | – | 1207 | 2849 | – |
| **Sex (%)** | | | | | | |
| Male | 50.7 | 50.6 | 0.1 | 46.5 | 44.6 | 1.9 |
| Female | 49.3 | 49.4 | −0.1 | 53.5 | 55.4 | −1.9 |
| **Marital status (%)** | | | | | | |
| Married/common-law | 81.7 | 73.9 | 7.8* | 68.0 | 63.1 | 4.9 |
| Single | 7.9 | 8.8 | −0.9 | 5.0 | 3.8 | 1.2 |
| Widowed | 2.2 | 2.4 | −0.2 | 17.0 | 21.9 | −4.9 |
| Divorced | 6.0 | 11.7 | −5.7* | 8.6 | 9.6 | −1.0 |
| Separated | 2.1 | 3.2 | −1.1 | 1.3 | 1.6 | −0.3 |
| **Immigrant status (%)** | | | | | | |
| Immigrant | 16.7 | 32.2 | −15.5** | 25.4 | 39.5 | −14.1** |
| Non-immigrant | 83.3 | 67.8 | 15.5** | 74.6 | 60.5 | 14.1** |
| **Place of birth (%)[c]** | | | | | | |
| Canada | 83.3 | 67.8 | 15.5** | 74.6 | 60.5 | 14.1** |
| Other North America | 1.5 | 1.4 | 0.1 | 1.7 | 1.3 | 0.4 |
| South America, Central America, Caribbean | 2.0 | 2.3 | −0.3 | 1.5 | 1.6 | −0.1 |
| Europe | 8.6 | 9.3 | −0.7 | 19.6 | 18.9 | 0.7 |
| Africa | 0.6 | 2.1 | −1.5 | 0.9 | 1.7 | −0.8 |
| Asia | 3.2 | 16.7 | −13.5** | 1.4 | 15.4 | −14.0** |
| Oceania and others | 0.9 | 0.4 | 0.5 | 0.3 | 0.6 | −0.3 |
| **Indigenous identity (%)** | | | | | | |
| Indigenous | 3.7 | 1.9 | 1.8 | 2.3 | 0.7 | 1.6 |
| Non-Indigenous | 96.3 | 98.1 | −1.8 | 97.7 | 99.3 | −1.6 |
| **Language most spoken at home (%)** | | | | | | |
| English/French | 94.8 | 86.4 | 8.4* | 97.2 | 79.8 | 17.4** |
| Other | 5.2 | 13.6 | −8.4* | 2.8 | 20.2 | −17.4** |
| **Postsecondary degree/diploma (%)** | | | | | | |
| No | 27.6 | 33.7 | −6.1* | 51.5 | 49.3 | 2.2 |
| Yes | 72.4 | 66.3 | 6.1* | 48.5 | 50.7 | −2.2 |
| **Working status (%)** | | | | | | |
| Not retired | 86.7 | 81.8 | 4.9 | 26.8 | 18.4 | 8.4* |
| Retired | 13.3 | 16.3 | −3.0 | 73.3 | 69.7 | 3.6 |
| Never worked | n/a | 2.0 | n/a | n/a | 11.9 | n/a |
| **Total personal income (%)** | | | | | | |
| < $20 000 | 14.3 | 23.2 | −8.9* | 16.1 | 30.6 | −14.5** |
| $20 000–49 999 | 21.7 | 26.8 | −5.1* | 46.9 | 44.0 | 2.9 |
| $50 000–99 999 | 35.3 | 30.3 | 5.0* | 27.4 | 19.4 | 8.0* |
| $100 000–149 999 | 15.7 | 9.4 | 6.3* | 5.5 | 2.4 | 3.1 |
| ≥ $150 000 | 13.0 | 10.3 | 2.7 | 4.1 | 3.7 | 0.4 |
| **Internal migration status (%)[d]** | | | | | | |
| Non-movers | 97.0 | 92.6 | 4.4 | 97.9 | 95.6 | 2.3 |
| Moved home within community | 1.6 | 5.4 | −3.8 | 1.6 | 3.0 | −1.4 |
| Moved home and community | 1.4 | 1.3 | 0.1 | 0.6 | 0.9 | −0.3 |

**Footnotes on the following page**

**TABLE 1 (footnotes)**
**Comparison of baseline CLSA and 2011 NHS demographic characteristics by age group, Calgary data[a]**

Abbreviations: CLSA, Canadian Longitudinal Study on Aging; n/a, not applicable; NHS, National Household Survey.

[a] Calgary data are derived from the CLSA comprehensive sample from the Alberta data collection site, which is located in Calgary. Only participants living within Calgary's jurisdictional region were included in this analysis.

[b] Sample sizes are not weighted. All other proportions were adjusted for sampling probabilities using inflation weights provided by the CLSA, based upon the size of the community-dwelling population living near the data collection site in 2011.

[c] The "Canada" category was manually calculated and added to this variable for comparison purposes.

[d] Defined as a within-Canada household relocation within the past 5 years.

[*] Questionably important difference (5%–9%).

[**] Practically important difference (≥ 10%).

underrepresented. Differences in education were also questionable. Older CLSA participants (≥ 65 years) were more likely to be not retired.

### *Baseline CLSA (2011–2015) and 2016 Census comparisons*

Baseline CLSA (2011–2015) and 2016 Census data comparisons were similar to the CLSA and 2011 NHS comparisons with just a few exceptions (see Table 2). In the older age category, discrepancies in educational achievements were greater, achieving a practical versus questionable level of importance. For both age groups, differences in the proportions of participants who had moved within Canada during the past 5 years were of practical importance compared with the 2016 Census data.

## Discussion

CLSA data can be used to provide valuable insights into the social and physical characteristics of middle-aged and older adults in Canada. In addition to being a key data source for researchers, the CLSA is of potential use for all levels of governments that are trying to understand their aging population and evaluate the impact of age-friendly policies such as "aging-in-place" (i.e. safely remaining in one's community throughout older age).[17,18]

The sampling frame the CLSA employs ensures national and provincial representativeness of the sample by age and sex. At the national level, the CLSA sample, and particularly the comprehensive cohort, is characterized by higher levels of education and household income as well as higher percentages of Canadian-born participants, compared with 2011 Census data.[5] The objective of our study was to explore how well baseline data collected from CLSA participants (between 2011 and 2015) reflected the "true" population at a local municipal level. To do this, we compared these data with both the 2011 NHS and 2016 Census data. Establishing a baseline description of the population would also be helpful when using CLSA and other data sources to evaluate policy implementation over time, given the longitudinal design of the CLSA.

In general, we found the largest discrepancies between CLSA and 2016 Census estimates. While Calgary CLSA participants were representative for sex and Indigenous identity, marital status, ethnic diversity (i.e. immigrant status, place of birth and language spoken at home), education, working status, personal income and internal migration diverged from the true population. For some of these measures, the differences between CLSA and NHS/Census estimates were greater than 10%, which we viewed as of practical importance when using CLSA data to assess the local population. These findings suggest that CLSA data for municipally defined populations may underrepresent certain marginalized populations, which could affect interpretation. The importance of accounting for these differences will depend on the research questions being asked and how the results will be used.

We used Calgary as a case study for evaluating the representativeness of CLSA data at a municipal level. While we cannot comment on the representativeness of CLSA data for other municipalities, our findings may inform others who are considering using CLSA data to describe the health and well-being of their aging population to assess the impact of public policy.[19,20] Calgary differs from other Canadian cities in terms of its economic and sociodemographic profile.[21] Others are advised to conduct similar comparisons for their own local setting. This would be particularly applicable for other cities with CLSA data collection sites (i.e. Surrey, BC; Vancouver, BC; Victoria, BC; Winnipeg, MB; Hamilton, ON; Ottawa, ON; Montréal, QC; Sherbrooke, QC; Halifax, NS; and St. John's, NL). Although the CLSA was not designed to be representative at a municipal level, there is growing interest in using the data to address local questions.[21]

The CLSA's inclusion and exclusion criteria may partially account for some of the differences observed. Because CLSA participants were required to be fluent in English or French, this may have systematically eliminated some older people who had been born outside of Canada. It is unclear, however, why people who reported being born in Asia were particularly underrepresented in our setting. And while efforts were made to over-sample CLSA participants with lower levels of education,[5,6] we found that participants with lower-level education attainment were nonetheless underrepresented.

Because of provincial privacy legislation, sampling from provincial health registries was not permitted in Alberta or Quebec.[12] Calgary participants were exclusively recruited using random-digit dialling of landlines.[12] This use of landlines may help explain the overrepresentation of those who had not moved in the past 5 years. The proportion of Canadian households with a landline has diminished over the last few years.[22] In addition, it is likely that someone who has recently moved would be more inclined to only use mobile telephone services in their new community,[22] and at the time of baseline data collection, Calgary was experiencing a high level of net internal migration.[23]

The random-digit dialling approach may also help account for the underrepresentation of lower-income households; these households are more likely to report using mobile telephone services only and no landline.[22] In Australia, where telecommunications trends are similar to those in Canada, Barr et al. found that relying on landlines only when sampling for a cohort

**TABLE 2**
**Comparison of baseline CLSA and 2016 Census demographic characteristics by age group for Calgary data[a]**

| Characteristic | 45–64 years | | | ≥ 65 years | | |
|---|---|---|---|---|---|---|
| | CLSA | 2016 Census | Difference | CLSA | 2016 Census | Difference |
| Sample size (n)[b] | 1640 | 319 600 | – | 1207 | 127 880 | – |
| **Sex (%)** | | | | | | |
| Male | 50.7 | 50.0 | 0.7 | 46.5 | 46.8 | −0.3 |
| Female | 49.3 | 50.0 | −0.7 | 53.5 | 53.2 | 0.3 |
| **Marital status (%)** | | | | | | |
| Married/common-law | 81.7 | 73.1 | 8.6* | 68.0 | 64.1 | 3.9 |
| Single | 7.9 | 10.6 | −2.7 | 5.0 | 4.1 | 0.9 |
| Widowed | 2.2 | 2.2 | 0.0 | 17.0 | 18.8 | −1.8 |
| Divorced | 6.0 | 10.8 | −4.8 | 8.6 | 11.2 | −2.6 |
| Separated | 2.1 | 3.3 | −1.2 | 1.3 | 1.9 | −0.6 |
| **Immigrant status (%)[c]** | | | | | | |
| Immigrant | 16.7 | 38.1 | −21.4** | 25.4 | 43.6 | −18.2** |
| Non-immigrant | 83.3 | 61.0 | 22.3** | 74.6 | 56.0 | 18.6** |
| **Place of birth (%)[d]** | | | | | | |
| Canada | 83.3 | 61.6 | 21.7** | 74.6 | 56.2 | 18.4** |
| Other North America | 1.5 | 1.2 | 0.3 | 1.7 | 1.4 | 0.3 |
| South America, Central America, Caribbean | 2.0 | 3.2 | −1.2 | 1.5 | 2.5 | −1.0 |
| Europe | 8.6 | 7.9 | 0.7 | 19.6 | 17.3 | 2.3 |
| Africa | 0.6 | 3.3 | −2.7 | 0.9 | 2.4 | −1.5 |
| Asia | 3.2 | 22.4 | −19.2** | 1.4 | 19.8 | −18.4** |
| Oceania and others | 0.9 | 0.4 | 0.5 | 0.3 | 0.5 | −0.2 |
| **Indigenous identity (%)** | | | | | | |
| Indigenous | 3.7 | 2.3 | 1.4 | 2.3 | 1.3 | 1.0 |
| Non-Indigenous | 96.3 | 97.7 | −1.4 | 97.7 | 98.7 | −1.0 |
| **Language most spoken at home (%)** | | | | | | |
| English/French | 94.8 | 82.5 | 12.3** | 97.2 | 79.5 | 17.7** |
| Other language | 5.2 | 17.5 | −12.3** | 2.8 | 20.5 | −17.7** |
| **Postsecondary degree/diploma (%)** | | | | | | |
| No | 27.6 | 33.6 | −6.0* | 23.0 | 47.8 | −24.8** |
| Yes | 72.4 | 66.4 | 6.0* | 77.0 | 52.2 | 24.8** |
| **Working status (%)** | | | | | | |
| Not retired | 86.7 | 80.6 | 6.1* | 26.8 | 20.2 | 6.6* |
| Retired | 13.3 | 19.4 | −6.1* | 73.3 | 79.8 | −6.5* |
| **Total personal income (%)** | | | | | | |
| < $20 000 | 14.3 | 18.8 | −4.5 | 16.1 | 26.3 | −10.2** |
| $20 000–49 999 | 21.7 | 26.2 | −4.5 | 46.9 | 43.8 | 3.1 |
| $50 000–99 999 | 35.3 | 31.0 | 4.3 | 27.4 | 21.6 | 5.8* |
| $100 000–149 999 | 15.7 | 11.9 | 3.8 | 5.5 | 4.1 | 1.4 |
| ≥ $150 000 | 13.0 | 12.1 | 0.9 | 4.1 | 4.2 | −0.1 |
| **Internal migration status (%)[e]** | | | | | | |
| Non-movers | 97.0 | 70.0 | 27.0** | 97.9 | 80.3 | 17.6** |
| Moved home within community | 1.6 | 20.9 | −19.3** | 1.6 | 13.1 | −11.5** |
| Moved home and community | 1.4 | 9.0 | −7.6* | 0.6 | 6.6 | −6.0* |

**Footnotes on the following page**

**TABLE 2 (footnotes)**
**Comparison of baseline CLSA and 2016 Census demographic characteristics by age group for Calgary data[a]**

**Abbreviations:** CLSA, Canadian Longitudinal Study on Aging; NHS, National Household Survey.

[a] Calgary data are derived from the CLSA Comprehensive sample from the Alberta data collection site, which is located in Calgary. Only participants living within Calgary's jurisdictional region were included in this analysis.

[b] Sample sizes are not weighted. All other proportions were adjusted for sampling probabilities using inflation weights provided by the CLSA, based upon the size of the community-dwelling population living near the data collection site in 2011.

[c] Percentages for 2016 data do not add up to 100% as we do not include a "non-permanent resident" category (not included in the CLSA).

[d] The "Canada" category was manually calculated and added to this variable for comparison purposes.

[e] Defined as a within-Canada household relocation within the past 5 years.

[*] Questionably important difference (5%–9%).

[**] Practically important difference (≥ 10%).

study reduced the accuracy of estimates for certain health indicators compared with when using a combination of landline and mobile phones.[24]

Our decision to remove CLSA participants who lived outside of the City of Calgary jurisdiction from our analysis may have also influenced the extent to which the representativeness of the sampling frame was maintained.

## *Strengths*

Strengths of this study include the relative novelty of assessing the representativeness of a municipally defined subsample of CLSA participants on characteristics other than age and sex. A similar methodological approach has been applied to comparable data sources in France,[7] Australia[9] and the USA,[10] and more recently in Canada.[8,11]

The CLSA research team has explored and reported on the extent to which the CLSA cohort is representative, at a national level, on select sociodemographic characteristics.[5] This current research investigates this question at the municipal level, addressing concerns that representativeness at the municipal level of analysis might differ from that found at the national level. Our endeavour is relevant, as interest in using CLSA data for municipally driven age-friendly initiatives is growing, and those using CLSA data to evaluate, for example, the impact of age-friendly policy, should be aware that some local subgroups may not be well represented. Identifying discrepancies between the characteristics of CLSA participants and the "true" population, coupled with thoughtful judgements about the importance of these discrepancies in understanding the state of the older local population, will help guide policy makers in applying their findings.

Our current study also contributes to the growing interest in population health intervention research methodologies focussing on activities that lie outside of traditional public health or health care jurisdictions that influence the health and well-being of the population.[25] As the CLSA begins to release longitudinal data, understanding the generalizability of the data will equip policy makers and academic researchers to make more informed interpretations of the potential connection between policy implementation and population health.

## *Limitations*

Our study offers a model that others can adapt to their own municipal contexts. Nevertheless, there are also a number of limitations to consider. For instance, we made judgements based on what we considered to be practically or questionably important differences between CLSA and 2011 NHS or 2016 Census data. There is no consistent precedent for these judgements in the literature.

Another limitation is the exclusion of missing CLSA data from this analysis. For most variables, the proportion was nominal, but for one (i.e. "personal income") the proportion was above the desired threshold of 5% that we had established. Although high rates of missing income data are not unusual in population-based studies, this leads to a less precise categorization of the variable and possibly a degree of bias if the missing values are clustered within particular social subgroups.[26] However, the consistency of the trends in several variables (i.e. retirement and education in relation to income; immigration status and place of birth in relation to ethnic diversity) affirms our cautious conclusions regarding the representativeness of the CLSA sample. As already noted, the CLSA was not designed to provide representative data at a municipal level.

It is also important to note limitations with the census data sources that we used as proxies for the "true" population. We used Canadian population data from both 2011 and 2016 as comparison data because these straddled the period when CLSA baseline data were collected. Changes in federal government policies to do with privacy led to permitting voluntary versus mandatory completion of portions of Canada's 2011 Census. This decision was reversed in time for the 2016 Census.[27] Although the national weighted response rate was 77.2% for the NHS,[15] the voluntary nature of participation may have introduced systematic biases into this dataset. Future waves of CLSA data should be compared with 2016 and subsequent census datasets, where participation is mandatory and the true population is better reflected.

The public use microdata file used to access the 2011 NHS data and the "Beyond 20/20" aggregated tables used to access the 2016 Census data report on just 25% of the data collected. Most municipalities will have access to these publicly available forms of census data in conducting their evaluation activities.

Finally, recoding variables contained within these data sources in order to make meaningful comparisons with CLSA data posed methodological challenges. These included merging age groups, as was necessary for both the 2011 and 2016 Census data. We also note that our decision to use "Not in the labour force" to indicate retirement may have led to an inflated number of people considered retired in both datasets. However, these data are counterbalanced by comparisons of those reporting being "not retired" in the CLSA and those

reporting being in the labour force in both the 2011 NHS and 2016 Census questionnaires.

Our analysis provides a case study that focuses on a single municipality. Exploring the representativeness in other municipalities with a CLSA data collection site was beyond the scope of our research objectives, data application agreement for the use of CLSA data and institutional ethics approval. We intended that our work support the City of Calgary in their exploration of data sources that could be used in the evaluation of their age-friendly strategy.[3]

## Conclusion

The CLSA is a valuable national resource for extending our understanding of determinants of health and well-being later in life, yet voluntary studies face challenges in recruiting representative cohorts. Our study examined the extent to which the baseline CLSA sample is representative of the actual Canadian population at the municipal level, specifically for Calgary, Alberta. Notable differences in sociodemographic characteristics were observed between the CLSA subsample of Calgary participants surveyed between 2011 and 2015 and true comparable populations as described by 2011 NHS and 2016 Census data. Ethnic diversity was underrepresented within Calgary's CLSA subsample, as were older participants reporting lower education and personal income.

Researchers and policy makers who use this important dataset to explore locally defined populations should also be aware of the potential sampling limitations. We recommend that municipalities that utilize CLSA data at a local level conduct a similar analysis to the one we performed, comparing geographically defined CLSA data with local or national census data. The use of multiple data sources is also recommended in order to triangulate or enrich interpretation of the findings obtained, especially those with implications for traditionally underserved populations such as lower socioeconomic status and ethnically diverse older adults.

## Ethics approval

REB approval obtained (University of Calgary REB17-0692).

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## Conflicts of interest

Dr. David B. Hogan is the Local Responsible Investigator for the Calgary data collection site of the Canadian Longitudinal Study on Aging.

## Authors' contributions and statement

AMT and DBH developed the research objectives and research design. SJN and SJ led the analysis of the data. SJN and AMT led the drafting and revising of the manuscript. All authors contributed to interpreting the data and revising the manuscript. All authors approved the manuscript for publication.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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# Original quantitative research

# Effects of removing a fee-for-service incentive on specialist chronic disease services: a time-series analysis

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This article has been peer reviewed.



## Abstract

**Introduction:** Physician payment models are known to affect the nature and volume of services provided. Our objective was to study the effects of removing a financial incentive, the fee-for-service premium, on the provision of chronic disease follow-up services by internal medicine, cardiology, nephrology and gastroenterology specialists.

**Methods:** We collected linked administrative health care data for the period 1 April 2013 to 31 March 2017 from databases held at the Institute for Clinical Evaluative Sciences (ICES) in Ontario, Canada. We conducted a time-series analysis before and after the removal of the fee-for-service premium on 1 April 2015. The primary outcome was total monthly visits for chronic disease follow-up services. Secondary outcomes were monthly visits for total follow-up services and new patient consultations. We compared internal medicine, cardiology, nephrology and gastroenterology specialists practising during the study timeframe with respirology, hematology, endocrinology, rheumatology and infectious diseases specialists who remained eligible to claim the premium. We chose this comparison group as these are all subspecialties of internal medicine, providing similar services.

**Results:** The number of chronic disease follow-up visits decreased significantly after removal of the premium, but there was no decrease in total follow-up visits. There was also a significant downward trend in new patient consultations. No changes were observed in the comparison group.

**Conclusion:** The decrease in volume of chronic disease follow-up visits can be explained by diagnostic criteria being met less often, rather than an actual reduction in services provided. Potential effects on patient outcomes require further exploration.

***Keywords:*** *physicians, chronic disease, remuneration, specialization, fee-for-service, economics*

### *Highlights*

- Chronic disease patients are mostly looked after by fee-for-service specialists.
- Fee-for-service payment models promote high service volumes.
- Removing a financial incentive for chronic disease follow-up visits led to a decrease in volume of those visits, without affecting total follow-up service volumes.
- Our results suggest that specialists changed their practices, but it remains unclear if this included providing fewer services to patients with chronic disease, increasing higher-paying services or both.
- This work suggests that policymakers must expect that changes to fee schedules may affect service provision in unanticipated ways.

## Introduction

The prevalence of chronic diseases is increasing as our population ages.[1] Specialist physicians see the patients with the most complex situations, with multiple comorbidities, who cannot be managed solely in primary care. Specialists often provide continuity of care in the form of outpatient office follow-up.

In Canada, specialists are typically paid on a fee-for-service basis; their counterparts in primary care are often remunerated via other payment models, including capitation. Although there is evidence for the effects of payment models on outcomes in primary care, evidence on the extent to which they affect the provision of services by specialists is less abundant. The removal of a premium code, representing a financial incentive for chronic disease follow-up care by specialists in Ontario, Canada, provided an opportunity to study changes in physician practice.

Effective 1 April 2015, the physician specialities of internal medicine, nephrology, gastroenterology and cardiology, practising in Ontario, were no longer eligible to claim a chronic disease premium code listed in the Ontario Health Insurance Program's (OHIP) Schedule of Benefits.[2] The code (E078) added a 50% increase in pay on top of follow-up assessment fees, so long as the claim was accompanied by one of 26 eligible diagnostic codes,

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amounting to an additional $19–$40 per service.[3] The rationale for removing the E078 code was not made clear, although the timing coincided with a number of changes to payments for physician services and cost-saving measures by Ontario's Ministry of Health and Long-Term Care (MOHLTC). Although the code was removed for these higher billing subspecialties of internal medicine, it remained eligible for others, including respirology, endocrinology, rheumatology, hematology and infectious diseases. Other specialties, including oncology and pediatrics, also remained eligible, but for this study we focussed on subspecialties of internal medicine, for their inherently comparable practice style and patient populations.

The removal of the E078 financial incentive for chronic disease follow-up allowed us to study the real-world effect, within the context of a fee-for-service payment model. Our objective was to determine if the volume of chronic disease follow-up visits provided by specialists changed following removal of E078 from the fee schedule. In this time-series analysis, we hypothesized that there would be a reduction in volume of chronic disease follow-up visits by specialists from whom the code was removed, and that there would be no such change in a group of specialists for whom the code remained.

## Methods

### Study design

We conducted a retrospective interrupted time-series analysis of physician services between 1 April 2013 and 31 March 2017, using linked health administrative databases from Ontario. Physician and hospital services in Ontario are covered by a public single-payer insurance program. The fiscal year-end of the insurance program is March 31st. Specialist physicians submit claims to OHIP and are reimbursed on a fee-for-service basis. The reporting of this study follows the guidelines outlined in the RECORD statement for observational studies.[4]

### Data sources

We used five linked databases to conduct this study. Datasets were linked using unique encoded identifiers and analyzed at ICES. We determined physician specialty using the Corporate Provider Database. Physician demographics and service volumes were determined using the ICES Physician Database. For information on physician services, billing claims and their associated diagnostic codes, we used the OHIP Claims database. The Registered Persons Database was used to obtain patient demographics and vital statistics. The Canadian Institute for Health Information's Discharge Abstract Database was used for comorbidity and hospitalization data. Programming of data extraction was done according to a prespecified dataset creation plan, available on request.

### Study population

We assembled a cohort of two groups of specialist physicians who bill fee-for-service. The first group included specialists who were no longer eligible to claim the chronic disease financial incentive, represented by the E078 premium code, after 1 April 2015 (internal medicine, nephrology, gastroenterology and cardiology). We refer to this group as "E078-removed." The second group remained eligible to claim the premium throughout the study timeframe; their subspecialties included endocrinology, respirology, rheumatology, hematology and infectious diseases. We refer to this group as "E078-remained." All physicians in the study were eligible to claim internal medicine fee codes; subspecialists (e.g. cardiologists) could also claim fee codes specific to their subspecialty. This is because subspecialists are doubly certified in internal medicine and their subspecialty.

To ensure their eligibility to claim for health services in Ontario, all physicians were required to have an OHIP specialty designation dated prior to 1 April 2013 and ceasing no earlier than 31 March 2017. Moreover, we excluded physicians who billed fewer than 100 annual claims during any year of the study to ensure they were actively practising in Ontario. To confirm that physicians were providing the chronic disease management services of interest, we excluded those who did not claim an E078 premium code during the 2 years prior to its removal.

We gathered data on physician demographics at 1 April 2013, including age, sex, location of medical school graduation, number of years since graduation and rural versus urban practice location. We used the ICES Physician Database to determine the relative full-time-equivalent, percentage of remuneration from fee-for-service claims, total number of visits, emergency department visits, outpatient office visits and hospital visits provided by physicians for fiscal years 2013 and 2015. Using OHIP data, we determined the relative percentage of claims, for each group, made using their internal medicine versus other subspecialty designations.

Because changes in physician service provision could affect the frequency of visits and which patients receive access to care, we created two groups of patients for comparison before and after the removal of E078 premium code. The first group included patients who had an outpatient assessment by at least one of the study physicians between 1 April 2013 and 31 March 2014. The second group met the same criteria but for the timeframe between 1 April 2016 and 31 March 2017. Although the patient groups were not identical, they could include a number of the same individuals. We collected demographic and clinical variables for these patients, including age, sex, regional income quintile, rurality (Statistics Canada definition), Charlson Comorbidity Score, receipt of any E078-eligible chronic disease diagnoses and number of annual consultation or follow-up visits.[5,6]

### Intervention and outcome variables

The intervention in this study was the removal of eligibility to claim the E078 chronic disease premium, effective 1 April 2015, from the E078-removed group of specialists. The primary outcome was the monthly rate of chronic disease follow-up visits, according to E078 premium code eligibility, between 1 April 2013 and 31 March 2017.

Secondary outcomes were monthly visits for the same follow-up services, disregarding E078-specific diagnoses, and monthly visits for new patient consultations. We tracked consultations because specialists could have reallocated their time in favour of these higher-paying services. The same outcomes were determined for the comparator E078-remained group.

### Statistical analysis

We compared the baseline characteristics between the E078-removed and E078-remained physicians using T-tests for continuous variables and chi-squared tests for categorical variables where a *p*-value of less than 0.05 was considered significant. For each group of physicians, we compared

baseline characteristics of patients seen before and after the intervention using standardized differences. A difference of greater than 10% represented a meaningful imbalance.

We used interventional autoregressive integrated moving average (ARIMA) interrupted time-series models to examine the effect of removing the premium on chronic disease follow-up visits, total follow-up visits and new patient consultations. We fit ARIMA models within both the E078-removed group and the E078-remained group for each outcome, adjusting for serial correlation and seasonality. We evaluated the effect of the intervention by testing for differences in the magnitude and trend of total monthly visits before and after 1 April 2015 for each model.

All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

### *Ethics approval*

The use of data in this project was authorized under section 45 of the province of Ontario's *Personal Health Information Protection Act*, which does not require review by a research ethics board.

## Results

After exclusions, we obtained a total cohort of 2560 physicians, with 1826 (71%) in the E078-removed group. The cohort was mostly composed of urban-based, mid- to late-career physicians (Table 1). The E078-removed group was more than 2 years older, on average, and had fewer women than the E078-remained group (22.3% vs. 43.5%).

On average, physicians in both groups maintained greater than one full-time-equivalent workload (comparing cohort physicians' total payments to averages within their subspecialties) before and after the intervention. Fee-for-service income accounted for most of the remuneration of both groups.

The E078-removed group provided significantly fewer total annual visits during the year after the intervention, driven by a decrease in outpatient office visits (Table 2). Conversely, the E078-remained group provided significantly more total annual visits, driven by an increase in outpatient office visits. Comparing fiscal years 2016/17 to 2013/14, the E078-removed group saw 4.3% more patients after the intervention, while the E078-remained group saw 11.4% more patients (Table 3).

There were no substantial differences in patient demographics or frequency of physician visits for either group. The only substantial difference found in patient factors was a reduction in the diagnosis of hypertensive heart disease for patients seen by an E078-removed group physician (8.6% before versus 4.6% after).

Claims for the E078 premium code, by the E078-removed group, dropped from approximately 60 000 per month to 5 000 per month after the intervention point (Figure 1). Claims by the E078-remained group stayed steady, ranging between 40 000 to 50 000 per month throughout the study timeframe.

When we plotted visits for follow-up services submitted as internal medicine specialists versus other subspecialty designations, we found no change for the E078-removed group. There was a reduction

**TABLE 1**
**Characteristics of specialist physicians, comparing those no longer eligible to claim the E078 chronic disease premium after 1 April 2015 with those who remained eligible**

| Characteristic | E078-removed group[a] n = 1826 | E078-remained group[b] n = 734 | *p*-value |
|---|---|---|---|
| **Demographic data** | | | |
| **Age at cohort entry, years** | | | |
| Mean (SD) | 50.0 (12.0) | 47.9 (10.4) | < 0.01 |
| Median (IQR) | 48 (40–59) | 47 (39–56) | – |
| **Female sex, n (%)** | 407 (22.3) | 319 (43.5) | < 0.01 |
| **Specialty, n (%)** | | | |
| Internal medicine | 989 (54.2) | – | – |
| Cardiology | 444 (24.3) | – | – |
| Gastroenterology | 237 (13.0) | – | – |
| Nephrology | 156 (8.5) | – | – |
| Respirology | – | 177 (24.1) | – |
| Endocrinology | – | 163 (22.2) | – |
| Rheumatology | – | 157 (21.4) | – |
| Hematology | – | 136 (18.5) | – |
| Infectious diseases | – | 101 (13.8) | – |
| **Years since medical school graduation** | | | |
| Mean (SD) | 24.1 (12.5) | 21.9 (10.9) | < 0.01 |
| Median (IQR) | 22 (14–33) | 20 (13–30) | – |
| **Medical degree from outside Canada, n (%)** | 397 (21.7) | 107 (14.6) | < 0.01 |
| **Rural practice address, n (%)** | 11 (0.6) | ≤ 5 | 0.12 |
| **Physician payment data, mean (SD)** | | | |
| **Average full-time-equivalent[c]** | | | |
| Fiscal year 2013[d] | 1.1 (0.4) | 1.1 (0.5) | 0.03 |
| Fiscal year 2015[d] | 1.1 (0.4) | 1.1 (0.4) | 0.45 |
| **Percent fee-for-service income** | | | |
| Fiscal year 2013[d] | 90.8 (18.7) | 79.3 (29.5) | < 0.01 |
| Fiscal year 2015[d] | 88.9 (27.7) | 77.2 (31.2) | < 0.01 |

**Abbreviations:** IQR, interquartile range; SD, standard deviation.

[a] E078-removed group includes internal medicine, cardiology, nephrology and gastroenterology specialists.

[b] E078-remained group includes respirology, endocrinology, rheumatology, hematology and infectious diseases specialists.

[c] Full-time-equivalent is determined by ratio of a physician's total payment to the average payment for their specialty.

[d] Ontario's fiscal year is from April 1st of the indicated year to March 31st of the following year.

**TABLE 2**
**Comparison of visits provided by specialist physicians before and after changes in eligibility to claim the E078 chronic disease premium**

| Visits | Physician medical practice data, mean number (SD) | | *p*-value |
|---|---|---|---|
| | Before removal of E078 premium – fiscal year 2013[a] | After removal of E078 premium – fiscal year 2015[b] | |
| **E078-removed group[c]** | | | |
| Total patient visits[d] | 3041 (2000) | 2857 (1878) | <0.01 |
| Office visits | 2169 (1850) | 2018 (1741) | 0.01 |
| Emergency department visits | 81 (168) | 83 (172) | 0.78 |
| Hospital visits | 785 (934) | 750 (904) | 0.25 |
| **E078-remained group[e]** | | | |
| Total patient visits[d] | 3155 (2236) | 3400 (2432) | 0.05 |
| Office visits | 2603 (2102) | 2894 (2340) | 0.01 |
| Emergency department visits | 32 (101) | 28 (95) | 0.38 |
| Hospital visits | 516 (711) | 473 (702) | 0.25 |

[a] The Ontario fiscal year from 1 April 2013 to 31 March 2014.

[b] The Ontario fiscal year from 1 April 2015 to 31 March 2016.

[c] E078-removed group includes internal medicine, cardiology, nephrology and gastroenterology specialists.

[d] Total patient visits include emergency department, hospital, office, home and long-term care visits.

[e] E078-remained group includes respirology, endocrinology, rheumatology, hematology and infectious diseases specialists.

**TABLE 3**
**Comparison of characteristics of patients seen by specialist physicians before and after changes in eligibility to claim the E078 chronic disease premium**

| Characteristic | E078-removed group[a] | | | E078-remained group[b] | | |
|---|---|---|---|---|---|---|
| | Before removal of E078 premium – fiscal year 2013[c] | After removal of E078 premium – fiscal year 2016[d] | Standardized difference[e], % | Before removal of E078 premium – fiscal year 2013[c] | After removal of E078 premium – fiscal year 2016[d] | Standardized difference[e], % |
| | n = 994 518 | n = 1 037 302 | | n = 467 324 | n = 520 554 | |
| **Demographic data** | | | | | | |
| **Age, years** | | | | | | |
| Mean (SD) | 58.5 (18.3) | 59.8 (17.9) | 7 | 56.5 (17.6) | 57.1 (17.6) | 4 |
| Median (IQR) | 61 (47–72) | 62 (49–73) | | 58 (45–69) | 59 (46–70) | |
| Female sex, n (%) | 493 913 (49.7) | 508 753 (49.0) | 1 | 278 768 (59.7) | 308 505 (59.3) | 1 |
| **Regional income quintile, n (%)** | | | | | | |
| Quintile 1 | 185 984 (18.7) | 211 862 (20.4) | 4 | 81 827 (17.5) | 101 605 (19.5) | 5 |
| Quintile 2 | 198 903 (20.0) | 216 293 (20.9) | 2 | 89 463 (19.1) | 104 001 (20.0) | 2 |
| Quintile 3 | 198 588 (20.0) | 208 377 (20.1) | 0 | 92 952 (19.9) | 103 881 (20.0) | 0 |
| Quintile 4 | 208 024 (20.9) | 196 232 (18.9) | 5 | 100 968 (21.6) | 101 641 (19.5) | 5 |
| Quintile 5 | 199 423 (20.1) | 202 575 (19.5) | 1 | 100 352 (21.5) | 108 466 (20.8) | 2 |
| Rural residence, n (%) | 87 271 (8.8) | 82 824 (8.0) | 3 | 34 933 (7.5) | 34 479 (6.6) | 3 |
| **Charlson Comorbidity Score[f], n (%)** | | | | | | |
| 0 | 91 840 (9.2) | 93 761 (9.0) | 1 | 41 819 (8.9) | 45 011 (8.6) | 1 |
| 1 | 46 998 (4.7) | 48 395 (4.7) | 0 | 21 489 (4.6) | 23 277 (4.5) | 1 |
| 2+ | 81 059 (8.2) | 86 485 (8.3) | 1 | 37 333 (8.0) | 40 433 (7.8) | 1 |
| No hospitalizations | 774 621 (77.9) | 808 661 (78.0) | 0 | 366 683 (78.5) | 411 833 (79.1) | 2 |
| **E078-eligible diagnosis, n (%)** | | | | | | |
| AIDS | 1418 (0.1) | 1592 (0.2) | 0 | 2766 (0.6) | 3312 (0.6) | 1 |
| AIDS-related complex | 617 (0.1) | 627 (0.1) | 0 | 2067 (0.4) | 1933 (0.4) | 1 |
| HIV infection | 1172 (0.1) | 1227 (0.1) | 0 | 3306 (0.7) | 3550 (0.7) | 0 |

**Continued on the following page**

**TABLE 3 (continued)**
**Comparison of characteristics of patients seen by specialist physicians before and after changes in eligibility to claim the E078 chronic disease premium**

| Characteristic | E078-removed group[a] | | | E078-remained group[b] | | |
|---|---|---|---|---|---|---|
| | Before removal of E078 premium – fiscal year 2013[c] | After removal of E078 premium – fiscal year 2016[d] | Standardized difference[e], % | Before removal of E078 premium – fiscal year 2013[c] | After removal of E078 premium – fiscal year 2016[d] | Standardized difference[e], % |
| | n = 994 518 | n = 1 037 302 | | n = 467 324 | n = 520 554 | |
| Diabetes mellitus | 221 786 (22.3) | 239 069 (23.0) | 2 | 133 400 (28.5) | 153 875 (29.6) | 2 |
| Coagulation defects | 9586 (1.0) | 8731 (0.8) | 1 | 8009 (1.7) | 8451 (1.6) | 1 |
| Hemorrhagic conditions | 9367 (0.9) | 9585 (0.9) | 0 | 9895 (2.1) | 10 349 (2.0) | 1 |
| Dementia | 29 461 (3.0) | 33 575 (3.2) | 2 | 11 471 (2.5) | 13 509 (2.6) | 1 |
| Parkinson's disease | 6122 (0.6) | 6980 (0.7) | 1 | 2289 (0.5) | 2826 (0.5) | 1 |
| Multiple sclerosis | 2459 (0.2) | 2622 (0.3) | 0 | 1445 (0.3) | 1624 (0.3) | 0 |
| Cerebral palsy | 466 (<0.1) | 461 (<0.1) | 0 | 276 (0.1) | 328 (0.1) | 0 |
| Epilepsy | 9152 (0.9) | 9880 (1.0) | 0 | 4331 (0.9) | 5174 (1.0) | 1 |
| Hypertensive heart disease | 85 887 (8.6) | 47 799 (4.6) | 16 | 15 140 (3.2) | 10 241 (2.0) | 8 |
| Congestive heart failure | 79 332 (8.0) | 80 529 (7.8) | 1 | 21 113 (4.5) | 22 396 (4.3) | 1 |
| Chronic bronchitis | 23 194 (2.3) | 23 855 (2.3) | 0 | 16 650 (3.6) | 19 669 (3.8) | 1 |
| Emphysema | 19 335 (1.9) | 21 157 (2.0) | 1 | 17 073 (3.7) | 20 113 (3.9) | 1 |
| Asthma, allergic bronchitis | 63 141 (6.3) | 58 486 (5.6) | 3 | 44 664 (9.6) | 50 474 (9.7) | 0 |
| Pulmonary fibrosis | 6566 (0.7) | 7780 (0.8) | 1 | 7825 (1.7) | 9986 (1.9) | 2 |
| Crohn's disease | 24 464 (2.5) | 25 088 (2.4) | 0 | 3633 (0.8) | 3987 (0.8) | 0 |
| Ulcerative colitis | 23 793 (2.4) | 24 945 (2.4) | 0 | 3307 (0.7) | 3714 (0.7) | 0 |
| Cirrhosis of the liver | 19 622 (2.0) | 21 074 (2.0) | 0 | 4503 (1.0) | 5325 (1.0) | 1 |
| Chronic renal failure | 88 826 (8.9) | 99 074 (9.6) | 2 | 23 468 (5.0) | 27 573 (5.3) | 1 |
| Lupus, scleroderma, dermatomyositis | 10 115 (1.0) | 11 001 (1.1) | 0 | 19 538 (4.2) | 22 150 (4.3) | 0 |
| Rheumatoid arthritis, Still's disease | 25 251 (2.5) | 25 935 (2.5) | 0 | 53 790 (11.5) | 57 450 (11.0) | 1 |
| Ankylosing spondylitis | 3612 (0.4) | 3997 (0.4) | 0 | 8666 (1.9) | 10 381 (2.0) | 1 |
| Seronegative spondyloarthropathies | 5096 (0.5) | 6383 (0.6) | 1 | 14 342 (3.1) | 17 490 (3.4) | 2 |
| Chromosomal anomalies | 2207 (0.2) | 2527 (0.2) | 0 | 2567 (0.5) | 3548 (0.7) | 2 |
| **Specialist physician visits** | | | | | | |
| **Annual follow-up assessments, n** | | | | | | |
| Mean (SD) | 2.5 (2.6) | 2.6 (2.7) | 4 | 3.0 (3.1) | 3.1 (3.1) | 2 |
| Median (IQR) | 2 (1–3) | 2 (1–3) | | 2 (1–4) | 2 (1–4) | |
| **Annual new consultations, n** | | | | | | |
| Mean (SD) | 0.7 (1.1) | 0.8 (1.1) | 3 | 0.8 (1.1) | 0.8 (1.1) | 1 |
| Median (IQR) | 0 (0–1) | 0 (0–1) | | 0 (0–1) | 0 (0–1) | |

**Abbreviations:** IQR, interquartile range; SD, standard deviation.

[a] E078-removed group includes internal medicine, cardiology, nephrology and gastroenterology specialists.

[b] E078-remained group includes respirology, endocrinology, rheumatology, hematology and infectious diseases specialists.

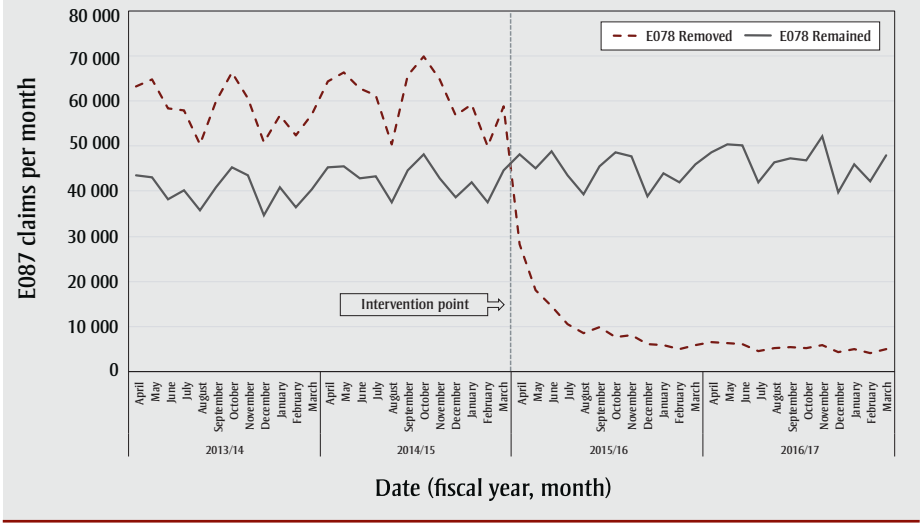
[c] The Ontario fiscal year from 1 April 2013 to 31 March 2014.

[d] The Ontario fiscal year from 1 April 2016 to 31 March 2017.

[e] Standardized difference is the difference between group means as a percentage of pooled standard deviation. A difference greater than 10% represents a meaningful imbalance.

[f] Charlson Comorbidity Score is predictive of health services use and mortality. Diagnostic inputs are derived from hospitalization data. If no hospitalization occurred within 2 years of cohort entry, no score is reported.

**FIGURE 1**
**Monthly claims of the E078 chronic disease premium by specialist physicians**




by more than 90% in visits submitted as internal medicine, following the intervention, by the E078-remained group (data available by request).

In our time-series analysis, the E078-removed group demonstrated a significant drop in chronic disease follow-up visits for eligible diagnoses immediately following the intervention point, by a factor of 0.86 ($p < 0.0001$, 95% CI: 0.82–0.90), and in the monthly trend following, by a factor of 0.99 ($p < 0.0001$, 95% CI: 0.98–0.99). There was no significant change in the E078-remained group at either the intervention point (95% CI: 0.95–1.07) or in the monthly trend following (95% CI: 0.99–1.01) (Figure 2).

Time-series analyses of secondary outcomes did not demonstrate significant changes in total follow-up visits, which disregard the diagnostic criteria for the E078 premium (Figure 3). Although there was no change in new patient consultations at the intervention point, there was a significant decrease in the monthly trend following the intervention, by a factor of 0.99 ($p < 0.05$, 95% CI: 0.99–1.00), in the E078-removed group.

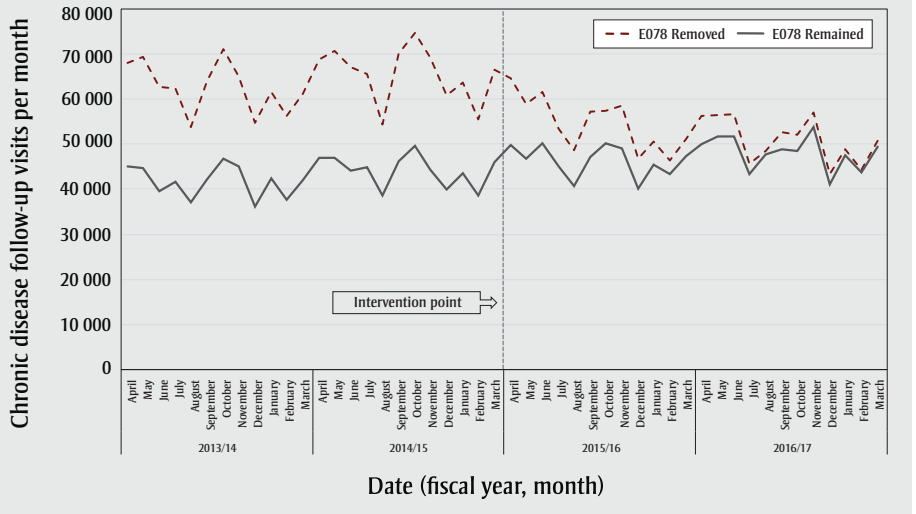
## Discussion

In this time-series analysis, we identified a reduction in the monthly volume of chronic disease follow-up visits provided by internal medicine, nephrology, gastroenterology and cardiology specialists following removal of the E078 chronic disease premium from the OHIP Schedule of Benefits. In comparison, there was no significant change in chronic disease follow-up visits by respirology, endocrinology, rheumatology, hematology and infectious disease specialists, who remained eligible to claim the premium.

We analyzed two secondary outcomes: total follow-up visits (not limited to E078-eligible diagnoses) and new patient consultations. The only significant change was a downward trend in new patient consultations provided by the E078-removed group, confirming that the provision of services did not skew in favour of consultations, which pay 2 to 4 times more than follow-ups. Since chronic disease follow-up visits are a subset of total follow-up visits, and the rate of the latter did not change, we concluded that the formerly E078-eligible diagnostic codes were being applied less often by the E078-removed group following the intervention. This is understandable, from the standpoint of economic behaviour, as a financial incentive for the E078-removed group to designate certain diagnoses over others no longer existed. This is supported by our baseline data for patients seen by an E078-removed group physician, revealing that patients were less likely to have been assigned a diagnostic code for hypertensive heart disease after the intervention. Patients seen by specialists often have more than one chronic disease. Therefore, more than one diagnostic code may apply. However, our findings cannot resolve whether specialists were assigning diagnostic codes that accurately reflected the condition for which the patient sought care, versus a stable comorbidity that would have met criteria for the E078 premium.

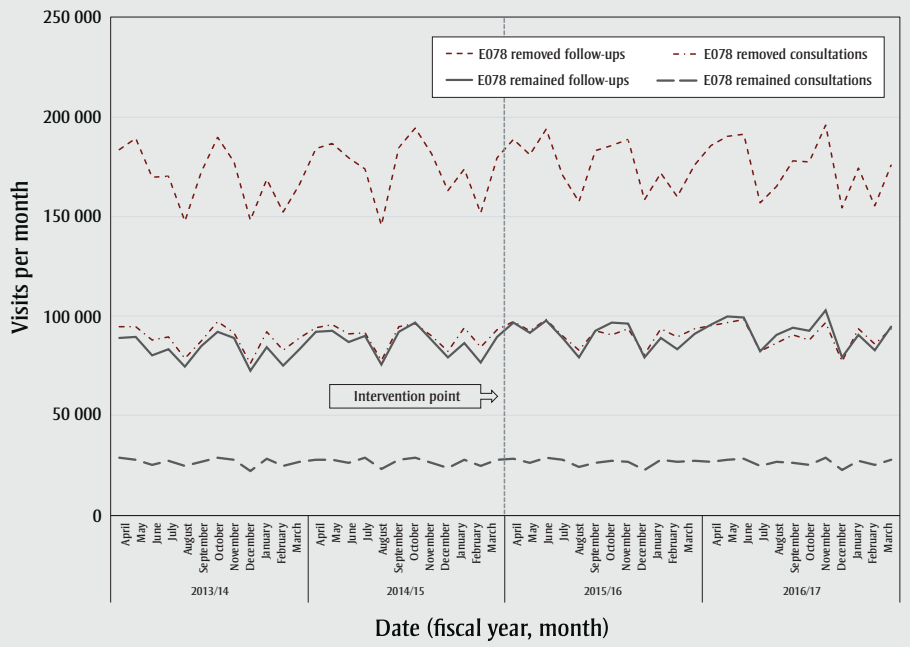
The reduction in use of internal medicine versus other subspecialty-specific billing codes by the E078-remained group may also be explained by economic behaviour. For example, after E078 was removed, an endocrinologist would not receive the premium when claiming internal medicine service codes, but would receive the premium when claiming endocrinology codes. Even though the endocrinologist could claim either set of codes, the rational option would be to use their subspecialty-specific ones, remaining eligible for premium payment.

**FIGURE 2**
**Monthly chronic disease follow-up visits by specialist physicians**




**Note:** E078-eligibility criteria include an assessment fee code plus one of 26 eligible chronic disease diagnoses.

**FIGURE 3**
**Monthly visits for total follow-up services and consultations by specialist physicians, which need not meet criteria for E078-eligibility**




Removal of the E078 premium represented a one-third reduction in remuneration for eligible services. In response to this, a physician could either increase the volume of these same services to make up for losses or shift their allocation of services to higher-paying tasks. We now know that the E078-removed group did not significantly increase their volume of follow-up services, nor did they shift to provide more consultations. In fact, they experienced a downward trend in providing new patient consultations, which aligns with our baseline data revealing a significant reduction in average total office visits provided in the year following loss of the premium. Given that physicians in the study were already working at greater than one full-time-equivalent, it is unlikely they would have had capacity to increase service volume. It may be possible that the decrease in office visits indicates a shift in allocation to other tasks, but we are unable to tell, from data collected for this study, if this actually occurred.

This study focussed on the effects of removing a fee-for-service payment incentive, which is representative of the predominate model for remuneration of specialists in Canada. It is generally known that fee-for-service payments can lead to the overprovision of low-value or unnecessary care, hence the push for salary-based or capitation payment models in primary care.[7,8] Moreover, prior studies on two models of salary-based funding for specialists, in Canadian academic centres, indicate better care for complex patients.[9-11]

This stands in contrast with more robust data, from primary care, showing that fee-for-service payment models may incent complex chronic disease management more than capitation models, where a set amount is provided per enrolled patient.[12-14] In addition, no strong evidence exists demonstrating that non-fee-for-service payment models for specialists would reduce costs; nor does the present study address this point. Exploring the effects of different payment models for specialists, on chronic disease management, requires more attention.

### *Strengths*

Given that physician services in Ontario are insured publicly, the data are valid and representative of the groups of specialists who were studied. Further, the findings from this report are generalizable to other jurisdictions in Canada, who also remunerate physicians via public insurance programs. On an international scale, specialists are also often paid fee-for-service, making the results from our study of wide interest.

In terms of methodology, because the intervention was at a single time point and affected the entire cohort, using time-series analysis is a sensitive statistical technique to detect a quantitative change in the outcome.

### *Limitations*

Our study focussed on changes in the volume of services provided by the E078-removed group. Although we compared outcomes with the E078-remained group, this was not a controlled experiment, so differences cannot be attributed solely to removal of the premium. The baseline characteristics of these two physician groups were substantially different, notably for type of specialty and proportion of women. These, among other unmeasured factors, could have influenced the outcomes of the study.

A number of changes were made to payments for physician services along with the premium removal.[2] Although global reductions in fee-for-service and non-fee-for-service payments applied to all physicians, there were other changes for specific service fees, which may have affected some specialties more than others. We did not quantify the potential effects of these changes to remuneration.

Our results can only be applied in relation to changes in economic incentives for physicians. Our study did not evaluate effects on patients' health outcomes. The patient data collected only indicated that there was an increase in the total number of individuals seen by both groups and that their basic demographics were similar before and after the fee schedule change.

## Conclusion

Removal of the E078 chronic disease premium from the OHIP Schedule of Benefits was followed by a significant decrease in the provision chronic disease follow-up visits. This was driven by changes in the use of diagnostic codes, rather than total follow-up service volumes. However, affected specialists experienced a downward trend in new patient consultations, and provided fewer total office visits, on average, in the year following removal of the premium, suggesting a shift in service allocation. These outcomes underscore

that policy-makers need to consider the effect on economic behaviour when planning to alter payment incentives for specialists, as this may have downstream effects on patient outcomes. Future work should focus on quantifying the possible changes in health outcomes for patients whose specialist physicians were included in the group no longer able to claim the chronic disease premium.

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## Conflict of interest

None.

## Authors' contributions and statement

AA: conceptualization, methodology, writing – original draft; ML: methodology, data curation, writing – review and editing; BA: methodology, data curation, formal analysis, writing – review and editing; SS: conceptualization, methodology, writing – review and editing; AG: conceptualization, supervision, writing – review and editing.

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# At-a-glance

# What proportion of the price of a typical alcoholic beverage is taxation in Canada and why does it matter?

*Samuel Churchill, MSc; Tim Stockwell, PhD; Adam Sherk, PhD*

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## Abstract

**Introduction:** Canadian distillers and brewers have claimed that between 50% and 80% of the price of alcoholic drinks are government taxes. These claims were made in campaigns to decrease alcohol taxation.

**Methods:** We investigated these claims using publicly available Statistics Canada data and provincial-level product sales data and breakdowns of the prices of typical alcohol beverages in major market sectors.

**Results:** In all cases, the rate of total sales tax and excise taxation are mostly between 20% and 30% of final retail prices, well below the industry claims.


***Keywords:*** *substance use, alcohol use, harm reduction, surveys, public health, costs, societal costs, Canadian Substance Use Costs and Harms, taxation*

### *Highlights*

- Alcohol industry groups have exaggerated the level of taxation applied to typical Canadian alcoholic beverages.
- Distillers claim the taxation rate is 80%, but our estimates show this to be in the range of 20% to 30%.
- Brewers claim the taxation rate is 47%, but our estimates show this to be in the range of 16% to 18%.

## Introduction

Comprehensive scientific reviews of the government policies that reduce alcohol consumption and related harm consistently conclude that pricing and taxation strategies are the most effective.[1-3] A recent formal assessment found that that most Canadian governments fail at implementing evidence-based alcohol policies and have particularly poor pricing and taxation strategies.[4]

The federal government reintroduced indexation of alcohol excise taxation in 2017 (to maintain its value in line with inflation). However, an assessment of the policy implementation found the overall level and structure of excise taxes relatively ineffective at improving public health and safety outcomes.[5] Major shortcomings include low tax rates as a legacy of past failures to index these to the cost of living; a failure to tax most alcoholic beverages on the basis of their alcohol content; and inconsistent rates across beverage types.

The scientific evidence in favour of using pricing and taxation strategies to reduce alcohol-related harms is strong. Nevertheless, such strategies have to be presented carefully as they are often unpopular.[1]

To prevent the reintroduction of the indexation of alcohol excise taxes, Canadian producers claimed that this would involve increasing taxes.[6] In fact, this move would only ensure prices keep pace with inflation. Canadian distillers and brewers claimed that 80% of the price of spirits[6] and 50% of the price of beer was already tax.[7]

Producers' claims have been in the public domain since 2018, and an independent examination of the figures is warranted. Alcohol producers likely oppose excise tax increases as they directly compete with their profit margins and affect the price at which they can sell their products to retailers and distributors. Moreover, industry claims neglect to rigorously define what they consider "taxation" for the purposes of their figures, leaving these definitions open to interpretation.

One interpretation is that industry figures incorporate government-owned retail monopoly profits into their definition of taxation. This line of reasoning sets different standards for private retailers, the bulk of alcohol sales in Canada[5], and government-owned retailers, and the profits of private retailers are not considered taxation.

Using product-level sales data from government liquor stores in British Columbia and Ontario, we investigated the veracity of these industry claims. We hope the outcomes of our analyses will explain what consumers are paying for. The analyses may also help policy makers evaluate alcohol industry claims when examining possible future alcohol tax and pricing reforms.

## Methods

To examine pricing and tax breakdowns, we consulted aggregate statistics provided by Statistics Canada[8,9,10] and product-level sales data from government liquor stores in British Columbia and Ontario, which we received directly from the provincial alcohol jurisdictions. Data from British

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Columbia are from 2014 and 2016, and data from Ontario are from 2017. We determined the following summary metrics from the product-level sales datasets:

- Typical beverage size in each major beverage category, that is, beer, wine, spirits, coolers and ciders, was chosen to be the most commonly sold size in terms of total sales in dollars and total sales in litres of beverage.
- Mean values, weighted by total sales in dollars, of the price, strength (i.e. percent alcohol), *ad valorem* sales tax and excise tax incurred at each of the typical beverage sizes for each of British Columbia and Ontario. These provincial values were then combined by another weighted mean, this time weighted by population, to produce a national estimate.

We considered four major beverage markets—beer, wine, spirits and ciders/coolers—when aggregating Statistics Canada data, and split ciders and coolers into their own categories when considering product-level data from British Columbia and Ontario.

When estimating the proportions in each market taken up by liquor manufacturer wholesale costs, government taxation and liquor authority profits from the Statistics Canada data, we combined a direct estimate of proportions based on Statistics Canada data with methods previously used to estimate the burden of excise taxation on alcoholic beverages in Canada.[11] Wholesale costs, *ad valorem* sales taxes and profits[9] were distributed based entirely on the market share of each beverage category.[8,9] Excise taxes were distributed based on previously described models[11], and excise taxation and excise tax changes are assumed to be fully passed through to consumers[12]. These models are based on detailed individual product price, sales and production data; the models took into account different tax rates for brewers with small, medium and large production volumes. To provide results that are generalizable across Canada, we have considered only representative tax rates that are available at an aggregated level, these being excise, federal goods and services tax (GST) and provincial sales tax (PST) rates from British Columbia and Ontario. An approach that singled out a particular market, for example Prince Edward Island with its additional 25% *ad valorem* sales tax on alcohol or the market of Ontario products produced within Ontario which are subject to an additional Basic Alcohol Tax, may produce different results, but would be far less generalizable to the whole of Canada.

## Results

In every major beverage market, the overall tax take is 20% to 31% (excise taxes + sales taxes), with the largest proportion applied to spirits (Table 1). In each market, the wholesale costs are approximately 37% to 42%, and the total liquor authority profits are the remainder, at 32% to 38%.

A bottle of spirits, the beverage with the highest tax burden by proportion of total price, has an average total tax contribution of $8.92 on the $43.01 price tag, or approximately 20.7% (Table 2). Similar computations on the rest of the beverages yield taxation burdens of less than 20% across all other beverage types. It is worth noting that *ad valorem* sales taxes account for the vast majority of the investigated taxation, with excise taxes adding very little to the total price of alcohol to beverages other than spirits. The greatest excise tax take, by percent of final price, falls onto spirits, where the excise taxation rates vary according to their alcoholic strength and volume.

## Discussion

Our results are a straightforward summary of the typical taxation included in the price of alcoholic beverages in Canada. They are meant to be interpreted on a national scale. When applying this analysis to a particular province, provincial alcohol taxation rates such as Ontario's Basic Alcohol Taxes on beverages produced within Ontario or Prince Edward Island's additional 25% *ad valorem* sales tax on alcohol must be considered. Even if such regional variation doubled a given tax burden, all results would fall far below the tax burdens claimed by industry.

Canadian distillers claim that 80% of the price of spirits in Canada is made up of taxation.[9] Our estimates show that the tax burden was 20% to 30%. Moreover, the pricing breakdown using aggregate Statistics Canada data suggests that distillers are receiving more than one-third of the final sale prices of the spirits they produce. This suggests that Canadian distillers need to define and support their claim more rigorously. Even if industry is including government retailer profits in their 80% taxation figure, the amounts do not match their claim.

Our findings also contradict the brewers' claim that almost half of the price of beer is made up of taxes. Our figures are between 16% and 18% of our product-level data (Table 2), and an estimated tax burden (excise plus sales) of 22% (Table 1). These figures are heavily dependent on provincial sales tax rates and the sliding excise tax rate scale that is based on brewery sizing.

We found that 41% of beer prices goes toward the wholesale prices (Table 1). Could industry be including government retailer profits in their 50% taxation figure? If so, we stress that such an interpretation is flawed because it sets different standards for private retailers and government-owned retailers.

There is a paucity of Canadian research into the relationship between excise taxes, levels of alcohol consumption and alcohol-related harm. While the existence and general scale of these relationships is generally well-established in the international literature,[1-3,11] their more precise quantification for Canadian markets would be valuable. Modelling studies of the likely impacts of alternative taxation and pricing policies on levels of consumption and

**TABLE 1**
**Percent contributions of taxes to the final retail price of "typical" alcoholic beverages in Canada, 2017/2018, aggregated**

| Beverage | Percent contribution (%) | | | | |
|---|---|---|---|---|---|
| | Wholesale | Excise tax | Profit | Sales tax | Excise + sales tax |
| Beer | 41.35 | 8.90 | 36.93 | 12.81 | 21.71 |
| Wine | 42.26 | 6.91 | 37.74 | 13.09 | 20.00 |
| Spirits | 36.67 | 19.22 | 32.75 | 11.36 | 30.58 |
| Coolers/cider | 41.21 | 9.22 | 36.80 | 12.77 | 21.99 |

**Data source:** Statistics Canada. Tables 10-10-0011-01, 10-10-0010-01 et 10-10-0012-01. Ottawa, (ON): Statistics Canada; 2018.[8-10]

**TABLE 2**
**Mean prices and taxes paid for typical container sizes in British Columbia and Ontario, by beverage type**

| Beverage | Volume (mL) | Mean alcoholic strength (%) | Mean price ($) | Mean sales tax ($) | Mean excise tax ($) | Mean remainder ($) | Mean total tax ($) |
|---|---|---|---|---|---|---|---|
| Beer[a] | 473 | 5.07[c] | 2.41 | 0.31 | 0.06 | 2.03 | 0.38 |
| Beer[b] | 2130 | 4.93[c] | 10.93 | 1.42 | 0.54 | 8.97 | 1.96 |
| Wine | 750 | 15.05 | 19.88 | 2.59 | 0.46 | 16.83 | 3.05 |
| Spirits | 750 | 37.86 | 43.01 | 5.60 | 3.32 | 34.09 | 8.92 |
| Coolers | 473 | 6.46 | 2.91 | 0.38 | 0.14 | 2.39 | 0.52 |
| Ciders | 500 | 4.71 | 2.94 | 0.38 | 0.15 | 2.41 | 0.53 |

**Note:** Data in table are aggregated from provincial product-level sales data.

[a] Single can of beer.

[b] Six-pack of 355 mL bottles.

[c] Alcohol strength is averaged over beverages in the same volume category. The 473 mL category contained more stronger, mass-produced options than the 2130 mL category, which contained more craft beers, hence the differing average strength.

harm in Canada[11] can be a helpful guide toward more effective public health policies to reduce harms from alcohol.

## Conclusion

In summary, the current baseline level of provincial and federal taxation on alcoholic beverages in Canada falls below one-third of the final retail prices of all alcohol beverage types, and below 22% for beer, wine and coolers/ciders. These analyses suggest that there is ample scope for increasing excise taxes on alcoholic products in Canada. This would improve public health outcomes and compensate for lost revenue due to past failures to index alcohol excise taxes to the cost of living.

## Conflicts of interest

None.

## Authors' contributions and statement

SC: Software, methodology, writing – original draft; TM: Conceptualization, methodology, writing – review and editing; AS: Methodology, writing – review and editing.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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# Release notice

# *Osteoporosis and related fractures in Canada: Report from the Canadian Chronic Disease Surveillance System 2020*

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In November 2020, the Public Health Agency of Canada released the report *Osteoporosis and related fractures in Canada: Report from the Canadian Chronic Disease Surveillance System 2020*.

This report provides a national overview on diagnosed osteoporosis, related fractures and the osteoporosis care gap among Canadians aged 40 years and older. It reports on data from the Canadian Chronic Disease Surveillance System (CCDSS), which identifies chronic disease cases in provincial/territorial administrative health databases linked to provincial/territorial health insurance registries.

## Highlights

### *Osteoporosis burden*

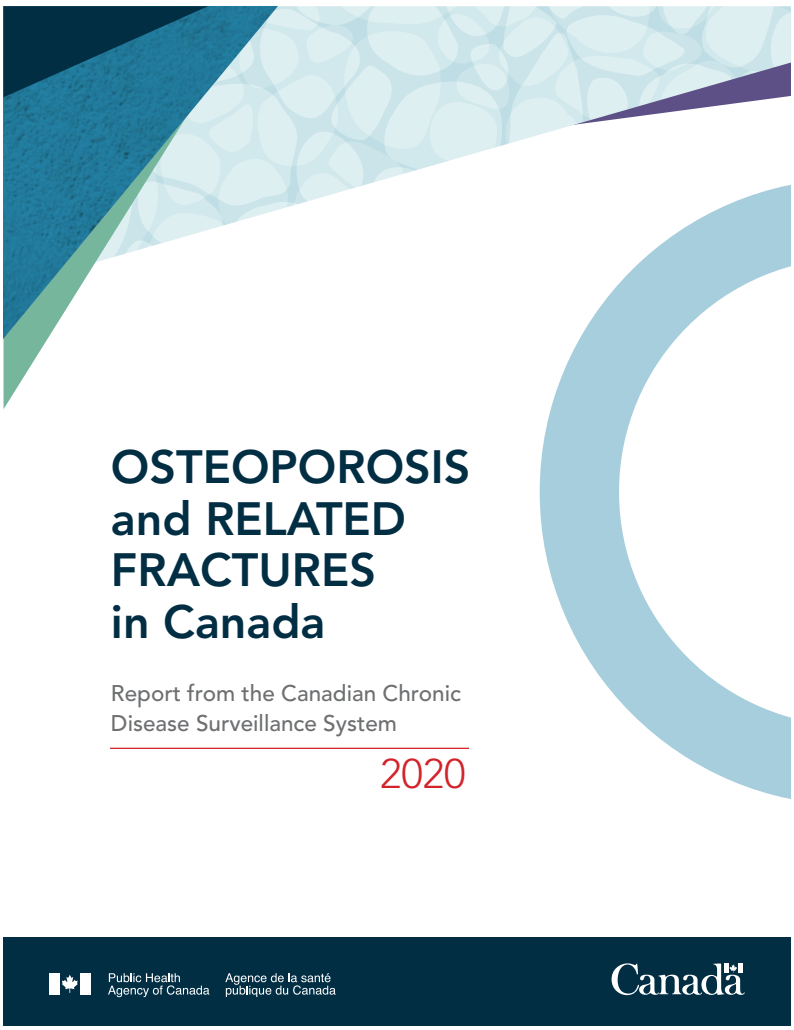
- In 2015-2016, 2.2 million Canadians aged 40 years and older were living with diagnosed osteoporosis.
- About 80% of those living with diagnosed osteoporosis were women.
- The risk of an osteoporosis diagnosis doubles every 5 years between the ages of 40 and 60.

### *Primary complications*

- In 2015-2016, there were 147 hip fractures per 100 000 Canadians aged 40 years and older.
- Women were two times more likely to sustain a hip fracture compared to men.
- About 25% of those with a hip fracture die of any cause within the following year.
- Men are 1.3 times more likely than women to die from any cause following a hip fracture.

### *Osteoporosis care gap*

- Less than 20% of Canadians who have a fracture receive an osteoporosis diagnosis, a bone mineral density test or an osteoporosis medication prescription within the following year.
- Men are less likely than women to receive any intervention.




View the latest surveillance data on osteoporosis, related fractures and the osteoporosis care gap.

# Call for papers – 2021 special issue
# Tobacco and vaping prevention and control in Canada



**Editors:** Jennifer O'Loughlin (University of Montreal), Thierry Gagné (University College London) and Robert Geneau (Editor-in-Chief, *Health Promotion and Chronic Disease Prevention in Canada* Journal, Public Health Agency of Canada)

It is estimated that more than 45 000 Canadians die from a tobacco-related disease each year,[1] making tobacco use the leading preventable cause of premature death in Canada.[2] In recent years, the growing use of vaping products, especially among youth, has also raised significant public health concerns. There is emerging evidence that vaping products are not without risks for individual users, with more research needed to determine the long-term risks. The electronic cigarette market, if left to expand without an appropriate mix of regulations in place, could also threaten the "Tobacco Endgame."[3,4] Tobacco and vaping control policies are now largely intertwined.

Canada continues to implement comprehensive tobacco control policies and programs as part of its commitment to reach a national target of less than 5% tobacco use by 2035.[5] Regulations on vaping products have also been introduced in recent years at the federal level and across several provinces and territories, with one of the clear aims being to curb the use of vaping products among youth.

The objective of this special issue is to disseminate current and emerging scientific evidence on tobacco and vaping-related epidemiology, prevention and control, with a focus on youth. To this effect, *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice* seeks relevant topical research articles that present new findings or synthesize existing evidence on:

- Policies, interventions and regulations related to tobacco and/or vaping initiation, use and consumption, and cessation, including tobacco and vaping-related policy gaps and implementation challenges;
- Health inequalities in tobacco/vaping use and related harms; and
- Associations between the use of vaping products, smoking cessation and harm reduction behaviours in both smokers and non-smokers.

International submissions will be considered if they include Canadian data, results (e.g. as part of global comparisons) and/or evidence-based discussion of implications for public health in Canada.

Consult the journal's website for information on invited article types and detailed submission guidelines for authors. Kindly refer to this call for papers in your cover letter. All manuscript submissions, pre-submission inquiries and questions about suitability or scope should be directed to PHAC.HPCDP.Journal-Revue.PSPMC.ASPC@canada.ca.

**Submission Deadline:** March 31st, 2021.

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# Other PHAC publications

**Researchers from the Public Health Agency of Canada also contribute to work published in other journals. Look for the following articles published in 2020 and 2021:**

**Choi BCK**. Big data ... small story. J Epidemiol Community Health. 2020:215752. https://doi.org/10.1136/jech-2020-215752

**Gheorghe M**, **Varin M**, **Wong SL**, **Baker M**, **Grywacheski V**, **Orpana H**. Symptoms of postpartum anxiety and depression among women in Canada: findings from a national cross-sectional survey. Can J Public Health. 2020. https://doi.org/10.17269/s41997-020-00420-4

James SL, Castle CD, Dingels ZV, […] **Badawi A**, […] **Orpana HM**, et al. Estimating global injuries morbidity and mortality: methods and data used in the Global Burden of Disease 2017 Study. Inj Prev. 2020;26(1):i125-53. https://doi.org/10.1136/injuryprev-2019-043531

James SL, Castle CD, Dingels ZV, […] **Badawi A**, […] **Lang JJ**, […] **Orpana HM**, et al. Global injury morbidity and mortality from 1990 to 2017: results from the Global Burden of Disease Study 2017. Inj Prev. 2020;26(1):i96-114. https://doi.org/10.1136/injuryprev-2019-043494

McLeod KE, Slaunwhite AK, Zhao B, […] **Mill C**, et al. Comparing mortality and healthcare utilization in the year following a paramedic-attended non-fatal overdose among people who were and were not transported to hospital: a prospective cohort study using linked administrative health data. Drug Alcohol Depend. 2021;218:108381. https://doi.org/10.1016/j.drugalcdep.2020.108381

Murray CJ, Abbafati C, Abbas KM, […] Global Burden of Disease 2019 Collaborators (including **Badawi A**, **Lang JJ** and **Orpana HM**), et al. Five insights from the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1135-59. https://doi.org/10.1016/S0140-6736(20)31404-5

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**Shields M**, **Tonmyr L**, **Hovdestad WE**, et al. Exposure to family violence from childhood to adulthood. BMC Public Health. 2020; 20(1):1673. https://doi.org/10.1186/s12889-020-09709-y

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Wang Z, Zhou Y, Zhang Y, […] **Liu S**, et al. Association of hospital admission for bronchiectasis with air pollution: a province-wide time-series study in southern China. Int J Hyg Environ Health. 2021;231:113654. https://doi.org/10.1016/j.ijheh.2020.113654

**Zheng H**, Toupin-April K, An Y, et al. Patient decisional needs when considering treatment intensification for type 2 diabetes: a qualitative study in China. Diabetes Res Clin Pract. 2020;170:108471. https://doi.org/10.1016/j.diabres.2020.108471