



Changes in health behaviours during early COVID-19 and socio-demographic disparities: a cross-sectional analysis

Anna Zajacova¹ · Anthony Jehn¹ · Matthew Stackhouse¹ · Patrick Denice¹ · Howard Ramos¹

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Abstract

Objectives The COVID-19 pandemic has profoundly disrupted daily life in Canada. This study assesses changes in health behaviours during the early stages of the pandemic and examines socio-demographic disparities associated with these changes.

Methods We analyze data on adults age 25 and older ($N = 4383$) from the public-use Canadian Perspectives Survey Series 1: Impacts of COVID-19 (CPSS-COVID). Multinomial regression models assess the association between demographic and socio-economic characteristics with increases or decreases in six health behaviours: alcohol, tobacco, and cannabis use, junk food consumption, and TV and internet screen time.

Results While findings varied across the six behaviours, overall, there was an increase in negative health behaviours: 14% of Canadian adults reported increasing their alcohol use (95% CI = 0.12, 0.15), 25% increased their junk food consumption (95% CI = 0.23, 0.27), and over 60% increased their screen time (62%, 95% CI = 0.60, 0.65 for TV and 66%, 95% CI = 0.63, 0.68 for internet). Younger and Canada-born adults were more likely to increase negative health behaviours than older and immigrant Canadians. Adults who reported financial impact of COVID-19 were more likely to increase all negative health behaviours (e.g., for increased junk food consumption, the relative risk ratio (RRR) = 1.81, 95% CI = 1.49, 2.20 relative to group reporting no impact).

Conclusion Our study documents the overall deterioration of health behaviours during the early stages of the COVID-19 pandemic. To minimize long-term harm to the Canadian population's health, the results highlight the need to tailor interventions, especially for younger Canadians, and the importance of mitigating financial impacts, which are linked to negative changes in health behaviours.

Résumé

Objectifs La pandémie de COVID-19 perturbe profondément la vie quotidienne au Canada. Notre étude évalue les changements survenus dans les comportements de santé aux premiers stades de la pandémie et examine les disparités sociodémographiques associées à ces changements.

Méthode Nous analysons les données sur les adultes de 25 ans et plus ($N = 4383$) tirées de la Série d'enquêtes sur les perspectives canadiennes 1 : Répercussions de la COVID-19 (SEPC-COVID) d'usage public. Des modèles de régression multinomiale permettent d'évaluer l'association entre les caractéristiques démographiques et socioéconomiques et les augmentations ou les diminutions de six comportements de santé : usage de l'alcool, du tabac et du cannabis, consommation d'aliments vides et temps passé devant la télévision et sur Internet.

Résultats Nos constatations varient entre ces six comportements, mais dans l'ensemble, il y a eu une augmentation des comportements de santé négatifs : 14 % des Canadiens adultes ont dit avoir accru leur usage de l'alcool (IC de 95 % = 0,12, 0,15), 25 % ont accru leur consommation d'aliments vides (IC de 95 % = 0,23, 0,27), et plus de 60 % ont accru leur temps d'écran (62 %, IC de 95 % = 0,60, 0,65 pour la télévision et 66 %, IC de 95 % = 0,63, 0,68 pour Internet). Les jeunes adultes et les adultes

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✉ Anna Zajacova
anna.zajacova@uwo.ca

¹ Social Science Centre, Room 5306, University of Western Ontario, London, Ontario N6A 5C2, Canada

nés au Canada étaient plus susceptibles d'avoir accru leurs comportements de santé négatifs que les adultes âgés et ceux ayant immigré au Canada. Les adultes ayant dit subir des contrecoups financiers de la COVID-19 étaient plus susceptibles d'avoir accru tous leurs comportements de santé négatifs (p. ex., pour la consommation accrue d'aliments vides, le rapport de risque relatif [RRR] = 1,81, IC de 95 % = 1,49, 2,20, comparativement au groupe n'ayant pas subi de contrecoups financiers).

Conclusion Notre étude décrit la détérioration globale des comportements de santé aux premiers stades de la pandémie de COVID-19. Pour réduire les torts que cela peut causer à long terme à la santé de la population canadienne, il faut, selon les résultats, adapter les interventions, surtout aux jeunes Canadiens, et atténuer les contrecoups financiers de la pandémie, qui sont liés à des changements négatifs dans les comportements de santé.

Keywords COVID-19 · Health behaviours · Canadian adults · Disparities

Mots-clés COVID-19 · comportement en matière de santé · Canadiens adultes · disparités

Introduction

The unprecedented COVID-19 pandemic has profoundly disrupted the daily lives of all Canadians. The immediate morbidity and mortality impacts have naturally received extensive research attention. Yet the public, academics, and policymakers also need to monitor the pandemic's potential long-term impact on the health of the Canadian population. Health behaviours are important modifiable factors that affect long-term health, well-being, and mortality; therefore, it is critical to assess how Canadians' health behaviours have changed during the early stages of the pandemic. A recent commentary published in the *Canadian Journal of Public Health* (Hobin and Smith 2020), for instance, highlighted the necessity of identifying policies that regulate alcohol consumption of Canadian adults during the pandemic, as alcohol use often increases under stressful conditions. The authors called for "evidence to inform decisions and actions" regarding alcohol availability. The present study provides additional evidence regarding alcohol use and other health-related behaviours, which is the first step to understanding what policies are needed.

Our aim is twofold: (1) to provide national estimates of changes in alcohol, tobacco, and cannabis use, junk food consumption, and inactive screen time, and (2) to examine the socio-demographic characteristics associated with these changes. Although Statistics Canada has released some basic estimates of changes in health behaviours (Roterman 2020), our first objective provides a more comprehensive understanding of how the pandemic has impacted Canadians' health behaviours by addressing multiple behaviours in one analysis. The second objective is crucial for understanding whether the COVID-19 circumstances exacerbate or attenuate health behavioural differences and point to where policy interventions are needed. Our analysis offers a useful comprehensive picture of lifestyle changes during the early stage of the pandemic.

The limited but growing body of research on health behaviours during the pandemic suggests that people made a number of changes. A study from Spain found that within the first

weeks of social restrictions to counteract COVID-19, some health behaviours improved and others worsened: people consumed more fruits and vegetables and less alcohol and tobacco, but they spent more inactive time in front of screens (López-Bueno et al. 2020). In Canada, a study concluded that previously physically active people became somewhat more active, while inactive individuals became more inactive (Lesser and Nienhuis 2020). A Statistics Canada report found that Canadians increased their use of alcohol precipitously, cannabis to a lesser degree, and tobacco marginally (Roterman 2020). Contrary to anecdotal media reports touting improved diets, international studies reported increased calorie intake and consumption of junk food (Ammar et al. 2020; Ramachandran and Gill 2020), resulting partly from stress and anxiety, and partly from additional unstructured time during the day and greater potential exposure to junk food advertisements or habitual consumption of junk food while watching TV (Scully et al. 2009).

The second objective of the present study is to identify whether there are socio-demographic disparities in health behavioural changes. How are age, gender, immigrant status, and socio-economic factors related to changes in health behaviours? This question is important for two reasons. First, there are large disparities in health behaviours such as smoking (Corsi et al. 2013), high-risk alcohol use, physical inactivity, poor diet quality (Mudryj et al. 2019), and cannabis use (Hango and LaRochelle-Côté 2018), all of which are disproportionately concentrated among Canada's more vulnerable groups. Second, COVID-19 has especially impacted vulnerable groups, both economically (Koebel and Pohler 2020; St-Denis 2020) and in terms of COVID-19 morbidity and mortality (Choi et al. 2020; Nayak et al. 2020). Such impacts may increase negative health behaviours as people try to cope with these additional sources of stress. Overall, our study offers a comprehensive picture of lifestyle changes in the Canadian population during the COVID-19 pandemic, which can be used to target interventions to improve long-term health outcomes and curb disparities therein.

Methods

Data

We draw on the public-use data from the Canadian Perspectives Survey Series 1: Impacts of COVID-19 (CPSS-COVID), a cross-sectional survey administered by Statistics Canada. Overall, the purpose of the survey was to collect information about changes in health and health behaviours during the pandemic. The sampling frame included persons aged 15 and older from all provinces and those enrolled in the Canadian Armed Forces.

The CPSS-COVID data were collected using short online surveys between March 29 and April 3, 2020. The sample was a randomly selected subset of Labour Force Survey (LFS) respondents. One individual per household was randomly selected from dwellings sampled for the LFS and mailed a letter prompting them to join the CPSS. The participation rate is 23%. Our analyses use the sampling weights calculated by Statistics Canada to correct for over- and under-sampling and non-response.

Target-population definition and sample exclusions We define the target population as Canadian adults aged 25 and older. From the 4627 total CPSS respondents, we excluded 244 (5.3% of total) aged 15–24. Many in this group have not yet established financial independence and have not completed their schooling; some are too young to legally access alcohol, tobacco, and cannabis, which could influence their reporting. Supplemental models that retain this age group yield findings similar to those shown below. We then excluded 52 individuals (1.2%) with missing predictor values and 12 (0.3%) with no valid health behavioural data, yielding an analytic sample of 4319.

Variables

Dependent variables include 6 items measuring changes in health behaviours: alcohol, tobacco, and cannabis use, junk food consumption, and inactive screen time (i.e., TV and internet use). These items were assessed with the question “Have your weekly habits changed for any of the following activities?” and respondents could answer “no change,” “increased,” or “decreased.”

Independent variables include demographic, socio-economic, and health-related characteristics. Demographic measures are age (in 10-year groups from 25–34 to 75+; included in all models as a continuous covariate; we also stratify the sample into three age groups 25–44, 45–64, and 65+), gender (male as the reference group), immigrant status (immigrated to Canada versus Canadian-born as the reference category), marital status (married/common-law as the reference group versus previously married, and never married),

presence of children (no children under 18 residing in respondent’s household as the reference category versus having children at home), and the type of dwelling (single detached home as the reference group, versus low-rise apartment, high-rise apartment, and other). All these covariates are known to influence health behaviours in general or may moderate the impact of the COVID-19 pandemic on adults. Health behaviours vary by age and gender (Schoenborn et al. 2013) and differ between immigrant and Canada-born adults (McDonald and Kennedy 2004). Surveys of US parents found that they experienced significantly higher levels of stress during COVID than non-parents (American Psychological Association 2020).

Measures of socio-economic status include level of education (high school diploma or less, trades certificate, college/CEGEP/other subbaccalaureate diploma, and bachelor’s degree or higher as the reference), employment status (“employed” as the reference versus absent–not COVID related, absent–COVID related, and “not employed”), and degree of financial impact (no impact as the reference category, versus too soon to tell, or experienced financial impact).

In supplemental analyses, we also included mental and physical health because of the close relationship between health behaviours and health (Lesser and Nienhuis 2020). We include self-rated mental health (SRMH) specifically because Statistics Canada briefs using the CPSS data found SRMH is correlated with health behaviours (Gilmour 2020; Roterman 2020). Physical health is measured with self-rated general health (SRH), as well as dichotomous indicators capturing whether the respondent has a compromised immune system and “diabetes or a chronic condition affecting your lungs, heart or kidneys.”

Approach

First, we characterized the target population with respect to key socio-demographic characteristics (Table 1) and described the changes in all health behaviours (Fig. 1). Next, we estimated multinomial logistic regression models of each health behaviour as a function of demographic and socio-economic characteristics (Table 2). All analyses use sampling weights. We present results from complete-case analyses, which is an appropriate approach given the low missingness on all independent variables.

Supplemental Tables show results for demographics-only models (Table S2a), models that include physical and mental health in addition to demographic and socio-economic characteristics (Table S2b), and average adjusted predictions for increase and decrease of each health behaviour (Table S2c) from models with the same covariates as in Table 2. A supplemental visualization (Supplemental Figure 2a–2f) illustrates the changes in the six health behaviours by age, gender, immigrant status, and financial impact, the characteristics

Table 1 Characteristics of the target population

Age (Years)		
25–34	0.20	[0.18, 0.22]
35–44	0.19	[0.17, 0.21]
45–54	0.18	[0.16, 0.20]
55–64	0.19	[0.18, 0.21]
65–74	0.17	[0.16, 0.19]
75+	0.07	[0.06, 0.09]
Female	0.51	[0.49, 0.53]
Immigrant	0.24	[0.22, 0.26]
Marital status		
Married/common-law	0.73	[0.70, 0.74]
Previously married	0.11	[0.10, 0.13]
Never married	0.16	[0.15, 0.18]
Children under 18 in the household	0.30	[0.28, 0.33]
Dwelling		
Single detached home	0.62	[0.60, 0.64]
Low-rise apartment	0.12	[0.11, 0.13]
High-rise apartment	0.09	[0.07, 0.10]
Other	0.17	[0.15, 0.19]
Education		
High school diploma or less	0.32	[0.30, 0.34]
Trades certificate	0.25	[0.23, 0.27]
College/CEGEP/other sub-BA diploma	0.11	[0.09, 0.12]
Bachelor's or higher degree	0.33	[0.30, 0.35]
Employment status		
Employed	0.48	[0.46, 0.51]
Absent—not COVID related	0.04	[0.03, 0.04]
Absent—COVID related	0.09	[0.07, 0.10]
Not employed	0.40	[0.37, 0.42]
Financial impact		
No impact	0.32	[0.30, 0.34]
Too soon to tell	0.25	[0.23, 0.27]
Impacted	0.43	[0.41, 0.45]

Source: Canadian Perspectives Survey Series 1: Impacts of COVID-19 (CPSS-COVID)

$N = 4319$. Weighted estimates [95% CIs]

most consistently associated with the health behavioural changes.

Results

Data from a sample of 4319 respondents were analyzed. Table 1 shows the distribution of key characteristics of the target population, estimated using the total analytic sample. Half of the population 25 and older are female (51%), 24% were born outside Canada, 73% are married, 62% live in detached homes, and 48% are currently employed. About a third of the population earned a high school diploma (32%), while

another third has at least a bachelor's degree (33%). With respect to the financial impact of the pandemic, 32% reported no impact, 25% said it was too soon to tell, and 43% already felt the impact.

Figure 1 shows the distribution of changes in the six health behaviours (Supplemental Table S1 lists the estimates and 95% confidence intervals (CI)). There are two noteworthy findings. First, health behaviours generally worsened during the early stages of the pandemic: the proportions of Canadians who increased their intake of addictive substances, junk food, or inactive screen time were much higher than the proportions who decreased these behaviours. The only exception is tobacco use, which increased and decreased for 3% of the population (see Supplemental Table S1). Second, the changes differ across health behaviours: 14% of Canadian adults increased alcohol intake and 5.5% increased cannabis use. Tobacco use changed relatively little, with 93% of Canadians reporting no change. Junk food consumption increased for 25% of the population. Finally, TV and internet use increased for about two thirds of Canadians.

Table 2 shows the association between socio-demographic characteristics and an increase or decrease (versus no change) in each health behaviour using multinomial logit models. The sample sizes for the six models range from 3996 for change in cannabis use to 4328 for TV time; all N s are shown in the Table. We observe an age gradient where older adults were less likely to increase alcohol, cannabis, junk food, and internet use compared to younger adults (for instance, adults 75 and older had 78% lower odds of increasing alcohol use [0.10, 0.47] compared to adults 25–34). Women were more likely to increase junk food (RRR = 1.70 [1.45, 2.00]), TV (RRR = 1.21 [1.06, 1.38]), and internet use (RRR = 1.27 [1.10, 1.45]). Immigrants, compared with Canadian-born adults, were less likely to increase alcohol (RRR = 0.42 [0.32, 0.55]), cannabis (RRR = 0.32 [0.20, 0.51]), and junk food consumption (RRR = 0.76 [0.61, 0.93]). Higher educational attainment was associated with greater risk of increased alcohol use and internet time but lower risk of increased tobacco and cannabis use. Financial impact was a predictor of increase in all six behaviours: Canadians who reported an impact as well as those who felt it was “too soon to tell” were likely to increase all six behaviours, compared with those who reported no impact (for instance, RRR = 1.81 [1.49, 2.20] for those impacted with respect to junk food consumption increase relative to adults with no impact).

The predictors of decreases in the behaviours are less clear. However, financial impact was associated with decreases in all six behaviours such that Canadians who experienced impact or said it was “too soon to tell” were more likely to also report that they decreased each behaviour, compared to adults who reported no impact. For decrease in alcohol use, for instance, RRR = 1.59 [1.19, 2.11] for those who said it was “too soon to tell,” and RRR = 1.60 [1.24, 2.08] for impacted Canadians, compared to those who experienced no impact.

Table 2 Multinomial logistic regressions of changes in six health behaviours

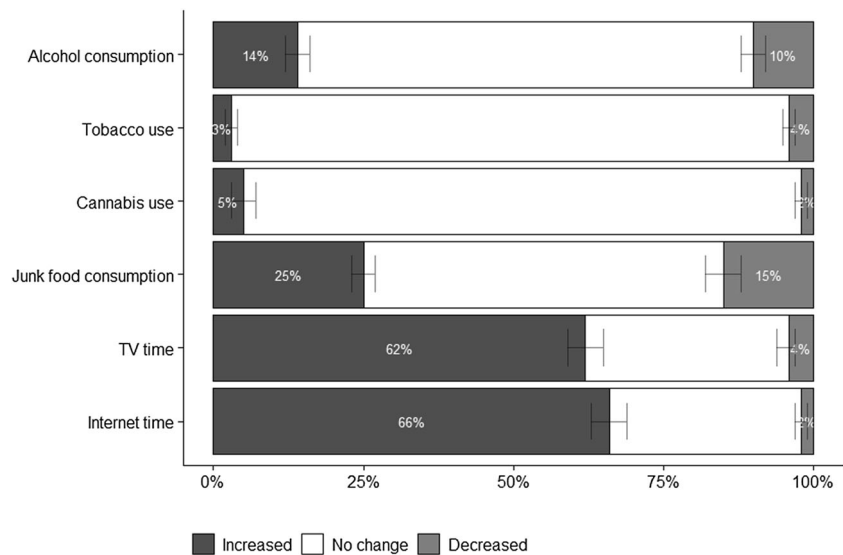
	Alcohol use	Tobacco use	Cannabis use	Junk food consumption	TV time	Internet time
Increased						
Age (25–34)						
35–44	1.43** [1.11, 1.84]	1.11 [0.66, 1.84]	1.07 [0.75, 1.51]	0.65*** [0.52, 0.82]	0.99 [0.79, 1.24]	0.63*** [0.50, 0.80]
45–54	0.62** [0.46, 0.83]	1.32 [0.80, 2.18]	0.27*** [0.16, 0.45]	0.56*** [0.44, 0.71]	1.03 [0.82, 1.29]	0.66*** [0.52, 0.83]
55–64	0.49*** [0.35, 0.68]	0.61 [0.34, 1.11]	0.18*** [0.11, 0.32]	0.32*** [0.24, 0.41]	0.79 [0.62, 1.00]	0.62*** [0.49, 0.80]
65–74	0.22*** [0.14, 0.36]	0.13*** [0.04, 0.38]	0.04*** [0.01, 0.11]	0.17*** [0.12, 0.24]	0.79 [0.61, 1.03]	0.57*** [0.43, 0.74]
75+	0.22*** [0.10, 0.47]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	0.04*** [0.02, 0.10]	0.68* [0.48, 0.95]	0.44*** [0.31, 0.62]
Female	0.89 [0.74, 1.08]	0.88 [0.61, 1.26]	0.79 [0.58, 1.06]	1.70*** [1.45, 2.00]	1.21** [1.06, 1.38]	1.27*** [1.10, 1.45]
Immigrant	0.42*** [0.32, 0.55]	0.65 [0.40, 1.07]	0.32*** [0.20, 0.51]	0.76** [0.61, 0.93]	1.00 [0.85, 1.18]	0.93 [0.78, 1.10]
Dwelling (Single detached)						
Low-rise apartment	1.17 [0.87, 1.57]	1.12 [0.65, 1.95]	0.77 [0.48, 1.22]	0.84 [0.65, 1.09]	0.67*** [0.54, 0.83]	0.86 [0.69, 1.08]
High-rise apartment	1.08 [0.75, 1.54]	1.60 [0.83, 3.10]	3.13*** [2.02, 4.87]	1.04 [0.77, 1.39]	1.08 [0.84, 1.39]	1.50** [1.15, 1.97]
Other	1.23 [0.95, 1.58]	2.42*** [1.59, 3.71]	1.06 [0.71, 1.59]	1.28* [1.04, 1.58]	0.80* [0.67, 0.96]	0.82* [0.68, 0.99]
Marital status (Married)						
Previously married	0.99 [0.68, 1.44]	3.17*** [1.91, 5.27]	1.36 [0.76, 2.43]	1.39* [1.04, 1.84]	1.05 [0.84, 1.31]	1.08 [0.86, 1.35]
Never married	1.33* [1.03, 1.73]	1.38 [0.86, 2.19]	1.32 [0.91, 1.91]	1.22 [0.98, 1.53]	1.04 [0.85, 1.28]	1.09 [0.88, 1.35]
Children	1.10 [0.87, 1.40]	0.56* [0.36, 0.87]	0.67* [0.47, 0.97]	1.09 [0.89, 1.32]	0.82* [0.69, 0.98]	1.34** [1.11, 1.62]
Education (BA or higher)						
College/CEGEP degree	0.83 [0.65, 1.05]	1.31 [0.77, 2.23]	1.44 [0.96, 2.18]	0.88 [0.72, 1.08]	0.92 [0.77, 1.10]	0.63*** [0.52, 0.76]
Trade diploma	0.62** [0.44, 0.87]	2.08* [1.14, 3.81]	1.69* [1.01, 2.82]	0.95 [0.71, 1.26]	0.99 [0.78, 1.26]	0.85 [0.66, 1.09]
High school or less	0.69** [0.54, 0.88]	2.86*** [1.79, 4.58]	1.98*** [1.34, 2.93]	1.13 [0.92, 1.37]	0.80* [0.68, 0.95]	0.56*** [0.47, 0.67]
Employment status (Employed)						
Absent–not COVID related	1.02 [0.65, 1.59]	0.88 [0.38, 2.06]	0.47 [0.17, 1.26]	0.78 [0.52, 1.16]	1.05 [0.73, 1.51]	1.64* [1.09, 2.46]
Absent–COVID related	1.07 [0.78, 1.45]	0.77 [0.43, 1.38]	1.38 [0.89, 2.15]	0.57*** [0.43, 0.75]	1.89*** [1.43, 2.50]	2.40*** [1.76, 3.28]
Not employed	0.81 [0.63, 1.04]	0.54** [0.34, 0.85]	1.44* [1.02, 2.05]	0.75** [0.62, 0.91]	1.08 [0.91, 1.28]	1.16 [0.97, 1.38]
Financial impact (No impact)						
Too soon to tell	1.45** [1.12, 1.88]	1.05 [0.61, 1.81]	2.52*** [1.59, 4.00]	1.89*** [1.52, 2.35]	1.54*** [1.30, 1.83]	1.39*** [1.17, 1.66]
Impacted	1.38** [1.09, 1.75]	1.77* [1.13, 2.77]	2.42*** [1.58, 3.71]	1.81*** [1.49, 2.20]	1.99*** [1.70, 2.33]	1.89*** [1.60, 2.22]
Decreased						
Age (25–34)						
35–44	1.46* [1.03, 2.07]	1.53 [0.89, 2.65]	1.34 [0.67, 2.69]	1.23 [0.91, 1.66]	1.11 [0.64, 1.93]	0.32** [0.13, 0.74]
45–54	1.34 [0.95, 1.90]	1.32 [0.73, 2.36]	0.78 [0.34, 1.80]	1.02 [0.74, 1.39]	1.24 [0.70, 2.21]	0.60 [0.29, 1.25]
55–64	1.07 [0.74, 1.54]	0.60 [0.29, 1.22]	0.41 [0.15, 1.12]	0.89 [0.64, 1.24]	1.16 [0.63, 2.13]	0.75 [0.36, 1.57]
65–74	0.86 [0.57, 1.30]	1.23 [0.65, 2.35]	0.38 [0.13, 1.09]	1.12 [0.78, 1.60]	1.06 [0.52, 2.19]	0.62 [0.27, 1.42]
75+	0.90 [0.51, 1.58]	0.54 [0.18, 1.63]	0.50 [0.11, 2.37]	1.02 [0.62, 1.67]	1.51 [0.59, 3.87]	0.20* [0.04, 0.94]

Table 2 (continued)

	Alcohol use	Tobacco use	Cannabis use	Junk food consumption	TV time	Internet time						
Female	0.84	[0.68, 1.04]	0.64*	[0.45, 0.92]	0.89	[0.52, 1.51]	0.89	[0.74, 1.07]	0.73	[0.51, 1.05]	0.64	[0.40, 1.02]
Immigrant	0.94	[0.73, 1.21]	1.38	[0.92, 2.07]	2.67***	[1.50, 4.74]	1.51***	[1.22, 1.86]	0.9	[0.58, 1.39]	1.65	[0.99, 2.75]
Dwelling (Single detached)												
Low-rise apartment	1.05	[0.75, 1.48]	1.14	[0.67, 1.91]	0.98	[0.46, 2.09]	1.35*	[1.02, 1.78]	1.76*	[1.08, 2.88]	0.58	[0.27, 1.27]
High-rise apartment	1.25	[0.87, 1.79]	0.87	[0.44, 1.72]	1.36	[0.60, 3.08]	1.07	[0.78, 1.48]	1.13	[0.58, 2.20]	0.55	[0.19, 1.55]
Other	1.10	[0.82, 1.46]	0.92	[0.56, 1.50]	0.91	[0.44, 1.89]	1.04	[0.81, 1.34]	1.14	[0.71, 1.84]	0.54	[0.28, 1.06]
Marital status (Married)												
Previously married	1.08	[0.77, 1.52]	1.23	[0.68, 2.23]	0.30	[0.06, 1.54]	1.38*	[1.03, 1.85]	1.79*	[1.05, 3.06]	1.23	[0.56, 2.72]
Never married	1.15	[0.84, 1.56]	1.52	[0.93, 2.50]	2.82**	[1.48, 5.37]	1.38*	[1.05, 1.82]	1.30	[0.78, 2.16]	1.25	[0.63, 2.45]
Children	0.74*	[0.56, 0.98]	0.95	[0.60, 1.51]	0.72	[0.36, 1.42]	1.02	[0.80, 1.30]	1.12	[0.71, 1.78]	1.10	[0.60, 2.02]
Education (BA or higher)												
College/CEGEP degree	0.91	[0.70, 1.19]	1.09	[0.66, 1.80]	1.30	[0.66, 2.56]	0.99	[0.78, 1.26]	0.97	[0.63, 1.51]	0.92	[0.52, 1.60]
Trade diploma	0.87	[0.61, 1.24]	1.10	[0.58, 2.06]	1.59	[0.68, 3.72]	0.86	[0.62, 1.19]	0.62	[0.32, 1.23]	0.26*	[0.08, 0.88]
High school or less	0.62***	[0.47, 0.81]	1.27	[0.82, 1.98]	0.65	[0.32, 1.32]	0.92	[0.73, 1.16]	0.67	[0.43, 1.06]	0.57	[0.32, 1.01]
Employment status (Employed)												
Absent-not COVID related	1.11	[0.64, 1.92]	3.01**	[1.46, 6.19]	2.59	[0.79, 8.50]	1.10	[0.68, 1.77]	0.77	[0.30, 1.96]	1.48	[0.40, 5.49]
Absent-COVID related	0.98	[0.67, 1.44]	1.52	[0.82, 2.83]	2.51*	[1.14, 5.55]	0.81	[0.59, 1.13]	0.38	[0.14, 1.03]	1.61	[0.64, 4.08]
Not employed	1.16	[0.90, 1.50]	2.27***	[1.46, 3.52]	3.11***	[1.63, 5.93]	0.78*	[0.61, 0.98]	0.51**	[0.32, 0.81]	1.21	[0.70, 2.09]
Financial impact (No impact)												
Too soon to tell	1.59**	[1.19, 2.11]	2.09**	[1.23, 3.55]	3.18**	[1.38, 7.29]	1.78***	[1.39, 2.28]	1.68*	[1.04, 2.70]	1.87*	[1.01, 3.46]
Impacted	1.60***	[1.24, 2.08]	2.21**	[1.34, 3.64]	2.27*	[1.01, 5.10]	1.70***	[1.36, 2.14]	2.10***	[1.37, 3.22]	2.39**	[1.35, 4.23]
N	4253	4072	3996	4158	4328	4323						

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$ Source: Canadian Perspectives Survey Series 1: Impacts of COVID-19 (CPSS-COVID)
Weighted estimates [95% CIs]. The base category is “no change” in health behaviours

Fig. 1 Changes in health behaviours during early COVID-19, Canadian adults age 25+. Source: Canadian Perspectives Survey Series 1: Impacts of COVID-19 (CPSS-COVID). Sample sizes range from 3996 for cannabis use to 4328 for TV time. Weighted estimates. Error bars show 95% confidence intervals for the estimated proportion increase and proportion decrease in each behaviour



Supplemental Tables show that the effect of demographics is relatively stable whether or not we control for SES (Table S2a), and the effect of demographics and SES remains stable even when controlling for physical and mental health (Table S2b). Supplemental Table S2c offers a counterfactual perspective: it shows average adjusted marginal effects of changes in each health behaviour in terms of percentage point differences between the change for a given socio-demographic group as compared to the omitted group. Finally, Supplemental Figure 2a-2f visualizes the magnitude of differences in health behavioural changes across age, gender, immigrant status, and financial impact. It highlights how the increases in negative health behaviours were more prevalent in younger compared to older Canadians. Gender differences were more muted, but women increased their junk food consumption and inactive screen time more than men. It also shows how immigrant Canadians were less likely to increase consumption of alcohol, cannabis, and junk food, and more likely to *decrease* cannabis and junk food consumption. Finally, those who experienced financial impact of the pandemic were more likely to increase their detrimental health behaviours compared to unaffected Canadians.

Discussion

The overwhelming disruption of the COVID-19 pandemic has spurred a tremendous amount of research in Canada and elsewhere. Most attention has, understandably, focused on the spread of the infection and on the estimation of hospitalization and mortality rates (Denice et al. 2020; Remuzzi and Remuzzi 2020). The pandemic’s disruption to daily lives and the long-term impacts of those changes have received less attention. This is an important gap because societal and economic

shocks can have a profound effect on population health and well-being as citizens experience job uncertainty, changes to their daily routine, and feelings of insecurity. Negative health behaviours, such as increased alcohol consumption, may be a coping mechanism in response to such hardships. Large-scale disruptions, moreover, often affect vulnerable populations more severely, potentially exacerbating the existing disparities in the health behaviours.

We focused on health behaviours as key modifiable health risks in the population (Schoenborn et al. 2013) and posed two questions: How have health behaviours changed during the pandemic? And have the changes exacerbated or attenuated socio-demographic disparities? Answers to these two questions are critical for developing policies and supports to identify groups in the Canadian population that are losing ground or have become particularly vulnerable during the pandemic. Unpacking who modifies their behaviours and how is important for assessing what interventions can be introduced to mitigate long-term and more pronounced poor health outcomes.

Overall, we found an increase in detrimental health behaviours, although there was a large variability in the changes across the behaviours. A particularly malleable behaviour is alcohol use, which increased in 14% of adults and decreased in 9%. This mixed pattern echoes evidence from a small UK study that found increased prevalence during COVID-19 of “high-risk drinking” but also increased efforts to reduce alcohol consumption (Jackson et al. 2020). Over a quarter of Canadian adults increased their junk food consumption, and 14% decreased it. A combination of physical inactivity and unhealthy diet choices compound and pose a major health risk (Lim et al. 2012). To this end, a worrisome finding is that screen-related inactivity skyrocketed: about

two thirds of Canadians increased their TV and internet use. This increase is problematic both immediately and longer-term. More inactive screen time during COVID-19 has already been linked to eye strain and eye fatigue (Helander et al. 2020); longer-term, it damages health via physical inactivity (Lee et al. 2012). This points to the need to ensure that public health policy not only focus on how to mitigate the spread COVID-19 through physical distancing but also focus on the need to avoid idle inactivity and offer viable means for people to remain active in periods of prolonged self-isolation or quarantine.

On the other hand, only 3% of Canadians increased (and another 3% decreased) their tobacco consumption. The 94% who did not change include presumably both smokers and non-smokers—so overall the data show no increases in smoking. The use of cannabis increased, but only among 6% of adults. While this is a modest increase, it could reflect the recent legalization, and thus greater social acceptance and experimentation, during lockdown. These results suggest that tobacco and cannabis use are rather stable behaviours. While they are unlikely to increase drastically during crises, cessation also is exceedingly difficult.

Changes in health behaviour did not occur in all sub-population groups equally. Age, gender, immigrant status, and economic well-being (captured by answers about the financial impact of the pandemic) independently and jointly moderated the changes. Younger adults increased all detrimental health behaviours to a greater degree than older adults. Perhaps this pattern is related to different health behavioural tendencies at different stages of the lifecycle, or to variation in the impact of COVID-19. Naturally, adults of different ages come from different birth cohorts. We cannot distinguish whether the observed patterns are age-driven or are inherent to different birth cohorts, but in either case the findings raise concern for younger adults in the Millennial and Generation X cohorts. With respect to public health interventions, the findings point to the need to target younger populations to reverse the months of shifting consumption patterns and inactivity during the early stages of the pandemic to assure that these do not become permanent habits that in turn contribute to long-term, chronic, and costly health problems.

Women did not differ from men in substance use changes, but they increased their junk food consumption and inactive screen time more. This may sound counterintuitive since women tend to have better health behavioural profiles than men (Schoenborn et al. 2013). However, this gender comparison is not uniform—for instance, women exercise less than men (Mielke et al. 2018)—and, additionally, our data capture *changes* in health behaviours, not their prevalence. We thus cannot assess women's junk food consumption levels relative to men's, only self-

reported changes during COVID-19. Immigrant adults generally increased their detrimental health behaviours to a lesser extent than their Canada-born counterparts—in fact, they were also significantly more likely to decrease at least some of the behaviours. This finding is generally consistent with the healthier baseline profile of immigrants to Canada, known as the Healthy Immigrant Effect (McDonald and Kennedy 2004; Vang et al. 2017). Our findings suggest a further immigrant advantage that could translate to better health in the long run.

Another important finding is that adults who reported a detrimental financial impact during the early stages of the pandemic were significantly and substantially more likely to increase all detrimental health behaviours compared to adults who reported no impact: they were roughly 40% more likely to increase alcohol use; 80–90% more likely to increase smoking, junk food, and inactive internet use; and over twice as likely to increase TV and cannabis use, compared to adults who did not experience a negative impact. These disparities, moreover, occur on top of existing socio-economic disparities in health behaviours (Pampel et al. 2010). COVID-19 has disproportionately harmed socio-economically vulnerable populations in terms of infection rates, hospitalizations, mortality, and economic security (Nayak et al. 2020; Nicola et al. 2020). Here, we document the inequitable impact of the pandemic on health behavioural changes with potential long-term health implications. The findings also suggest that policies mitigating against loss of income have the potential to counteract negative health behaviours and, thereby, long-term ill health.

The predictors of decreases in the behaviours are less clear. This is likely in part because the proportions of those who decreased behaviours were often modest; therefore, we had lower statistical power in estimating the correlates. The findings, however, suggest that the mechanisms underlying decreases in negative health behaviours may differ from those underlying increases. However, even with respect to the decreases in negative health behaviours, the most consistent correlate is financial impact: respondents who experienced an impact or said it was “too early to tell” were more likely to decrease all negative health behaviours, compared to their peers who did not report a financial impact.

Our conclusions are constrained by limitations in the data. Important health behaviours were omitted; for instance, physical activity was not directly assessed, and screen time did not distinguish whether the changes were for leisure or work-related use. We also do not know if a respondent lost their job, the duration of unemployment, or their family income, all of which are vital economic covariates of health behaviours. Further, the respondents' racialized/ethnic/Indigenous identity and province of residence were not asked in the survey. These characteristics matter because COVID-19 infections and mortality differ across areas with different proportions of visible

minority adults in Canada (Choi et al. 2020) and elsewhere (Webb Hooper et al. 2020). Province of residence could capture how changes in health behaviours relate to the varied pandemic conditions. We look forward to the inclusion of these measures in future waves of the CPSS COVID-19 data.

Conclusion

We document important negative changes in health behaviours among Canadian adults during early COVID-19 months and highlight how these changes widen existing, especially economic, disparities. It is vital to keep tracking longer-term trends to understand whether the behaviours rebound or continue deteriorating for all major population groups in Canada. In this way, tailored interventions can be implemented to ensure a return to at least baseline healthy lifestyles as we continue to fight and recover from the COVID-19 pandemic.

Authors' contributions All authors contributed to the study conception, development, and revisions. The analyses were performed by Zajacova and Jehn. The manuscript was drafted by Zajacova and all authors assisted in all revisions of the text. All authors read and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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