Major challenges in substance use research in Canada in 2019

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Abstract

Aims: To synthesize knowledge on substance use and substance-attributable burden in Canada to determine research priorities for the next 3 to 5 years.

Methods: We searched for and analyzed the latest epidemiological estimates of substance use prevalence and attributable burden and for economic data on the costs of substance use.

Results: Based on trends over 2014-2019, opioid, alcohol, and cannabis use were identified as research priorities due to their current or anticipated future impact on health burden in Canada. Specifically, future research efforts should be directed towards: (a) reducing the number of opioid prescriptions, investing in interventions for those already addicted to opioids, preventing both the development of opioid use disorders and deaths due to overdose; (b) identifying ways to reduce hazardous and harmful drinking, particularly among those with low socioeconomic status; and (c) monitoring and evaluating the impacts of the recent policy implementations for the legalization of cannabis on various outcomes. While tobacco attributable burden has been decreasing, it is important to continue to monitor vaping use over time.

Conclusions: Substance use is a significant and increasing risk factor for burden of disease, and research efforts are necessary to reduce this burden in Canada.

Introduction

The contributions of substance use (alcohol, tobacco and illicit drugs) to the total disease and injury burden have been increasing globally over the past decades relative to other risk factors (GBD 2017 Risk Factor Collaborators, 2018). North America has been no exception to this trend. As Case and Deaton (2017) have pointed out, the US has recently been experiencing a stagnation and slight decrease in life expectancy, and alcohol and opioid use have played a major role (Case & Deaton, 2017, 2020; J. Rehm, 2020; J. Rehm & Probst, 2018; White, Castle, Hingson, & Powell, 2020).

This has raised the question of whether similar trends and developments could also be seen in Canada. Accordingly, this contribution examines the health and economic impact of substance use in Canada. However, we did not only want to examine substance use trends and developments in Canada; we also looked for implications of these trends, and what kind of research in substance use would be most beneficial to shape the future, independent of the current COVID-19 pandemic (for further considerations see (Jürgen Rehm et al., 2020; Volkow, 2020).

Methods

After a systematic search for reviews on related topics yielded no results (see Appendix 1 for search terms used), two main search strategies were employed to assess the impact of substance use on health and economic indicators in Canada. First, for epidemiological data on burden of disease attributable to various risk factors, we relied on the last iteration of the Global Burden of Disease study (GBD 2017 Risk Factor Collaborators, 2018; Institute for Health Metrics and Evaluation, 2018). Second, we searched recent publications by the Canadian Institute for Health Information, Health Canada, Statistics Canada, and other relevant Canadian institutions for research on substance use.

Results

Substance Use is a Significant Contributor to Burden of Disease in Canada

Table 1

Burden of Disease Attributable to Alcohol, Tobacco and Illicit Drugs in Main Indicators for 2017: Death, Years of Life Lost (YLLs), and Disability-Adjusted Life Years (DALYs) per 100,000 Population

Substance and Region	Deaths	YLLs	DALYs
Global			
Alcohol	37.2	1,147.8	1,413.1
Tobacco	106.0	2,294.3	2,792.8
Illicit drugs	7.7	271.2	545.2
Total (assuming 10% overlap)	135.8	3,341.9	4,276.1
Attributable fraction	30%	27%	27%
North America High-Income			
Alcohol	23.9	921.0	1,246.3
Tobacco	136.3	2,533.6	3,384.7
Illicit drugs	30.3	1,193.7	1,957.1
Total (assuming 10% overlap)	171.4	4,183.4	5,929.3
Attributable fraction	34%	45%	43%
Canada			
Alcohol	14.5	612.5	865.2
Tobacco	142.7	2,470.1	3,384.3
Illicit drugs	11.9	424.4	927.6
Total (assuming 10% overlap)	152.2	3156.4	4659.4
Attributable fraction	35%	45%	41%

Source: Institute for Health Metrics and Evaluation

Substance use is a major and – compared to other factors – increasing risk factor for burden of disease (BoD) globally and in high-income countries such as Canada. Table 1 provides an overview of the burden of substance use attributable to alcohol, tobacco and illicit drugs according to important BoD indicators in 2017, based on the Institute for Health Metrics and Evaluation. Overall, in Canada, substance use was responsible for 35% of all deaths, 45% of all years of life lost (YLLs), and 41% of all BoD, as expressed in disability-adjusted life years (DALYs). All calculations for overall BoD attributable to substance use assume a 10% overlap between substances (J. Rehm, Manthey, Shield, & Ferreira-Borges, 2019).

In Canada, tobacco, drug, and alcohol use were ranked first, eighth and ninth, respectively, among the top 10 risk factors contributing to DALYs in 2017. Furthermore, drug and alcohol use were among the fastest-growing risk factors in terms of percentage increase of DALYs from 2007 to 2017. Drug use was ranked first, and alcohol use was ranked third with 31.5% and 18.4% increases in DALYs, respectively, during this time, while tobacco-attributable DALYs decreased by 0.7% (Institute for Health Metrics and Evaluation, 2018). Moreover, in 2017–2018, there were 156,108 hospitalizations which were 100% attributable to substance use; more than for heart attacks and strokes combined. Among these hospitalizations, the highest numbers were caused by alcohol (82,740, 53.0%), cannabis (23,410, 15.0%), opioids (19,279, 12.3%), other stimulants (17,479, 11.2%), and cocaine (12,203, 7.8%) (Canadian Institute for Health Information, 2019)). In short, drug and alcohol use contribute a significant BoD to Canada and their relative impacts have been increasing. Meanwhile, although still high, the burden caused by tobacco has been declining.

Substance use disorders are a significant contributor to substance-related burden in Canada (Table 2). In 2017, the 12-month prevalence of substance use disorders was 3,342 per 100,000 population, which caused 989 DALYs per 100,000 population. Substances that had the highest prevalence of respective substance use disorders were alcohol, followed by opioids, and then cannabis. Substances that contributed the top three burdens in terms of DALYs were opioids, alcohol, and cocaine, respectively (Global Burden of Disease Collaborative Network, 2018).

Table 2

The Prevalence of substance use disorders and their attributable DALYs, by Type of Substance, in 2017

Type of Substance	Prevalence (No per 100,000 Popn)	DALYs (DALYs per 100,000 Popn)
Alcohol	1,492	256
Opioids	953	551
Cannabis	617	18
Cocaine	261	54
Amphetamine	49	14
All types	3,342	989

Source: Global Burden of Disease Collaborative Network, 2018

Substance Use Affects Life Expectancy in North America

In North America, there are signs of an increasing impact of substance use on public health (GBD 2017 Risk Factor Collaborators, 2018; J. Rehm, Anderson, Fischer, Gual, & Room, 2016) including, but not limited to, the impact on life expectancy in the US (Case & Deaton, 2015, 2017; J. Rehm, 2020; J. Rehm & Probst, 2018), mainly attributable to opioid and alcohol use.

In Canada, life expectancy was increasing up until 2016, albeit with a decreasing slope, but between 2016 and 2018 it stagnated (Statistics Canada, 2020b). Alcohol, and especially opioids, contributed significantly to this development. Among younger adults in Canada, alcohol and drug use were the most impactful risk factor for mortality,

contributing to 25% of deaths in 2016, up from less than 20% in 1990 (Probst & Rehm, 2018). Recently, opioid overdose deaths have sharply increased (from 3,017 deaths in 2016 to 4,100 and 4,460 in 2017 and 2018; this accounted for 8.4, 11.2, and 12.0 deaths per 100,000 population, per year respectively) (Public Health Agency Canada, 2019) and deaths and hospitalizations attributable to alcohol have also increased to record levels (Probst & Rehm, 2018; Public Health Agency Canada, 2018b).

Alcohol and Drug Use Impose a High Economic Cost to Canadian Society

The Canadian Substance Use Costs and Harms Scientific Working Group conducted a study estimating the economic costs and harms of substance use in Canada for the years 2007 to 2014. The following cost categories were separated: lost productivity ($15.7 billion), healthcare ($11.1 billion), criminal justice ($9.0 billion), and other indirect costs ($2.7 billion). Overall, the cost of substance use was $38.4 billion in Canada in 2014, translating into $1,081 per capita (Canadian Substance Use Costs and Harms Scientific Working Group, 2018). The study also demonstrated that between 2007 and 2014, the costs per capita attributable to substance use increased by 5.5%, adjusted for inflation. Table 3 shows that alcohol, tobacco, opioids, and cannabis were the leading four substances that contributed the most to the cost of substance use, respectively. Cannabis, alcohol, CNS depressants, and tobacco were the top four substances that had the highest increase in cost per person between 2007 and 2014, respectively. Substance use caused a significant economic burden to Canadian society and most of these costs have increased over the past years. At the same time, the net income received by the federal government from liquor authorities and total taxes and other revenues totaled $12.2 billion in the fiscal year of 2017 (Statistics Canada, 2020a). Tobacco tax revenue received by Canadian governments in the fiscal year of 2018 was $8.3 billion (Physicians for a Smoke-Free Canada, 2019). Costs for both substances still exceeded the incomes.

Table 3

Overall Costs of Substance Use in Canada in 2014 and Trends in Economic Costs from 2007 to 2014

Type of Substance	Overall Cost in 2014		Cost per Person		
	Overall Costs (Billion)	% of Total Overall Costs	2007 ($ per Person)	2014 ($ per Person)	Change (%)
Alcohol use	14.6	38.1	369	412	11.6
Tobacco use	12.0	31.2	315	337	6.8
Opioid use	3.5	9.1	97	98	0.9
Cannabis use	2.8	7.3	67	70	19.1
Cocaine	2.2	5.8	20	16	-17.9
CNS depressants	1.5	4.0	39	43	10.0
Other substances	0.6	1.5	84	63	-24.6

Source: Canadian Substance Use Costs and Harms Scientific Working Group. (2018)

Summary of Areas of Substance Use Which Need Research Prioritization in Canada

Opioid use.

The increasing number of fatalities involving opioids represents a growing public health crisis. More than 14,700 deaths in Canada between January 2016 and September 2019 were attributable to opioids, with the trend still increasing. Of the deaths in 2019, 94% were the result of accidental overdoses, of which more than three-quarters (78%) involved fentanyl and fentanyl-related substances (Special Advisory Committee on the Epidemic of Opioid Overdoses, 2020). Among OD deaths with completed investigations in 2019, 67% involved only non-pharmaceutical opioids, 9% involved both pharmaceutical and non-pharmaceutical opioids, and 19% involved only pharmaceutical opioids (i.e., oxycodone, hydrocodone, morphine) (Special Advisory Committee on the Epidemic of Opioid Overdoses, 2020). In 2019, the vast majority of opioid ODs occurred among males (75%) and the largest share occurred among adults aged 30 to 39 years old (27%).

Rates of harm due to opioid overdose continue to rise across Canada. The number of hospitalizations attributable to opioid overdoses between January 2016 and September 2019 equaled 19,490. In 2018, opioid overdoses caused the hospitalization of 15 Canadians every day. In total, there were 5,349 hospitalizations due to opioid overdoses in Canada in 2018 (accounting for an age-standardized rate of 18.6 per 100,000 population (Special Advisory Committee on the Epidemic of Opioid Overdoses, 2020).

The national rate for hospitalizations for opioid overdoses in 2018 was up 8% from 2016 and 27% from 2013 (Canadian Institute for Health Information, 2018b). Opioid overdoses affect medium-sized and suburban communities across Canada more than urban centers. Between 2013 and 2017, the fastest-growing rate of hospitalizations due to opioid overdose was found in younger adults aged 25-44 years (with an increase of 62%), followed by adolescents aged 15–24 years (with a 53% increase). Over the four-year span, the greatest increase in the male population was in the age group 25–44 years, whereas in the female population the greatest increase was in the age group 15–24 years. Another

significant group is that of pregnant women who use opioids; statistics show that there was a 20% increase in the rate of hospitalizations for neonatal withdrawal symptoms between 2013 (4.3 per 1,000 in-hospital live births) and 2017 (5.2 per 1,000 in-hospital live births) (Canadian Institute for Health Information, 2018c).

Although Statistics Canada has started to harmonize OD data, major gaps still exist in data reporting for deaths, hospitalizations, and Emergency Department (ED) visits. In addition, while research and interventions focus on treatments for opioid use disorders and avoiding ODs, root causes for these problems are not being addressed such as by changing the healthcare system to markedly reduce the number of opioid prescriptions written by medical professionals (Fischer, Rehm, & Tyndall, 2016), especially for patients at risk (Ladapo et al., 2018), as well as by protecting people from the current supplies of toxic street drugs (Fischer, Pang, & Tyndall, 2019).

While an unprecedented number of research projects has have been initiated to address the current opioid crisis, including the Emerging Health Threat projects created by the Canadian Research Initiative in Substance Misuse (CRISM) (Canadian Research Initiative in Substance Misuse (CRISM), 2015), significant knowledge gaps still exist. Thus, while it is clear that prescription opioid use has been one of the major pathways to opioid addiction and ODs (Imtiaz, Shield, Fischer, & Rehm, 2014), the best ways to address non-medical use of opioids is unclear, and more Canada-specific research is needed. Different solutions in different provinces may also need to be considered. Furthermore, whereas the take-home Naloxone, opioid-agonist therapy, and overdose prevention services based on a modeling study have been successful interventions in reducing opioid ODs in British Columbia (Irvine et al.), it is necessary to develop a multi-pronged approach to address both the needs of those who are already addicted to opioids as well as to prevent the development of future opioid use disorders and ODs. Economic studies to determine the best mix of different measures to treat opioid addiction are necessary. Such studies exist for other substance use areas (Chisholm, Doran, Shibuya, & Rehm, 2006) but not for the area of opioid research.

Alcohol.

Alcohol use has profound impacts on chronic and acute health in Canada (Public Health Agency Canada, 2016; J. Rehm et al., 2017). Overall, alcohol consumption is linked to more than 200 different diseases, conditions, and types of injuries (J. Rehm et al., 2009). A systematic review of 255 reviews and meta-analyses confirmed the importance of alcohol use as a risk factor for diseases and injuries (J. Rehm et al., 2017). These conditions include more than 40 ICD-10 three-digit categories which are either wholly or partially attributable to alcohol and showed a linear relationship between the volume of alcohol use and the risk of disease or death. Previous studies showed that ischemic diseases and diabetes are exceptions since these two conditions have curvilinear relationships with alcohol use: beneficial effects of light to moderate drinking were seen in people without irregular heavy drinking occasions (or binge drinking) (J.

Rehm et al., 2017). However, the recent systematic analysis from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2016 for 195 countries and territories, 1990–2016, suggests that there is no safe lower limit for alcohol drinking (GBD 2016 Alcohol Collaborators, 2018); see also Shield and Rehm (2019). The reason is that the estimated protective effects for ischemic heart disease and diabetes in women are often offset by monotonic associations with cancer (Burton & Sheron, 2018). This finding has further implications for public health policy, and suggests that policies that reduce population-level consumption should be prioritized (Burton & Sheron, 2018).

Adult Canadians (15 years of age and older) consumed an average of 9.1 litrers of pure alcohol per person per year in 2017 (Manthey et al., 2019). In the same year, the prevalence of current alcohol use (past 12 months) was 69% among adult Canadians (about 21.3 million) who used alcohol in the past year (Manthey et al., 2019), with a higher prevalence among men (78%, 11.8 million) compared to women (61%, 9.5 million) (Manthey et al., 2019).

In 2017, 21% (4.7 million) and 15% (3.3 million) of Canadian alcohol users (aged 15 years and older who drank alcohol in the past year) exceeded Canada's Low-Risk Alcohol Drinking Guidelines for long- and short-term risks, respectively. Males' alcohol use was more problematic than females', and drinking behaviors of young adults (aged 20–24 years) was more problematic than those of adults (aged 25 years and older) and adolscents (aged 15-19 years) for both long- and short-term risks (Statistics Canada, 2019).

In 2015–2016, there were more hospitalizations in Canada for 100% alcohol-attributable disease (77,000) than for heart attacks (75,000) (Canadian Institute for Health Information, 2017). In 2017–2018, as mentioned above, the situation was even worse (Canadian Institute for Health Information, 2019). The number of hospitalizations for harm caused by alcohol use rose to 82,740. An average of ten patients died in the hospital every day due to substance use – most (77%) from health complications related to alcoholism. Note: the 100% alcohol-attributable diseases include, for example, chronic alcohol use disorder, alcohol withdrawal, alcohol-induced cirrhosis of liver, alcohol-induced pancreatitis, not including alcohol-related injuries (Canadian Institute for Health Information, 2017). In 2014, alcohol contributed to 14,826 deaths in Canada whereas there were 1472 road crash deaths which involved alcohol in 2014 (Canadian Centre on Substance Use and Addiction, 2019; Lyon, Brown, Van Laar, & Robertson, 2019).

In addition to the fact that alcohol use seems to link to more premature deaths in the US than opioid use, the following are warning signs for Canada, especially for women:

- The rate of women who died from causes linked directly to alcohol has increased by 26% since 2001, compared with a roughly 5% increase over the same period for men (Canadian Institute for Health Information, 2018a) (see also (Public Health Agency Canada, 2018a)).
- More than 25,000 women had alcohol-related hospitalizations in 2016–2017, representing a nearly 3% increase over the previous year. By comparison, the

increase for men was 0.6% over the same period (Canadian Institute for Health Information, 2017).

- The proportion of alcohol-attributable deaths to all deaths increased in recent years (Canadian Institute for Health Information, 2018a), again particularly for women.

Based on data from 1991 to 2006 Canadian Census Mortality and Cancer follow-up study, age-standardized mortality rates from alcohol-related causes of death in particular were clearly influenced by income (Tjepkema, Wilkins, & Long, 2013a), education (Tjepkema, Wilkins, & Long, 2012) and occupation (Tjepkema, Wilkins, & Long, 2013b). Mortality rates from alcohol-related causes of death were lowest among people in the highest socioeconomic status quintile, and highest among people in the lowest quintile.

Clearly, alcohol use is one of the most overlooked risk factors in Canada and current policy development may further aggravate the situation (i.e., the implementation of lowering the minimum price of beer from approximately $1.25 to $1.00 for a can or bottle in Ontario) (Manthey et al., 2019). Alcohol use should be reintegrated into research priorities based on its current impact. Research priorities in the area of alcohol should cover knowledge generation to inform the government on implementing evidence-based alcohol control policies to guide the health and social service system to reduce and prevent hazardous and harmful drinking and its related health consequences, particularly for people with low socio-economic status.

Cannabis.

Based on causal impacts on cannabis use disorders, schizophrenia, lung cancer and road traffic injuries, cannabis use in Canada in 2012 was estimated to cause 287 deaths (95% CI: 108-609); 10,533 YLLs (95% CI: 4,760-20,833); 55,813 YLDs (95% CI: 38,175-74,094), and 66,346 DALYs (95% CI: 47,785-87,207) (Imtiaz et al., 2016). The cannabis-attributable burden of disease was greatest among young people, and males accounted for twice the burden of females. The most prominent single cause of the cannabis-attributable burden of disease was cannabis use disorders (Imtiaz et al., 2016). In Canada, the burden caused by cannabis-attributable consequences appears to occur through motor vehicle accidents and cannabis use disorders, while those caused by lung cancer and psychosis happen on a significantly smaller scale (Fischer, Imtiaz, Rudzinski, & Rehm, 2016).

In 2017, before cannabis legalization, 15% (or 4.4 million) of Canadians adults (15 years of age and older) had consumed cannabis over the past year. Among cannabis users, about three out of four used cannabis in the past three months, and one out of four used cannabis every day or almost every day. More males (19%, 2.7 million) used cannabis than females (11%, 1.7 million). The prevalence of cannabis use among young adults aged 20 to 24 (33%) was higher than among adolescents aged 15 to 19 (19%) and adults aged 25 years and older (13%) (Statistics Canada, 2019).

However, Canada's legalization of cannabis in October 2018, together with a wide availability of medical marijuana, constitutes a unique experiment in a high-income country, which needs to be monitored as the results are not yet clear and will very much depend on the success of similar implementation in different provinces (Crepault, Rehm, & Fischer, 2016; J. Rehm et al., 2017). For example, all provinces determine the minimum legal purchasing age for cannabis at 19 years old except for Alberta and Quebec. Many other policy interventions vary among provinces and require evaluation. These policy options include controlling the distribution of cannabis (through government or private sale); regulating its availability; influencing demand through pricing and taxation; curtailing higher-risk products and formulations; prohibiting marketing, advertising and sponsorship; displaying product information; preventing cannabis-impaired driving; enhancing access to treatment and expanding treatment options; as well as investing in education and prevention (Crepault et al., 2016). The results of these policy interventions have to be monitored and evaluated, especially the impact of heavy use/frequent use over time, the use of cannabis while operating machinery such as a car, the use of cannabis containing high levels of tetrahydrocannabinol (THC), the smoking of cannabis mixed with tobacco, and the use of cannabis in early and mid-adolescence (J. Rehm et al., 2017). If all these regulatory measures are carefully introduced based on best available evidence, with independent monitoring and surveillance, and with openness to change in case of negative consequences, Canada has a chance to become a leader as a country with evidence-driven public health policy decision-making (J. Rehm et al., 2017).

Discussion

Based on the above data, three areas of substance use deserve particular attention with respect to public health in Canada, and research is necessary to help shape the best interventions and policies in these areas:

1. Opioid use and resulting overdoses (ODs)
2. The increasing burden of disease resulting from alcohol use
3. Monitoring the legalization of cannabis, and its potential effects

Tobacco is not mentioned here—despite having the largest impact on the number of deaths—as the tobacco-attributable burden of disease is decreasing (Institute for Health Metrics and Evaluation, 2018). This suggests that the current collective efforts and investment put into the implementation of policies, programs and research to curtail problems caused by tobacco use are headed in a good direction and should continue to do so. Additionally, Canada has previously articulated an endgame strategy for tobacco control with clearly identified priorities for tobacco control (Dubray, Chaiton, & Schwartz, 2019). However, it should be noted that the prevalence of vaping e-cigarettes is on the rise with most recent estimates in Canada demonstrating that lifetime use of e-cigarettes increased significantly from 8.5 to 15.4% between 2013 and 2017 among adults 15 years of age and older (Reid et al., 2019). Additionally, vaping has increased in popularity with the emergence of new vaping devices such

as those containing nicotine salts and high nicotine concentrations (Hammond et al., 2019). Some longitudinal studies have also suggested that the use of e-cigarettes may be associated with an increased risk of subsequent cigarette smoking among adolescents (Berry et al., 2019). Given that the long-term health impacts of vaping e-cigarettes are unknown (National Academies of Sciences & Engineering & Medicine, Health Medicine Division, Board on Population Health and Public Health Practice, & Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems, 2018), it is important to continue to monitor e-cigarette use over time.

Declaration of Interests

The authors declare that there is no conflict of interest.

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