



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Research paper

Comparing mortality from covid-19 to mortality due to overdose: A micromort analysis

Yena Lee^{a,b,*}, Leanna M.W. Lui^a, Elisa Brietzke^c, Yuhua Liao^{d,e}, Ciyong Lu^d, Roger Ho^f, Mehala Subramaniapillai^a, Rodrigo B. Mansur^{a,g}, Joshua D. Rosenblat^{a,g}, Roger S. McIntyre^{a,b,g,h}

^a Mood Disorders Psychopharmacology Unit, Toronto Western Hospital, University Health Network, Toronto, ON, Canada, M5T 2S8

^b Institute of Medical Science, University of Toronto, Toronto, ON, Canada, M5S 1A8

^c Department of Psychiatry, Queen's University School of Medicine, Kingston, ON, Canada; Centre for Neuroscience Studies (CNS), Queen's University, Kingston, ON, Canada

^d Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-Sen University, Guangzhou, China

^e Department of Psychiatry, Shenzhen Nanshan Center for Chronic Disease Control, Shenzhen, China

^f Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore; Institute for Health Innovation and Technology (iHealthtech), National University of Singapore

^g Department of Psychiatry, University of Toronto, Toronto, ON, Canada, M5S 1A8

^h Department of Pharmacology, University of Toronto, Toronto, ON, Canada, M5S 1A8



ARTICLE INFO

Keywords:

Micromort
Mortality rate
Opioid
Public health
Substance abuse
Comorbidity
COVID-19
Severe acute respiratory syndrome coronavirus 2
Resilience
Well-being
Risk
Mortality
Outcome and Process Assessment, Health Care
Epidemiology
Opioid Epidemic
Middle Aged
Drug Overdose
Suicide
Public Health
Population Health
Social Medicine
Global Health
Public Policy
Epidemics
Pandemics
Coronavirus Infections
Pandemics / prevention & control*

ABSTRACT

Objective: To compare the mortality risk due to covid-19 with death due to overdose in British Columbia, Canada. The opioid epidemic was declared a public health emergency in 2016.

Methods: Mortality risk was calculated in micromorts with covid-19 data for January–October 2020, derived from the BC center for Disease Control, and illicit drug toxicity deaths for January 2010–September 2020, derived from the BC Coroners Service. Age-stratified covid-19 incidence and deaths per 100,000 population and age-stratified illicit drug toxicity death rates per 100,000 population were calculated. A micromort is a unit of risk equivalent to a one-in-a-million chance of death.

Results: During the covid-19 pandemic, illicit drug toxicity deaths reached 1.0 micromorts per day, representing an increase of 0.5 micromorts per day relative to 2019 rates. In comparison, covid-19 mortality risk was 0.05 micromorts per day among individuals from the general population living in British Columbia and 21.1 micromorts per day among those infected with covid-19. Covid-related mortality risk was significantly lower among individuals aged <60 years, relative to older adults, whereas drug toxicity-related mortality was highest for individuals aged 30–59 years.

Conclusions: The mortality associated with covid-19 is apparent and distributed unevenly across subpopulations. The mortality due to overdose has increased during covid-19 and exceeds mortality due to covid-19. Our results instantiate the triple threat caused by covid-19 (i.e., public health crisis, economic crisis and mental health crisis) and quantitatively highlight the externality of increased mortality due to deaths of despair in response to public health efforts to reduce covid-related mortality.

* Correspondence Author: Yena Lee, 399 Bathurst St 9MP-325, Toronto, ON, Canada, M5T 2S8.

E-mail addresses: yenalee.lee@utoronto.ca (Y. Lee), leanna.lui@mail.utoronto.ca (L.M.W. Lui), elisa.brietzke@queensu.ca (E. Brietzke), luciyong@mail.sysu.edu.cn (C. Lu), roger_ho@nuhs.edu.sg (R. Ho), m.subram@mail.utoronto.ca (M. Subramaniapillai), rodrigo.mansur@uhn.ca (R.B. Mansur), joshua.rosenblat@uhn.ca (J.D. Rosenblat), roger.mcintyre@uhn.ca (R.S. McIntyre).

<https://doi.org/10.1016/j.jad.2021.09.059>

Received 14 December 2020; Received in revised form 17 September 2021; Accepted 21 September 2021

Available online 24 September 2021

0165-0327/© 2021 Elsevier B.V. All rights reserved.

Humans
 Age Groups
 Mental Health
 British Columbia
 Canada
 Loneliness
 Depression
 Depressive Disorder
 Mood Disorders
 Unemployment

1. Introduction

The coronavirus disease 2019 (covid-19) pandemic threatens global health across geopolitical boundaries and economic strata (World Health Organization 2020; Secretary-General of the OECD 2020). The pandemic threatens the trifecta of health as defined by the World Health Organization: physical health, mental health, and social well-being (World Health Organization 2005; Public Health Agency of Canada 2020, Czeisler et al., 2020). In addition to infection-related case fatality and the indeterminate threat of chronic symptoms, the covid-19 pandemic has exposed and amplified the underlying loneliness epidemic (McGinty et al., 2020, Nabavi, 2020, Killgore et al., 2020).

Loneliness is a pervasive public health concern that is related to, but distinct from social isolation: a person who is socially isolated is alone, but not necessarily lonely. A person who lacks desired social connectedness is not necessarily alone but feels lonely (Lindsay et al., 2019, Beller and Wagner, 2018). Moreover, loneliness predicts adverse mental and physical health outcomes, as well as greater non-communicable disease-related morbidity (e.g., hypertension, diabetes) and mortality (Richard et al., 2017, Leigh-Hunt et al., 2017, Miller, 2011, Matthews et al., 2019, Holt-Lunstad and Smith, 2016, Park et al., 2020).

Social isolation, unemployment, financial insecurity, low educational attainment, childhood trauma, and substance misuse are associated with loneliness, suicide, and deaths of despair (Miller, 2011, Bruce et al., 2019, Macdonald et al., 2018, Creed and Reynolds, 2001, Milner et al., 2016). Approximately 20–30% of opioid overdoses may represent intentional self-harm (Braden et al., 2017, Oquendo and Volkow, 2018, Johnson et al., 2013, Mack et al., 2017). Increased rates of opioid overdoses and alcohol dependence have contributed to declining life expectancy among middle-aged Americans, whereas morbidity and mortality among youth and older adults continue to fall in the US (Case and Deaton, 2015). Similarly, within Canada, opioid-related deaths emerged as a national public health crisis in 2016, claiming 8.4 lives per 100,000 population nation-wide in 2016; the highest provincial opioid-related death rate of 20.7 per 100,000 population in 2016 was observed in British Columbia (Belzak and Halverson, 2018, Wood, 2018). Opioid overdose rates were highest among individuals between the ages of 19 and 59, and were especially high in males (Mack et al., 2017, Belzak and Halverson, 2018).

While coronavirus infection-related mortality disproportionately affects older adults, the prevalence of loneliness has increased globally during the pandemic, particularly among young and middle-aged adults (Bu et al., 2020, González-Sanguino et al., 2020, Trad et al., 2020). Lower-income individuals with poor social support or pre-existing mental illness are especially vulnerable to loneliness (Killgore et al., 2020, Ustun, 2020). Furthermore, unemployment and suicide are robustly linked at a population level. During the Great Recession of 2008, a 1% increase in unemployment rate was correlated with a 0.8–1.6% increase in suicide rates in USA, Canada, and European economies (De Vogli et al., 2013, Reeves et al., 2014, Stuckler et al., 2009, Phillips et al., 2014, Luo et al., 2011). An estimated 28% of excess suicides observed between 2007 and 2010 in the USA were attributable to the increase in unemployment rate during this period (from 5.8% to 9.6%) (Reeves et al., 2012).

The economic fallout of the covid-19 pandemic has been projected to increase suicide rates by 3–8% in the US and 5–27% in Canada, per year, over 2020 and 2021, as a result of lockdown-related unemployment (RS McIntyre and Lee, 2020, RS McIntyre and Lee, 2020). Similarly, the Well Being Trust projected over 27,000–154,000 excess deaths of despair in the US (between 2020 and 2029) due to unemployment (Pettersen et al., 2020). Monthly suicide rates increased significantly in Japan after emergency lockdown measures were lifted in late May 2020 (Ueda et al., 2020). Women, unemployed persons, students, and individuals under age 40 experienced egregious increases in suicide incidence relative to previous years (Ueda et al., 2020). For example, monthly suicide rates increased among women by 21–22% in August and September, relative to the respective mean monthly rates for 2017–2019 (Ueda et al., 2020).

Taken together, covid-19 poses an unprecedented threat to mental health, especially in the context of the opioid epidemic, the loneliness epidemic, and the economic crisis (Xiong et al., 2020, C Wang et al., 2020). The hazards of covid-19 and related containment measures on public health are pluralistic: their effects vary within the populace as a function of a multitude of factors mediating resilience. Loneliness and other individual or systemic factors (e.g., limitations in healthcare access, housing and food security, economic opportunity) that amplify (or mitigate) risk in the context of the opioid epidemic may also mediate vulnerability (or resilience) in the context of covid-19.

Herein, we compare mortality rates attributable to coronavirus infection and illicit substance overdose in British Columbia, Canada. We additionally evaluate changes in lifestyle behaviours during the covid-19 lockdown in a nationally representative sample and describe their potential impacts on overall life expectancy.

We express population-level mortality risks in micromorts and maladaptive lifestyle changes in microlives. Introduced by Ronald A. Howard in 1980, micromorts are commonly used in actuarial sciences and decision analyses to quantify the risk of death per unit of exposure to a risk factor or event (Howard, 1980). Micromorts are easier to interpret and comprehend than abstract numerical figures, and have been used to convey risks associated with surgical operations and medical treatments (Fry et al., 2016, Hickson et al., 2020, Howard, 1989). Similarly, microlives are commonly used to quantify the risk of death associated with chronic exposure (Spiegelhalter, 2012). For example, the mortality risk of general anesthesia is 10 micromorts per procedure (0.001% chance of dying), which is comparable to the mortality risk of skydiving (10 micromorts per jump by an experienced diver) (Fry et al., 2016). Chronic cigarette smoking reduces adult life expectancy by 6.5 years on average; said differently, averaged over a lifetime, smoking reduces life expectancy by 7 micromorts per day (3.5 hours per day) (Shaw et al., 2000).

2. Methods

2.1. Data sources

As of manuscript writing (November 10, 2020), British Columbia entered phase 1 on March 14, 2020 (i.e., banned gatherings with over 50 people, required self-isolation for travellers, restricted non-essential travel), phase 2 on May 19, 2020 (i.e., partial return to school), and phase 3 on June 24, 2020 (i.e., return to school, re-opening non-essential

travel within BC) (BC Centre for Disease Control 2020). The cumulative count and incidence (per 100,000 population) of covid-19 deaths in British Columbia were derived for January 15 to October 24, 2020 from the BC center for Disease Control (BC Centre for Disease Control 2020). Monthly illicit drug toxicity death rates in British Columbia for January 1, 2010 to September 30, 2020 were derived from the BC Coroners Service (BC Coroners Services 2020).

Age-stratified covid-19 and drug overdose events were available for age groups <19, 19–29, 30–39, 40–49, 50–59, 60–69, and 70–79. Sex- and age-stratified covid-19 data were unavailable for the present analysis. In contrast to the public health agencies of Quebec, Alberta, and Ontario, the government of British Columbia does not publish information about individual cases as of manuscript writing (Cox and Keller, 2020).

Survey data of changes in lifestyle behaviours during the covid-19 pandemic were obtained by Statistics Canada between May 4, 2020 and May 10, 2020 ($N = 4,600$) under the aegis of "Canadian Perspective Survey Series 2: Monitoring the Effects of COVID-19" (Messacar et al., 2020). Individuals ages 15 and older were sampled from census and administrative government records across Canada using a stratified, multi-stage, probability-based sampling design to comprise a nationally representative study sample. The cumulative response rate was 14.5% (Canada, 2020). Age was reported categorically in the survey (i.e., 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75 and older).

2.2. Measuring risk

A micromort is a unit of risk equivalent to a one-in-a-million chance of death. Micromorts convert abstract mortality statistics into conceptually simple, intuitive and comparable quantities (Fry et al., 2016). The risk of dying while giving birth vaginally can be expressed as 120 micromorts, whereas undergoing general anesthesia is associated with 10 micromorts; the risk of dying on the day of birth is 430 micromorts (Fry et al., 2016, Howard, 1984, Walker et al., 2014). The daily population risk of dying due to non-natural causes is approximately 1 micromort (Walker et al., 2014). Greater micromort values denote greater mortality risk.

Similarly, one microlife represents a 30-minute change in life expectancy; microlives are designed to quantify the risk of death associated with chronic exposure (Spiegelhalter, 2012). For example, eating an extra serving of red meat every day is estimated to reduce average life expectancy by 1.2 years, which is comparable to losing 1.1 microlives (33 minutes) per day for 57 years, from age 35 to 80 (Spiegelhalter, 2012). The difference in average life expectancy between living in the year 2010 vs. 1910 is 15 microlives (7.5 hours) per day (Spiegelhalter, 2012).

2.3. Statistical analysis

One micromort is equivalent to a mortality rate of 0.1 per 100,000 population (or case frequency). A mortality rate of 1 per 100,000 population over a period of 5 days is equivalent to 2 micromorts per day. Therefore, the number of covid-19 deaths, accumulated over 283 days of observation (January 15 to October 24, 2020), can be converted to micromorts per day as follows: number of deaths / population estimate of 5,139,568 * 1,000,000 / 283 days. Similarly, the number of covid-19 deaths / number of covid-19 cases * 1,000,000 / 283 days estimates, in micromorts per day, mortality risk among individuals with covid-19 (as opposed to mortality risk among BC residents generally, irrespective of covid-19 infection status).

Illicit drug overdose mortality risk was likewise computed, using the cumulative number of deaths per 100,000 population, during the 214 day-period in 2020 wherein monthly data were available during the lockdown (March 1 to September 30, 2020). Illicit drug overdose mortality rates per 100,000 population for 2010–2019 was converted to micromorts per day for each year.

Self-reported changes in alcohol consumption, smoking, empty calorie consumption, and sedentary lifestyle were surveyed ascertained as

being "Increased", "Decreased", and "No change" during the pandemic (i.e., "Have your weekly habits changed for any of the following activities?"; "Consuming alcohol", "Using tobacco products", "Eating junk food or sweets", "Watching television", "Spending time on the internet"). Survey data were stratified by age group and sex and descriptively reported in the present analysis.

3. Results

3.1. Covid-19 incidence and mortality in British Columbia

Covid-19 was associated with a mortality risk of 0.2 micromorts per day for individuals living in British Columbia between January 15 and October 24, 2020. The case rate was 336.9 per 100,000 population ($n = 13,427$) and the death rate was 6.5 per 100,000 population ($n = 258$). The median age of covid-19 cases was 37, while the median age of covid-19 deaths was 85.

The mortality risk of covid-19 for individuals under the age of 40 was null, 0.1 micromorts per day for individuals aged 40–79 years, and 2.6 micromorts per day for individuals over the age of 79 (Table 1). Individuals under the age of 40 comprised 54.4% ($n = 7,298$) of the cumulative count of covid-19 cases; all individuals under the age of 40 who had tested positive for covid-19 survived, including 153 hospitalized cases. Individuals between the ages of 40 and 79 accounted for 41.0% ($n = 5,513$) of covid-19 cases and 31.4% ($n = 81$) of deaths. Older adults (age ≥ 80) accounted for 4.6% ($n = 616$) of covid-19 cases and 68.6% ($n = 177$) of deaths. The mortality risk of covid-19 for individuals who had tested positive for covid-19 varied across age groups (Table 1).

For individuals who had tested positive for covid-19 – including those residing in long-term care facilities – the mortality risk of covid-19 was 67.9 micromorts per day. Among covid-19 cases who were not residents of a long-term care facility, mortality risk diminished to 21.1 micromorts per day. Covid-19-associated mortality risk rose to 1,152.4 micromorts per day for covid-positive residents of long-term care facilities. Long-term care facility residents accounted for 70.2% ($n = 181$) of covid-19 deaths.

3.2. Illicit drug overdose deaths in British Columbia

The rate of illicit drug toxicity deaths rose relatively slowly between 2010 and 2015. The increase in overdose mortality rate accelerated in 2016 and was declared a public health emergency. The rates continued to rise between 2017 and 2018, then decreased in 2019 (micromorts per day [by year]: 0.1 [2010], 0.2 [2011–2014], 0.3 [2015], 0.6 [2016], 0.8 [2017], 0.9 [2018], 0.5 [2019]). Illicit drug mortality rates steadied at 0.5 micromorts per day throughout January–February 2020. Fentanyl was detected in 80–85% of illicit drug toxicity fatalities between 2016 and 2020.

However, during the covid-19 lockdown, overdose mortality risk increased to 1.0 micromorts per day, representing an increase of 0.5 micromorts per day (March–September 2020) from 2019 and January–February 2020 rates. Relative to March–September 2019 ($n = 583$ deaths), there were 465 excess overdose-related deaths in March–September 2020 ($n = 1,048$). When compared to the former peak of the opioid crisis in 2018, the increase during the lockdown is commensurate with an increase of 0.1 micromorts per day (114 excess deaths).

The highest rates of illicit drug overdose deaths in March–September 2020 were observed among adults ages 40–49 (1.8 micromorts per day) and ages 30–39 and 50–59 (1.6 micromorts per day). Overdose deaths among individuals under the age of 40 accounted for 42.6% of illicit drug deaths during the covid-19 pandemic (0.9 micromorts per day); overdose deaths among individuals aged 40–49 years accounted for an additional 23.2%.

Table 1

A comparison of covid-19 and illicit drug overdose mortality rates in British Columbia, Canada. Covid-19 statistics for Jan–Oct 2020 and illicit drug overdose statistics for Mar–Sep 2020 were obtained from the British Columbia center for Disease Control. One micromort equates to a one-in-one-million chance of dying.

Age group	Covid-19			Illicit drug overdose	
	Mortality per 100,000 (cumulative deaths)	Micromorts per day	Micromorts per day for covid+ cases	Mortality per 100,000 (cumulative deaths)	Micromorts per day
<19	0	0	0	2.2 (12)	0.1
19–29	0	0	0	42.5 (188)	1.2
30–39	0	0	0	58.4 (246)	1.6
40–49	0.8 (4)	0.03	7.0	64.1 (243)	1.8
50–59	1.3 (7)	0.04	13.8	58.9 (250)	1.6
60–69	5.2 (27)	0.1	89.8	25.6 (99)	0.7
70–79	12.8 (43)	0.4	237.0	3.7 (9)	0.1
80–89	70.2 (102)	1.9	883.4	0	0
≥90	194.5 (75)	5.3	1,274.1	0	0
Overall	6.5 (258)	0.2	67.9	35.9 (1,048) ^a	1.0
Overall (excluding long-term care residents)	1.9 (77)	0.05	21.1	-	-

^a The total count of overdose deaths includes one case whose age was unknown.

3.3. Maladaptive lifestyle behaviours in Canada

Self-reported changes in alcohol consumption, smoking, empty calorie consumption, and sedentary lifestyle were surveyed in a nationally representative sample in May 2020 (Table 2). The proportion of respondents reporting increased alcohol consumption was greater among younger and middle-aged adults, relative to older adults (e.g., 29.0% in ages 25–34 and 27.5% in ages 35–44 vs. 4.9% in ages ≥75). Similarly, empty calorie consumption increased among a larger proportion of younger individuals than among older adults (e.g., 50.9% in ages 15–24 vs. 14.0% in ages ≥75). The majority of respondents reported increased sedentary behavior (i.e., watching television, internet browsing) across all age groups, with the greatest increases observed in younger individuals (Fig. 1). Over 90% of respondents, irrespective of age, reported no changes in tobacco smoking during the pandemic.

4. Interpretation

Opioid-related deaths and hospitalizations declined in 2019, and the first quarter of 2020, relative to the height of the opioid crisis in 2018 (Health Canada 2020). However, during the covid-19 pandemic, illicit drug toxicity deaths reached 1.0 micromorts per day (March–September 2020), surpassing the peak mortality risk of 0.9 micromorts per day in 2018. There were 465 excess overdose-related deaths in March–September 2020, representing an increase of 0.5 micromorts per day, relative to March–September 2019 (n = 583 deaths). In comparison, the mortality risk associated with covid-19 (excluding individuals residing in long-term care facilities) was 0.05 micromorts per day among individuals living in British Columbia and 21.1 micromorts per day among those infected with covid-19.

Table 2

Self-reported changes in lifestyle behaviours during the covid-19 pandemic. Participants were surveyed by Statistics Canada between May 4, 2020 and May 10, 2020 (N = 4,600). One micromort represents a 30-minute change in life expectancy, averaged over lifetimes at a population-level.

Increase in maladaptive behavior	Age Group, n (% of participants reporting change)							Microlives per day (literature value)
	15–24	25–34	35–44	45–54	55–64	65–74	≥75	
Alcohol consumption	50 (21.6)	177 (29.0)	210 (27.5)	146 (19.7)	144 (14.3)	90 (10.4)	15 (4.9)	-1 for each drink after the first (up to 6) (Gigerenzer et al., 2007)
Tobacco smoking	13 (5.6)	40 (6.6)	50 (6.6)	27 (3.7)	41 (4.2)	19 (2.3)	3 (1.1)	-0.4 per cigarette (Shaw et al., 2000)
Empty calorie consumption	118 (50.9)	285 (46.8)	300 (39.3)	238 (32.3)	306 (30.8)	207 (24.6)	42 (14.0)	-1 per 5 kg above ideal body weight of average height (Spiegelhalter, 2012, Prospective Studies Collaboration 2009)
Watching television	160 (69.3)	373 (61.1)	422 (54.9)	403 (54.1)	563 (55.7)	499 (56.9)	169 (53.3)	-1 for two hours (Wijndaele et al., 2011)
Internet usage	195 (84.1)	438 (71.9)	517 (67.4)	479 (64.2)	603 (59.5)	533 (60.6)	193 (60.5)	-2 for 3 hours of sitting (Katzmarzyk and Lee, 2012)

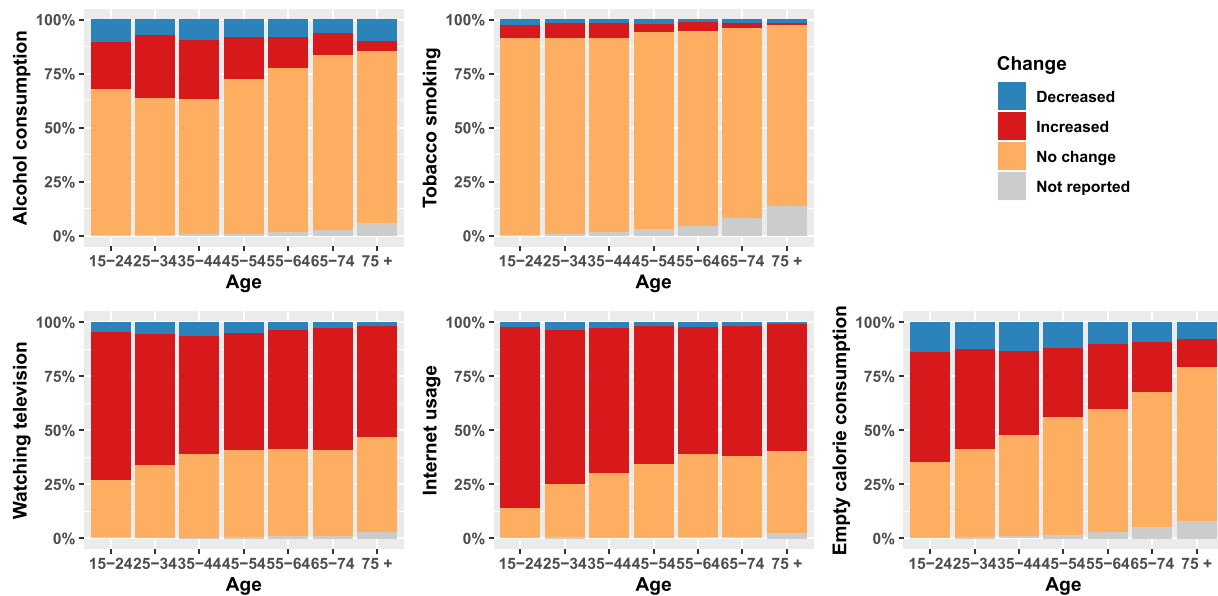


Fig. 1. Self-reported changes in lifestyle behaviours during the covid-19 pandemic. Participants were surveyed by Statistics Canada between May 4, 2020 and May 10, 2020 ($N = 4,600$; by age [n]: 15–24 [$n = 233$], 25–34 [$n = 612$], 35–44 [$n = 770$], 45–54 [$n = 749$], 55–64 [$n = 1023$], 65–74 [$n = 886$], 75+ [$n = 327$]).

Q Wang et al., 2020, Hao et al., 2020, Lee et al., 2020). Moreover, the uncertainty of covid-19 as a health risk, the indeterminate availability of treatments and vaccines, the unpredictable duration of lockdown measures, and the crisis of misinformation related to covid-19 additionally distress the mental health and social well-being of predisposed individuals (Wang et al., 2020, VanderWeele, 2020).

Covid-19 has disproportionately harmed the financial livelihood of vulnerable citizens, altered social support and networks, and diminished the availability and accessibility of health and social services (e.g., related to substance use) (Enns et al., 2020, Holmes et al., 2020). Individuals with pre-existing substance use disorders may experience additional difficulties accessing harm reduction services and drug rehabilitation facilities (e.g., methadone clinics, buprenorphine supply) due to lockdown-related service restrictions (e.g., reduced hours, lowered patient capacity for physical distancing, temporary closures, reduced staff availability or need for additional staff to enforce covid-related safety measures) (Green et al., 2020, Alexander et al., 2020, Becker and Fiellin, 2020). Telehealth interventions may be warranted to reduce substance use-related mortality (e.g., online motivational interviewing, counselling) (Zhou et al., 2020).

A significant proportion of younger adults reported increases in alcohol consumption and other maladaptive behaviours, which may additionally contribute to covid-related morbidity and mortality. Furthermore, the economic fallout of the covid-19 pandemic disproportionately affects working-age individuals (OECD Economics Department 2020). Individuals under the age of 40 comprise 47.3% of the BC population and individuals under the age of 50 comprise 59.8% of the BC population (BC Centre for Disease Control 2020). A recent analysis modeling covid-19 mortality rates in the UK reported that, while school closures and the isolation of younger people effectively decelerated the demand for intensive care unit beds, these measures may have significantly increased the total number of deaths long-term by prolonging the epidemic (Rice et al., 2020). Furthermore, the restrictive measures have lowered the reproduction number to near one, thereby increasing the risk for unpredictable superspreading events and community outbreaks (Rice et al., 2020).

4.1. Limitations

The cumulative age-standardized covid-19 case rate of 244.9 per 100,000 population in British Columbia is lower than the national average of 550.1 per 100,000 population; and the incidence of opioid-related overdoses in British Columbia is significantly higher than in other parts of Canada, which may limit the generalizability of our findings to other Canadian provinces or territories and beyond (Public Health Agency of Canada 2020, Probst and Rehm, 2018). While we were able to estimate mortality risk for subpopulations who had tested positive for covid-19, we were unable to estimate mortality risk for subpopulations with opioid use disorders, who have significantly greater risk for drug toxicity deaths. Micromorts and microlives represent averages over populations and lifetimes; they are not intended to consider or account for individual variability in risk factors (e.g., pre-existing chronic disease), behaviours (e.g., mask wearing, personal hygiene, physical activity), or other moderators of mortality or exposure. Our results, derived from population level data, compare mortality risk between aggregate groups of people; we dissuade readers from generalizing our findings and making inferences about mortality risk in individual persons.

5. Conclusions

Our study represents the first use of microrisk analysis in psychiatry, and supports the utility of micromorts in medicine for communicating risk assessments and informing medical decisions. A growing body of evidence indicates that covid-19 will have long-term health effects beyond the immediate threat of infection mortality (e.g., opioid overdose, suicide, depression, acute stress disorder). Non-communicable diseases are projected to account for 85.7% and 67.8% of health-related disability in high- and low-income countries, respectively, by the year 2040 (Foreman et al., 10). Policy makers should align physical health, mental health, and social well-being priorities when designing and implementing measures to manage covid-19. Interventions to mitigate covid-19 risk should be informed by consideration of social factors that moderate not only physical health, but also mental health and social well-being within the plurality of the population, and should not have the externality of increasing mortality due to other causes.

Contributors

YL conceptualized the article; collected, analyzed, and interpreted the data; and wrote the first draft of the article and revised it based on feedback from co-authors. All authors reviewed and approved the article and meet ICJME authorship criteria.

Author statement

All authors have approved the final manuscript and note that this is our original work.

Author Y. Lee received salary support from the Global Alliance for Chronic Diseases/Canadian Institutes of Health Research (CIHR)/National Natural Science Foundation of China's Mental Health Team Grant and the CIHR Frederick Banting and Charles Best Canada Graduate Scholarship; personal fees from Champignon Brands. Author RSM reports research grant support from Chronic Diseases/Canadian Institutes of Health Research (CIHR)/National Natural Science Foundation of China's Mental Health Team Grant; reports speaker/consultation fees from Lundbeck, Janssen, Purdue, Pfizer, Otsuka, Allergan, Takeda, Neurocrine, Sunovion, Minerva, Intra-Cellular, Abbvie; and is a shareholder and CEO of Champignon Brands. Author EB reports research grants from the Faculty of Health Sciences, Department of Psychiatry, and center for Neuroscience Studies (Queen's University), FAPESP, CNPq, CAPES, and L'Oreal for Women in Science Award; and speaker/advisor honoraria from Daiichi-Sankyo, Lundbeck, and Janssen-Cilag not related to the current work. Authors LMWL, Y. Liao, RBM, RH, MS, and CL declare no competing interests.

Data sharing

All data used in the study are publicly available. Canadian Perspectives Survey Series data are published by Statistics Canada: <https://www150.statcan.gc.ca/n1/en/catalog/45,250,004>.

Covid-19 statistics are published by the BC center for Disease Control: <http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data>. Illicit drug toxicity data are published by the BC Coroners Service: <https://www2.gov.bc.ca/gov/content/life-events/death/coroners-service/statistical-reports>.

Other statements

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research. Ethics review was not obtained as it is not required by Health Canada for studies using publicly available data.

Dr. Roger McIntyre is the guarantor of the clinical content of this submission.

Declaration of Competing Interests

No funding sources to declare.

References

- Alexander, GC, Stoller, KB, Haffajee, RL, Saloner, B., 2020. An epidemic in the midst of a pandemic: opioid use disorder and COVID-19. *Ann. Intern. Med.* [Internet] 173 (1), 57–58. <https://doi.org/10.7326/M20-1141>. Jul 7 Available from.
- BC Centre for Disease Control, 2020. BCCDC COVID-19 Situational Report Week 43 [Internet]. Provincial Health Serv. Authority. Oct [cited 2020 Nov 5]. Report No.: Week 43. Available from. <http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data>.
- BC Coroners Services, 2020. Illicit Drug Toxicity Deaths in BC, January 1, 2010 – September 30, 2020 [Internet]. Ministry of Public Saf. Solicitor General [cited 2020 Nov 5]. Available from. <https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug.pdf>.
- Becker, WC, Fiellin, DA., 2020. When Epidemics Collide: coronavirus Disease 2019 (COVID-19) and the Opioid Crisis. *Ann. Intern. Med.* [Internet] 173 (1), 59–60. <https://doi.org/10.7326/M20-1210>. Jul 7 Available from.
- Beller, J, Wagner, A., 2018. Loneliness, social isolation, their synergistic interaction, and mortality. *Health Psychol.* [Internet] 37 (9), 808–813. <https://doi.org/10.1037/hea0000605>. Sep Available from.
- Belzák, L, Halverson, J., 2018. The opioid crisis in Canada: a national perspective. *Health Promot. Chronic Dis. Prev. Can.* [Internet] 38 (6), 224–233. <https://doi.org/10.24095/hpcdp.38.6.02>. Jun Available from.
- Braden, JB, Edlund, MJ, Sullivan, MD., 2017. Suicide Deaths With Opioid Poisoning in the United States: 1999–2014. *Am. J. Public Health* [Internet] 107 (3), 421–426. <https://doi.org/10.2105/AJPH.2016.303591>. Mar Available from.
- Bruce, LD, Wu, JS, Lustig, SL, Russell, DW, Nemecek, DA., 2019. Loneliness in the United States: a 2018 National Panel Survey of Demographic, Structural, Cognitive, and Behavioral Characteristics. *Am. J. Health Promot.* [Internet] 33 (8), 1123–1133. <https://doi.org/10.1177/0890117119856551>. Nov Available from.
- Bu, F, Steptoe, A, Fancourt, D., 2020. Who is lonely in lockdown? Cross-cohort analyses of predictors of loneliness before and during the COVID-19 pandemic. *Public Health* [Internet] 186, 31–34. <https://doi.org/10.1016/j.puhe.2020.06.036>. Sep Available from.
- Canada, Statistics, 2020. Canadian Perspective Survey Series 2: monitoring the Effects of COVID-19 Study Documentation [Internet]. Canadian Perspectives Survey Series (CPSS) [cited 2020 Nov 5]. Available from. <https://search1.odesi.ca/#/details?uri=%2Fodesi%2Fcpss-5311-E-series2.xml>.
- Case, A, Deaton, A., 2015. Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century. *Proc. Natl. Acad. Sci. U S A* [Internet], 112 (49), 15078–15083. <https://doi.org/10.1073/pnas.1518393112>. Dec 8 Available from.
- Cox, W, Keller, J., 2020. Western Canada: data on B.C. COVID cases hard to come by. *The Globe and Mail* [Internet]. Sep 16 [cited 2020 Nov 10]; Available from. <https://www.theglobeandmail.com/canada/british-columbia/article-western-canada-data-on-bc-covid-cases-hard-to-come-by/>.
- Creed, PA, Reynolds, J., 2001. Economic deprivation, experiential deprivation and social loneliness in unemployed and employed youth. *J. Community Appl. Soc. Psychol.* [Internet] 11 (3), 167–178. May Available from. <http://doi.wiley.com/10.1002/casp.612>.
- Czeisler, ME, Lane, RI, Petrosky, E, Wiley, JF, Christensen, A, Njai, R, et al., 2020. Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic - United States. *MMWR Morb. Mortal Wkly. Rep.* [Internet] 69 (32), 1049–1057. <https://doi.org/10.15585/mmwr.mm6932a1>, 2020 Aug 14 Available from.
- De Vogli, R, Marmot, M, Stuckler, D., 2013. Excess suicides and attempted suicides in Italy attributable to the great recession. *J. Epidemiol. Community Health* [Internet] 67 (4), 378–379. <https://doi.org/10.1136/jech-2012-201607>. Apr Available from.
- Enns, A, Pinto, A, Venugopal, J, Grywachski, V, Gheorghie, M, Kakkar, T, et al., 2020. Substance use and related harms in the context of COVID-19: a conceptual model. *Health Promot. Chronic Dis. Prev. Can.* [Internet] 40 (11/12). <https://doi.org/10.24095/hpcdp.40.11/12.03>. Sep [cited 2020 Nov 10] Available from.
- Foreman, KJ, Marquez, N, Dolgert, A, Fukutaki, K, Fullman, N, McGaughey, M, et al., 2018 Nov 10. Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. *Lancet* [Internet] 392 (10159), 2052–2090. [https://doi.org/10.1016/S0140-6736\(18\)31694-5](https://doi.org/10.1016/S0140-6736(18)31694-5). Available from.
- Fry, AM, Harrison, A, Daigneault, M., 2016. Micromorts—what is the risk? *Br. J. Oral Maxillofac. Surg.* [Internet] 54 (2), 230–231. <https://doi.org/10.1016/j.bjoms.2015.11.023>. Feb Available from.
- Gigerenzer, G, Gaissmaier, W, Kurz-Milcke, E, Schwartz, LM, Woloshin, S., 2007. Helping Doctors and Patients Make Sense of Health Statistics. *Psychol. Sci. Public Interest* [Internet] 8 (2), 53–96. <https://doi.org/10.1111/j.1539-6053.2008.00033.x>. Nov Available from.
- González-Sanguino, C, Ausín, B, Castellanos, MÁ, Saiz, J, López-Gómez, A, Ugidos, C, et al., 2020. Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain Behav. Immun.* [Internet] 87 (bbi, 8800478), 172–176. <https://doi.org/10.1016/j.bbi.2020.05.040>. Jul Available from.
- Green, TC, Bratberg, J, Finnell, DS., 2020. Opioid use disorder and the COVID 19 pandemic: a call to sustain regulatory easements and further expand access to treatment. *Subst Abuse* [Internet] 41 (2), 147–149. <https://doi.org/10.1080/08897077.2020.1752351>. Available from.
- Hao, F, Tan, W, Jiang, L, Zhang, L, Zhao, X, Zou, Y, et al., 2020. Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. *Brain Behav. Immun.* [Internet] 87 (bbi, 8800478), 100–106. <https://doi.org/10.1016/j.bbi.2020.04.069>. Jul Available from.
- Health Canada, 2020. Federal Actions on Opioids to Date. *Government of Canada*.
- Hickson, C, Hoskins, F, Ogollah, R, Walker, KF, Thornton, JG., 2020. The risks of a range of maternal pregnancy choices, expressed as “baby micromorts” (risk of death per million births). *Eur. J. Obstet. Gynecol. Reprod. Biol.* [Internet] 251, 194–198. <https://doi.org/10.1016/j.ejogrb.2020.05.051>. Aug Available from.
- Holmes, EA, O'Connor, RC, Perry, VH, Tracey, I, Wessely, S, Arseneault, L, et al., 2020. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry* [Internet] 7 (6), 547–560. [https://doi.org/10.1016/S2215-0366\(20\)30168-1](https://doi.org/10.1016/S2215-0366(20)30168-1). Jun Available from.
- Holt-Lunstad, J, Smith, TB., 2016. Loneliness and social isolation as risk factors for CVD: Implications for evidence-based patient care and scientific inquiry. *Heart* [Internet]. 102 (13), 987–989. <https://doi.org/10.1136/heartjnl-2015-309242>. Jul 1 Available from.
- Howard, RA., 1980. On Making Life and Death Decisions. In: Schwing, RC, Albers, WA (Eds.), *Societal Risk Assessment: How Safe is Safe Enough?* [Internet], editors.

- Springer US, Boston, MA, pp. 89–113. https://doi.org/10.1007/978-1-4899-0445-4_5. Available from.
- Howard, R.A., 1984. On Fates Comparable to Death. *Manage Sci* [Internet] 30 (4), 407–422. <https://doi.org/10.1287/mnsc.30.4.407>. Apr 1 Available from.
- Howard, R.A., 1989. Microrisks for medical decision analysis. *Int. J. Technol. Assess. Health Care* [Internet] 5 (3), 357–370. <https://doi.org/10.1017/s026646230000742x>. Available from.
- Johnson, E.M., Lanier, W.A., Merrill, R.M., Crook, J., Porucznik, C.A., Rolfs, R.T., et al., 2013. Unintentional prescription opioid-related overdose deaths: description of decedents by next of kin or best contact, Utah, 2008–2009. *J. Gen. Intern. Med.* [Internet] 28 (4), 522–529. <https://doi.org/10.1007/s11606-012-2225-z>. Apr Available from.
- Katzmarzyk, P.T., Lee, I.-M., 2012. Sedentary behaviour and life expectancy in the USA: a cause-deleted life table analysis. *BMJ Open* [Internet] 2 (4). <https://doi.org/10.1136/bmjopen-2012-000828>. Jul 9 Available from.
- Killgore, W.D.S., Cloonan, S.A., Taylor, E.C., Dailey, N.S., 2020. Loneliness: a signature mental health concern in the era of COVID-19. *Psychiatry Res.* [Internet], 113117. Aug;290 (qc4, 7911385) Available from: <http://dx.doi.org/10.1016/j.psychres.2020.113117>.
- Lee, Y., Yang, B.X., Liu, Q., Luo, D., Kang, L., Yang, F., et al., 2020. Synergistic effect of social media use and psychological distress on depression in China during the COVID-19 epidemic. *Psychiatry Clin. Neurosci.* [Internet]. <https://doi.org/10.1111/pcn.13101>. Jul 1 Available from.
- Leigh-Hunt, N., Bagguley, D., Bash, K., Turner, V., Turnbull, S., Valtorta, N., et al., 2017. An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health* [Internet] 152, 157–171. <https://doi.org/10.1016/j.puhe.2017.07.035>. Nov Available from.
- Lindsay, E.K., Young, S., Brown, K.W., Smyth, J.M., Creswell, J.D., 2019. Mindfulness training reduces loneliness and increases social contact in a randomized controlled trial. *Proc. Natl. Acad. Sci. U S A* [Internet]. 116 (9), 3488–3493. <https://doi.org/10.1073/pnas.1813588116>. Feb 26 Available from.
- Luo, F., Florence, C.S., Quispe-Agnoli, M., Ouyang, L., Crosby, A.E., 2011. Impact of business cycles on US suicide rates, 1928–2007. *Am. J. Public Health* [Internet] 101 (6), 1139–1146. <https://doi.org/10.2105/AJPH.2010.300010>. Jun Available from.
- Macdonald, S.J., Nixon, J., Deacon, L., 2018. Loneliness in the city: examining socio-economics, loneliness and poor health in the North East of England [Internet]. *Public Health* 165, 88–94. <https://doi.org/10.1016/j.puhe.2018.09.003>. Available from.
- Mack, K.A., Jones, C.M., Ballesteros, M.F., 2017. Illicit Drug Use, Illicit Drug Use Disorders, and Drug Overdose Deaths in Metropolitan and Nonmetropolitan Areas - United States. *MMWR Surveill. Summ.* [Internet] 66 (19), 1–12. <https://doi.org/10.15585/mmwr.ss6619a1>. Oct 20 Available from.
- Matthews, T., Danese, A., Caspi, A., Fisher, H.L., Goldman-Mellor, S., Kopa, A., et al., 2019. Lonely young adults in modern Britain: findings from an epidemiological cohort study. *Psychol. Med.* [Internet] 49 (2), 268–277. <https://doi.org/10.1017/S0033291718000788>. Jan Available from.
- McGinty, E.E., Presskreischer, R., Han, H., Barry, C.L., 2020. Psychological Distress and Loneliness Reported by US Adults in 2018 and April 2020. *JAMA* [Internet] 324 (1), 93–94. <https://doi.org/10.1001/jama.2020.9740>. Jul 7 Available from.
- McIntyre, R.S., Lee, Y., 2020a. Projected increases in suicide in Canada as a consequence of COVID-19. *Psychiatry Res.* [Internet] 290, 113104. <https://doi.org/10.1016/j.psychres.2020.113104>. Aug Available from.
- McIntyre, R.S., Lee, Y., 2020b. Preventing suicide in the context of the COVID-19 pandemic. *World Psychiatry* [Internet] 19 (2), 250–251. <https://doi.org/10.1002/wps.20767>. Jun Available from.
- Messacar, D., Morissette, R., Deng, Z., 2020. Canadian Perspectives Survey Series 2: monitoring the effects of COVID-19, May 2020 [Internet]. Government of Canada, Statistics Canada 00026, 45280001. May [cited 2020 Oct 7]. Report No Available from. <https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00026-eng.htm>.
- Miller, G., 2011. Social neuroscience. Why loneliness is hazardous to your health. *Science* [Internet] 331 (6014), 138–140. <https://doi.org/10.1126/science.331.6014.138>. Jan 14 Available from.
- Milner, A., Krnjacki, L., Butterworth, P., LaMontagne, A.D., 2016. The role of social support in protecting mental health when employed and unemployed: a longitudinal fixed-effects analysis using 12 annual waves of the HILDA cohort. *Soc. Sci. Med.* [Internet] 153, 20–26. <https://doi.org/10.1016/j.socscimed.2016.01.050>. Mar Available from.
- Nabavi, N., 2020. Long covid: how to define it and how to manage it. *BMJ* [Internet] 370, m3489. <https://doi.org/10.1136/bmj.m3489>. Sep 7 Available from.
- OECD Economics Department, 2020. Evaluating the Initial Impact of COVID-19 Containment Measures On Economic Activity [Internet]. New OECD outlook on the global economy [cited 2020 Apr 14]. Available from. https://read.oecd-ilibrary.org/view/?ref=126_126496-evgsj2gmqj&title=Evaluating_the_initial_impact_of_COVID-19_containment_measures_on_economic_activity.
- Oquendo, M.A., Volkow, N.D., 2018. Suicide: a Silent Contributor to Opioid-Overdose Deaths. *N. Engl. J. Med.* [Internet] 378 (17), 1567–1569. <https://doi.org/10.1056/NEJMp1801417>. Apr 26 Available from.
- Park, C., Majeed, A., Gill, H., Tamura, J., Ho, R.C., Mansur, R.B., et al., 2020. The Effect of Loneliness on Distinct Health Outcomes: a Comprehensive Review and Meta-Analysis. *Psychiatry Res.* [Internet] 294, 113514. <https://doi.org/10.1016/j.psychres.2020.113514>. Oct 19 Available from.
- Pettersson, S., Westfall, J.M., Miller, B.F., 2020. Projected Deaths of Despair from COVID-19 [Internet]. Well Being Trust. May Available from https://wellbeingtrust.org/wp-content/uploads/2020/05/WBT_Deaths-of-Despair_COVID-19-FINAL-FINAL.pdf.
- Phillips, J.A., Suicide, Nugent C.N., 2007–2009, the Great Recession of, 2014. The role of economic factors in the 50U.S. states [Internet]. *Soc. Sci. Med.* 116, 22–31. <https://doi.org/10.1016/j.socscimed.2014.06.015>. Available from.
- Probst, C., Rehm, J., 2018. Alcohol use, opioid overdose and socioeconomic status in Canada: a threat to life expectancy? *CMAJ* [Internet] 190 (44), E1294–E1295. <https://doi.org/10.1503/cmaj.180806>. Nov 5 Available from.
- Prospective Studies Collaboration, 2009. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet* [Internet] 373 (9669), 1083–1096. Mar 28 Available from. <http://www.sciencedirect.com/science/article/pii/S0140673609603184>.
- Public Health Agency of Canada, 2020a. From Risk to Resilience: An Equity Approach to COVID-19 The Chief Public Health Officer of Canada's Report On the State of Public Health in Canada 2020 [Internet]. Public Health Agency of Canada, 200173. Oct. Report No. Available from. <https://www.canada.ca/content/dam/phac-aspc/documents/corporate/publications/chief-public-health-officer-reports-state-public-health-canada-from-risk-resilience-equity-approach-covid-19/cpho-covid-report-eng.pdf>.
- Public Health Agency of Canada, 2020b. Canada COVID-19 Weekly Epidemiology Report (25 to 31 October) [Internet]. Public Health Agency of Canada. Nov Available from. <https://www.canada.ca/content/dam/phac-aspc/documents/services/diseases/2019-novel-coronavirus-infection/surv-covid19-weekly-epi-update-20201106-eng.pdf>.
- Reeves, A., Stuckler, D., McKee, M., Gunnell, D., Chang, S.-S., Basu, S., 2012. Increase in state suicide rates in the USA during economic recession. *Lancet* [Internet] 380 (9856), 1813–1814. [https://doi.org/10.1016/S0140-6736\(12\)61910-2](https://doi.org/10.1016/S0140-6736(12)61910-2). Nov 24 Available from.
- Reeves, A., McKee, M., Stuckler, D., 2014. Economic suicides in the Great Recession in Europe and North America. *Br. J. Psychiatry* [Internet] 205 (3), 246–247. <https://doi.org/10.1192/bjp.bp.114.144766>. Sep Available from.
- Rice, K., Wynne, B., Martin, V., Ackland, G.J., 2020. Effect of school closures on mortality from coronavirus disease 2019: old and new predictions. *BMJ* [Internet] 371, m3588. <https://doi.org/10.1136/bmj.m3588>. Oct 7 Available from.
- Richard, A., Rohrmann, S., Vandeleur, C.L., Schmid, M., Barth, J., Eichholzer, M., 2017. Loneliness is adversely associated with physical and mental health and lifestyle factors: results from a Swiss national survey. *PLoS One* [Internet]. 12 (7), e0181442. <https://doi.org/10.1371/journal.pone.0181442>. Jul 17 Available from.
- Secretary-General of the OECD, 2020. COVID-19 Crisis Response in MENA Countries [Internet]. Organisation for Economic Co-operation and Development. Nov [cited 2020 Nov 10]. Available from. <https://www.oecd.org/coronavirus/policy-responses/covid-19-crisis-response-in-mena-countries-4b366396/>.
- Shaw, M., Mitchell, R., smoke?, Dorling D., Time for a, 2000. One cigarette reduces your life by 11 min. *BMJ* [Internet] 320 (7226), 53. Jan 1 Available from. <https://www.ncbi.nlm.nih.gov/pubmed/10617536>.
- Spiegelhalter, D., 2012. Using speed of ageing and “micro-lives” to communicate the effects of lifetime habits and environment. *BMJ* [Internet] 345, e8223. <https://doi.org/10.1136/bmj.e8223>. Dec 14 Available from.
- Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., McKee, M., 2009. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. *Lancet* [Internet] 374 (9686), 315–323. [https://doi.org/10.1016/S0140-6736\(09\)61124-7](https://doi.org/10.1016/S0140-6736(09)61124-7). Jul 25 Available from.
- Trad, N.K., Frank Wharam, J., Druss, B., 2020. Addressing Loneliness in the Era of COVID-19. *JAMA Health Forum* [Internet] 1 (6). Jun 1 [cited 2020 Nov 10] e200631–e200631. Available from. <https://jamanetwork.com/channels/health-forum/fullarticle/2766811>.
- Ueda, M., Nordström, R., Matsubayashi, T., 2020. Suicide and mental health during the COVID-19 pandemic in Japan [Internet]. *Epidemiology. medRxiv* 468. Available from. <https://www.medrxiv.org/content/10.1101/2020.10.06.20207530v3.abstr>.
- Ustun, G., 2020. Determining depression and related factors in a society affected by COVID-19 pandemic. *Int. J. Soc. Psychiatry* [Internet] (gt5, 0374726), 20764020938807. <https://doi.org/10.1177/0020764020938807>. Jun 30 Available from.
- VanderWeele, T.J., 2020. Challenges Estimating Total Lives Lost in COVID-19 Decisions: consideration of Mortality Related to Unemployment, Social Isolation, and Depression. *JAMA* [Internet] 324 (5), 445–446. <https://doi.org/10.1001/jama.2020.12187>. Aug 4 Available from.
- Walker, K.F., Cohen, A.L., Walker, S.H., Allen, K.M., Baines, D.L., Thornton, J.G., 2014. The dangers of the day of birth. *BJOG* [Internet] 121 (6), 714–718. <https://doi.org/10.1111/1471-0528.12544>. May Available from.
- Wang, C., Chudzicka-Czupala, A., Grabowski, D., Pan, R., Adamus, K., Wan, X., et al., 2020. The Association Between Physical and Mental Health and Face Mask Use During the COVID-19 Pandemic: a Comparison of Two Countries With Different Views and Practices. *Front. Psychiatry* [Internet] 11, 901. Available from. <https://www.frontiersin.org/article/10.3389/fpsy.2020.569981>.
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R.S., et al., 2020a. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav. Immun.* [Internet] 87 (bbi, 8800478), 40–48. <https://doi.org/10.1016/j.bbi.2020.04.028>. Jul Available from.
- Wang, Q., Xu, R., Volkow, N.D., 2020b. Increased risk of COVID-19 infection and mortality in people with mental disorders: analysis from electronic health records in the United States. *World Psychiatry* [Internet]. <https://doi.org/10.1002/wps.20806>. Oct 7 Available from.
- Wijndaele, K., Brage, S., Besson, H., Khaw, K.-T., Sharp, S.J., Luben, R., et al., 2011. Television viewing time independently predicts all-cause and cardiovascular mortality: the EPIC Norfolk study. *Int J Epidemiol* [Internet] 40 (1), 150–159. <https://doi.org/10.1093/ije/dyq105>. Feb Available from.
- Wood, E., 2018. Strategies for Reducing Opioid-Overdose Deaths - Lessons from Canada. *N. Engl. J. Med.* [Internet] 378 (17), 1565–1567. <https://doi.org/10.1056/NEJMp1800216>. Apr 26 Available from.

World Health Organization, 2005. Constitution [Internet]. World Health Organization [cited 2020 Nov 10]. Available from. <https://www.who.int/about/who-we-are/constitution>.

World Health Organization, 2020. WHO Coronavirus Disease (COVID-19) Dashboard [Internet]. WHO Health Emergency Dashboard [cited 2020 Nov 10]. Available from. <https://covid19.who.int>.

Xiong, J, Lipsitz, O, Nasri, F, Lui, LMW, Gill, H, Phan, L, et al., 2020. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J. Affect.*

Disord. [Internet] 277, 55–64. <https://doi.org/10.1016/j.jad.2020.08.001>. Aug 8 Available from.

Zhou, X, Snoswell, CL, Harding, LE, Bambling, M, Edirippulige, S, Bai, X, et al., 2020. The Role of Telehealth in Reducing the Mental Health Burden from COVID-19. *Telemed. J. E Health* [Internet] 26 (4), 377–379. <https://doi.org/10.1089/tmj.2020.0068>. Apr Available from.