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Update of Canada's Low-Risk Alcohol Drinking Guidelines: Final Report for Public Consultation

August 2022

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This document was published by the Canadian Centre on Substance Use and Addiction (CCSA).

Suggested citation: Paradis, C., Butt, P., Shield, K., Poole, N., Wells, S., Naimi, T., Sherk, A., & the Low-Risk Alcohol Drinking Guidelines Scientific Expert Panels. (2022). *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Final Report for Public Consultation.* Ottawa, Ont.: Canadian Centre on Substance Use and Addiction.

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Production of this document has been made possible through a financial contribution from Health Canada. The views expressed herein do not necessarily represent the views of Health Canada.

This document can also be downloaded as a PDF at www.ccsa.ca

Ce document est également disponible en français sous le titre :
Le projet d'actualisation des Directives de consommation d'alcool à faible risque du Canada : rapport final pour consultation publique

ISBN 978-1-77178-994-3

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Acknowledgements

The Canadian Centre on Substance Use and Addiction (CCSA) would like to extend its appreciation and gratitude to members of the Low-Risk Alcohol Drinking Guidelines Scientific Expert Panels for their expertise, guidance and other invaluable contributions (in alphabetical order):

Co-chairs for the project:

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- Jennifer Heatley, Public Health at Government of Nova Scotia
- Erin Hobin, Public Health Ontario
- Harold R. Johnson, Lawyer and Author[1]
- Ryan McCarthy, Canadian Centre on Substance Use and Addiction (co-chair for the Knowledge Mobilization Scientific Expert Panel)
- Kate Morissette, Public Health Agency of Canada
- Chris Mushquash, Lakehead University
- Daniel Myran, Ottawa Hospital Research Institute
- Tim Naimi, Canadian Institute for Substance Use Research, University of Victoria
- Nancy Poole, Centre of Excellence for Women's Health
- Justin Presseau, Ottawa Hospital Research Institute
- Adam Sherk, Canadian Institute for Substance Use Research, University of Victoria
- Kevin D. Shield, Institute for Mental Health Policy Research, Centre for Addiction and Mental Health
- Tim Stockwell, Canadian Institute for Substance Use Research, University of Victoria
- Sharon Straus, University of Toronto
- Kara Thompson, St. Francis Xavier University
- Samantha Wells, Institute for Mental Health Policy Research, Centre for Addiction and Mental Health

[1] Harold R. Johnson passed away during the development of this report. We greatly appreciate his important contributions to this process, and we extend our sincere condolences to his family and friends.

- Matthew Young, Gambling Research Exchange Ontario, Carleton University, and the Canadian Centre on Substance Use and Addiction

The following members and their colleagues also led the production of reports and reviews that informed the update of the 2011 LRDGs (in alphabetical order):

- Sam Churchill, Adam Sherk and Tim Naimi: Lifetime Risk of Alcohol-Attributable Death and Disability: Shadow analysis
- Tim Naimi. Per occasion alcohol use
- Nancy Poole and Lorraine Greaves: Sex, Gender and Alcohol: What Matters for Women in Low-Risk Drinking Guidelines?
- Nancy Poole and Lorraine Greaves: Specific messages for girls and women to supplement the Guidance on Alcohol and Health
- Kevin Shield: Lifetime Risk of Alcohol-Attributable Death and Disability
- Kathryn Graham, Bryan Tanner, Jesus Chavarria, Tavleen Dhinsa, Jean Francois Crépault and Samantha Wells: Association Between Alcohol Use and Aggression and Violence: A Rapid Overview of Reviews to Inform Canada's Low-Risk Alcohol Drinking Guidelines

The project has also benefited from the efforts and contributions of the following organizations and individuals (in alphabetical order):

- Autrement Dit: Plain language summary of the Guidance on Alcohol and Health
- Cochrane Canada: Update of a Systematic Review of the Effect of Alcohol Consumption on the Development of Depression, Anxiety and Suicidal Ideation
- Cochrane Canada: Update of Canada's Low-Risk Alcohol Drinking Guidelines: Summary of Evidence on Understanding and Response to Alcohol Consumption Guidelines
- Christine Levesque, Nitika Sanger and Hanie Hadelati: Assistance in all aspects of the evidence review portion of this project
- Jennifer Reynolds for her assistance in overseeing the first public consultation and the stakeholder's consultations
- Lauren Levett, Scott Hannant, Christina Davies, Wendy Schlachta, Manon Blouin, Patricia-Anne Croteau, John Thurston, Virginia St-Denis, Ahmer Gulzar, Lili Yan and Victoria Lewis: Assistance with project management, communications, editing, translation and other support throughout the project

In addition, CCSA would like to thank members of the Low-Risk Alcohol Drinking Guidelines Executive Committee who generously contributed their time and expertise throughout this project (in alphabetical order):

Co-chairs:

- Shannon Nix, Health Canada
- Rita Notarandrea, Canadian Centre on Substance Use and Addiction

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- Ally Butler, Substance use and Strategic Initiatives, Government of British Columbia
- Ian Culbert, Canadian Public Health Association
- Scott Hannant, Canadian Centre on Substance Use and Addiction
- Carol Hopkins, Thunderbird Partnership Foundation
- Jennifer Saxe, Health Canada
- Candice St-Aubin, Public Health Agency of Canada
- Robert Strang, Council of Chief Medical Officers of Canada
- Sam Weiss, Canadian Institute of Health Research

Conflict of Interest

The list of potential conflicts of interest is available on CCSA's website: Disclosure of Affiliations and Interests.

About this Document

This report contains three documents produced for three different target groups.

Public Summary

The Public Summary is a one-page summary intended for the general public.

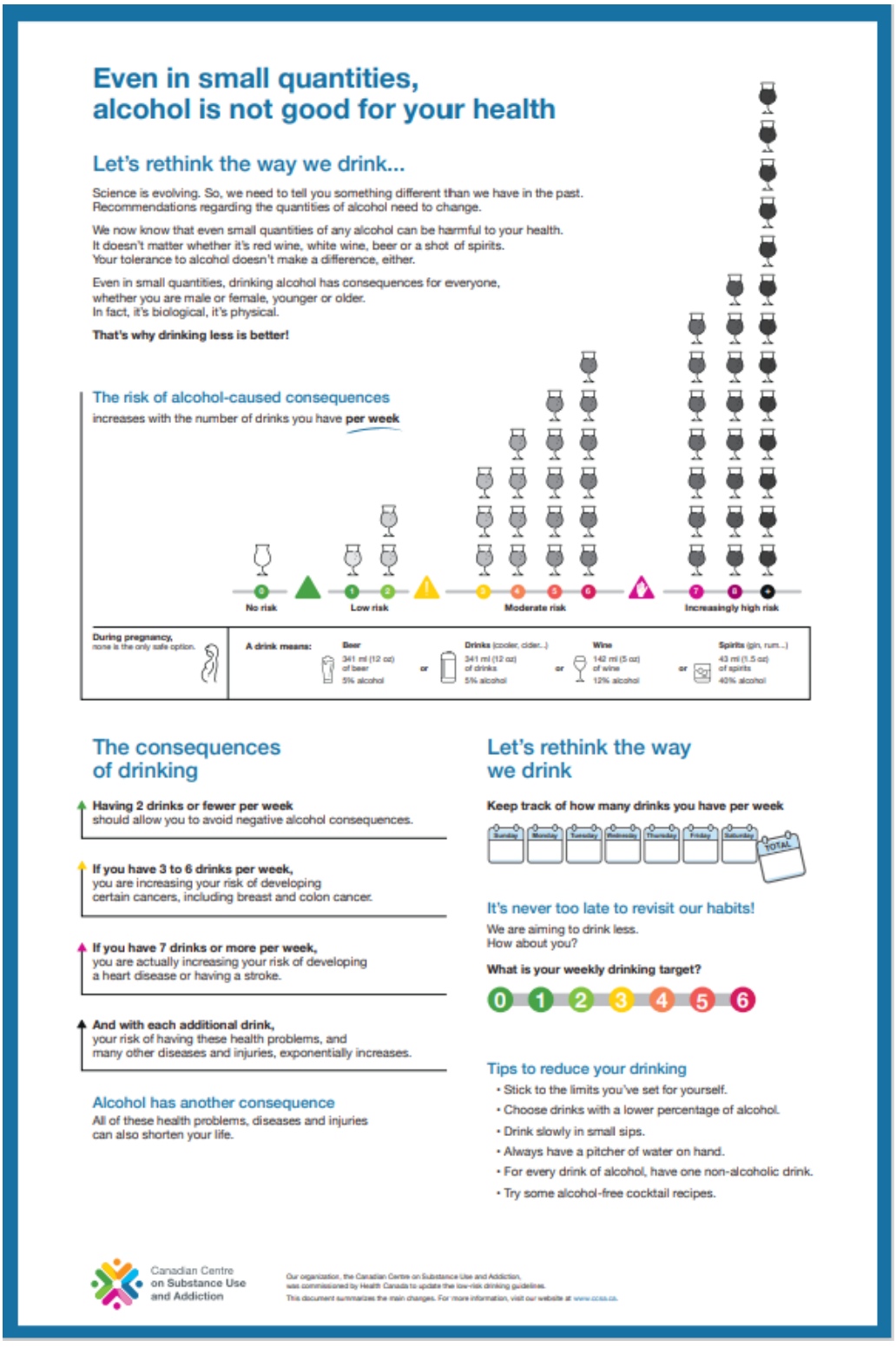
Technical Summary

The Technical Summary is intended for health organizations, health professionals (e.g., physicians, nurses, counsellors) and people who would like to learn about the update of the *Low-Risk Alcohol Drinking Guidelines*, its key takeaways, the risks associated with alcohol and the implications.

Technical Report

The Technical Report is intended for alcohol scientists, policy makers and healthcare professionals who are interested in understanding the detailed process followed, the types of evidence and the way they were used to update the *Low-Risk Alcohol Drinking Guidelines*.

Public Summary



Even in small quantities, alcohol is not good for your health

Let's rethink the way we drink...

Science is evolving. So, we need to tell you something different than we have in the past. Recommendations regarding the quantities of alcohol need to change.

We now know that even small quantities of any alcohol can be harmful to your health. It doesn't matter whether it's red wine, white wine, beer or a shot of spirits. Your tolerance to alcohol doesn't make a difference, either.

Even in small quantities, drinking alcohol has consequences for everyone, whether you are male or female, younger or older. In fact, it's biological, it's physical.

That's why drinking less is better!

The risk of alcohol-caused consequences

increases with the number of drinks you have **per week**

The consequences of drinking

Having 2 drinks or fewer per week should allow you to avoid negative alcohol consequences.

If you have 3 to 6 drinks per week, you are increasing your risk of developing certain cancers, including breast and colon cancer.

If you have 7 drinks or more per week, you are actually increasing your risk of developing a heart disease or having a stroke.

And with each additional drink, your risk of having these health problems, and many other diseases and injuries, exponentially increases.

Alcohol has another consequence

All of these health problems, diseases and injuries can also shorten your life.

Let's rethink the way we drink

Keep track of how many drinks you have per week

It's never too late to revisit our habits!

We are aiming to drink less.
How about you?

What is your weekly drinking target?

0 1 2 3 4 5 6

Tips to reduce your drinking

- Stick to the limits you've set for yourself.
- Choose drinks with a lower percentage of alcohol.
- Drink slowly in small sips.
- Always have a pitcher of water on hand.
- For every drink of alcohol, have one non-alcoholic drink.
- Try some alcohol-free cocktail recipes.

Canadian Centre on Substance Use and Addiction

Our organization, the Canadian Centre on Substance Use and Addiction, was commissioned by Health Canada to update the low-risk drinking guidelines. This document summarizes the main changes. For more information, visit our website at www.ccsa.ca.

Technical Summary

Alcohol is a legal psychoactive substance used by about three-quarters of people living in Canada. For some, alcohol use is intertwined with their lifestyle. It is often used in connection with social events or to mark special occasions. However, alcohol can cause harm to the person who drinks and sometimes to others around them. Few people recognize that alcohol is a leading preventable cause of death and disability, injuries, accidents and social problems. In 2017, alcohol contributed to 18,000 deaths in Canada. That same year, the costs associated with alcohol use in Canada were $16.6 billion, with $5.4 billion of that sum spent on health care.

Canada's Guidance on Alcohol and Health

Canada's Guidance on Alcohol and Health consists of seven key takeaways:

1. All levels of alcohol consumption are associated with some risk, so drinking less is better for everyone.
2. Among healthy individuals, there is a continuum of risk for alcohol-related harms where the risk is:
   - Negligible to low for individuals who consume two standard drinks or less per week;
   - Moderate for those who consume between three and six standard drinks per week; and
   - Increasingly high for those who consume more than six standard drinks per week.
3. On any occasion, any level of consumption has risks, and with more than two standard drinks, most individuals will have an increased risk of injuries or other problems.
4. Disproportionately more injuries, violence and deaths result from men's drinking.
5. Above low levels of alcohol consumption, the health risks increase more steeply for women than for men.
6. It is safest not to drink while pregnant and during the pre-conception period.
7. For women who are breastfeeding, it is safest not to use alcohol.

Aim and Approach

Canada's Guidance on Alcohol and Health is informed by a public health perspective. It is intended to replace Canada's Low-Risk Alcohol Drinking Guidelines. Its stated focus is to provide people living in Canada with accurate and current information about the risks and harms associated with the use of alcohol. The guidance should help people to make well-informed and responsible decisions about their alcohol consumption.

A fundamental idea underlying this project is that people living in Canada have a right to know.

The Guidance on Alcohol and Health is also intended to form the evidence base for future alcohol policy and prevention resources, with a view to changing Canada's drinking culture and curbing the normalization of harmful alcohol use in society.

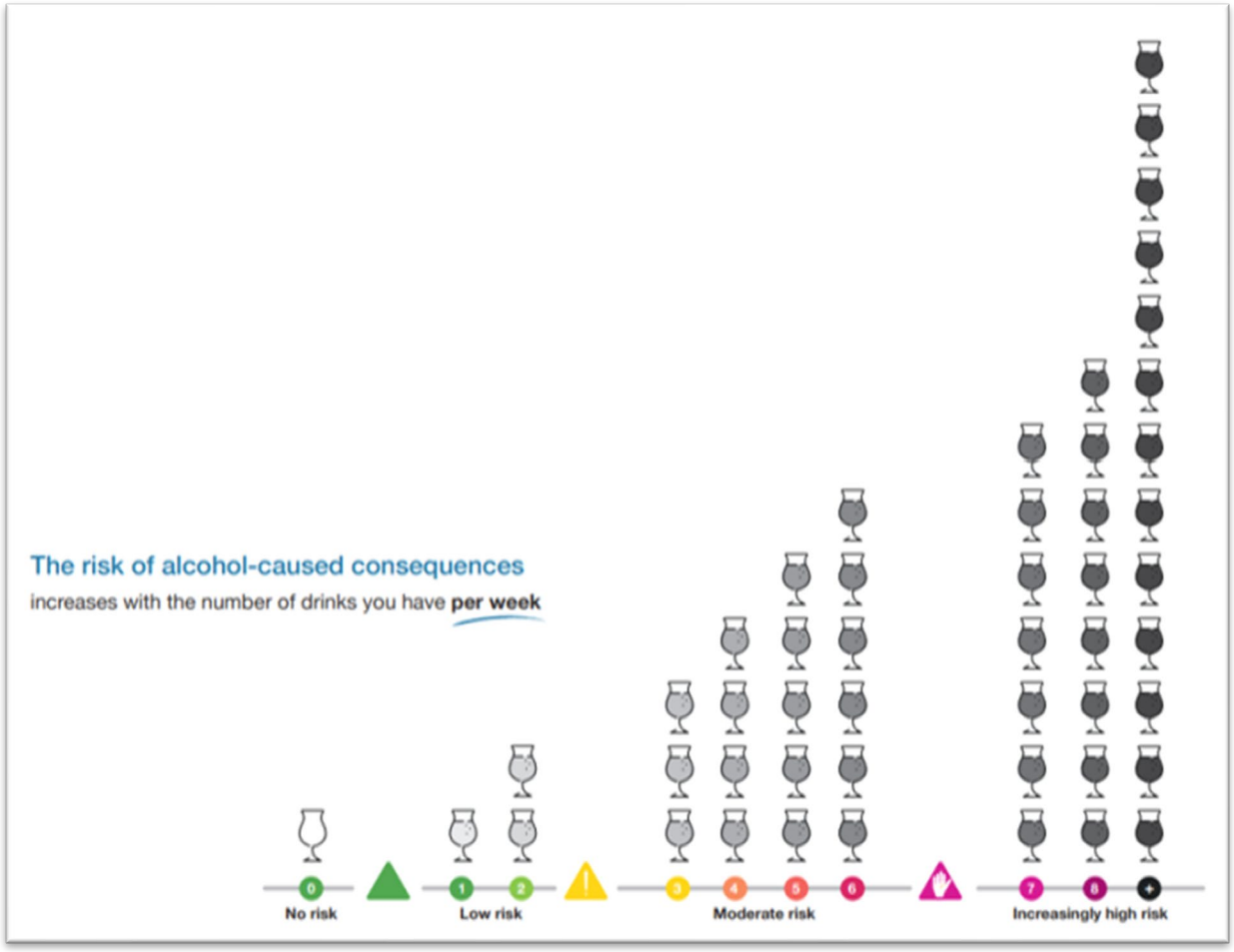
The production of the new guidance followed a rigorous and transparent approach to assess the impact of various levels of alcohol use on deaths and disabilities. The analyses were based on the

most recent data and methods, which have evolved since the Low-Risk Alcohol Drinking Guidelines were released over a decade ago.

Risk Associated with Various Levels of Alcohol Use

Throughout the life course, there are established thresholds of mortality risk that people are willing to accept. For involuntary risks such as air pollution, a 1 in 1,000,000 lifetime mortality risk has been used as a gold standard. That is, people are willing to accept a 1 in 1,000,000 risk of death when exposed to these risks. For risks associated with activities that people undertake deliberately and from choice, such as unprotected sexual practices, smoking and so on, people may accept risks about 1,000 times greater. Hence, advice and recommendations made to people about voluntary activities use a 1 death in 1,000 lifetimes cut point. However, for drinking alcohol, it is not unusual for guidelines to be based on a risk threshold 10 times greater, which is a 1 in 100 mortality risk.

Hence, there is a continuum of risk whereby the risk for those who consume two standard drinks or less per week is negligible to low; it is moderate for those who consume between three and six standard drinks per week; and it is high for those who consume above six standard drinks per week, with increasingly higher levels of risk with every additional drink.



Risk Associated with Each Occasion of Alcohol Use

On any drinking occasion, the risk of acute outcomes such as unintentional injuries and violence is strongly associated with consuming larger amounts of alcohol and a reduced ability to think clearly or perform certain activities (i.e., is caused by alcohol impairment). **The risk of negative outcomes begins to increase with any consumption, and with more than two standard drinks, most individuals will have an increased risk of injuries or other problems.**

Binge drinking, usually defined as consuming five standard drinks or more for men, or four standard drinks or more for women in one setting, is a pattern of consumption that results in legal impairment for most people. It is a well-established risk factor for death from any cause, including unintentional injuries, violence, heart disease and high blood pressure, inflammation of the gastrointestinal system, and the development of an alcohol use disorder (i.e., alcohol dependence).

Many of the complications arising from acute impairment and binge drinking involve second-hand effects that affect someone other than the person who drinks alcohol (e.g., violence, child abuse and neglect).

Risk for Men

Men drink more alcohol than women do and are more likely to drink in excess. As a consequence, they are more likely to be involved in alcohol-impaired driving collisions, to be treated in hospitals and hospitalized for alcohol-related medical emergencies and health problems, to be diagnosed with an alcohol use disorder, and to die from alcohol-related causes. Alcohol is also more strongly associated with perpetration of violence for men than for women.

Men are also more likely than women to take other risks (e.g., use other substances, drive under the influence) that when combined with alcohol further increase their likelihood of experiencing and causing alcohol-related harms. Overall, **disproportionately more injuries, violence and deaths result from men's drinking**.

Risk for Women

The physiological differences between women and men have only a small impact on lifetime risk of death. However, it is unequivocal that **above low levels of consumption, lifetime risk of health harms increases more steeply for women than for men**. Enzymes, genes, body weight and size, organ function and metabolism are important in processing alcohol and are affected by sex-related factors. These biological factors enhance the impact of alcohol on females, causing faster intoxication, more risk for disease (including breast cancer), and more long-term harm (such as liver damage and injury) on lesser amounts.

Risk for Women Who Are Pregnant or Breastfeeding

Reproductive health is compromised by alcohol use. In general, there is mixed evidence on the impact of alcohol on pregnancy and delivery outcomes, with possible increases in miscarriage, hypertensive disorders of pregnancy and placental abnormalities.

Alcohol is a teratogen or agent that can cause malformation of the fetus. It can lead to learning, health and social effects with lifelong impacts, including brain injury, birth defects, behavioural problems, learning disabilities and other health problems. These adverse effects are also observed at relatively low levels of exposure or short-term exposure to high levels of consumption. For this reason, **it is safest to not to drink at all while pregnant and during the pre-conception period**.

Alcohol consumption can also negatively impact breastfeeding by causing a decrease in milk production, early cessation of breastfeeding and effects on infant sleep patterns. Moreover, alcohol enters breast milk through passive diffusion meaning that breastfeeding infants, who are unable to metabolize alcohol, can be exposed to it. Therefore, **for women who are breastfeeding, no alcohol use is safest for the baby**.

Risk for Men and Women

Alcohol use is influenced by many gender-related factors, including alcohol marketing tactics, gender roles, attitudes and expectations. As a consequence, many harms from alcohol use are gender-related, including stigma, sexual assault and intimate partner violence.

Reasons for the New Guidance on Alcohol and Health

Alcohol and Cancer

Cancer is the leading cause of death in Canada. However, the fact that **alcohol is a carcinogen that can cause at least seven types of cancer** is often unknown or overlooked. The most recent available data show that the use of alcohol causes nearly 7,000 cases of cancer deaths each year in Canada, with most cases being breast or colon cancer, followed by cancers of the rectum, mouth and throat, liver, esophagus and larynx. According to the Cancer Society of Canada, drinking less alcohol is among the top 10 healthy habits to prevent cancer.

Alcohol and Heart Disease

Heart disease is the second leading cause of death in Canada and alcohol is not good for the heart. For many years, the commonly held belief that drinking in moderation offered protection against heart disease has been widely publicized. Research in the last decade is more nuanced with the most recent and highest quality systematic reviews showing that **drinking a little alcohol neither decreases nor increases the risk of heart disease**. **At higher levels of use, alcohol is a risk factor for most types of cardiovascular disease**, including coronary artery disease and heart attacks, heart failure, high blood pressure, atrial fibrillation and stroke.

Alcohol and Violence

Alcohol is frequently associated with violent and aggressive behaviour, including intimate partner violence, male-to-female sexual violence, and aggression and violence between adults. Alcohol can also increase the severity of violent incidents. No exact dose–response relationship can be established but consuming alcohol increases the risk of perpetrating alcohol-related violence. Thus. it is reasonable to infer that individuals can reduce their risk of perpetrating aggressive or violent acts by limiting their alcohol use. Based on consistent evidence, it is highly likely that **avoiding drinking to intoxication will reduce individuals' risk of perpetrating alcohol-related violence**.

Taken together, overwhelming evidence confirms that when it comes to drinking alcohol: Less is better.

Policy Implications

To support people living in Canada who will want to drink less, governments —working in close collaboration with employers, healthcare providers and community stakeholders —need to implement policies that promote public health. This includes strengthening regulations of alcohol advertising and marketing, restrictions on the physical availability of alcohol and the adoption of minimum prices for alcohol.

As a priority, people living in Canada need consistent, easy-to-use information at the point of pour to track their alcohol use in terms of standard drinks. They also have a right to clear and accessible information about the health and safety of the products they buy. A direct consequence of the current project is a recommendation **for Health Canada to require, through regulation, the mandatory labelling of all alcoholic beverages to list the number of standard drinks in a container**, the Guidance on Alcohol and Health, health warnings and nutrition information.

Technical Report

Introduction

Canada's first Low-Risk Alcohol Drinking Guidelines (LRDGs) were originally published by the Canadian Centre on Substance Use and Addiction (CCSA) in November 2011 (Butt et al., 2011). The guidelines were developed by an independent expert working group, with members drawn from Canadian addiction research agencies. The 2011 LRDGs provided people living in Canada with advice on how to minimize relative long-term risk of serious diseases caused by the consumption of alcohol over a number of years (e.g., liver disease, some cancers) and relative short-term risk of injury or acute illness due to the overconsumption of alcohol on a single occasion (Stockwell et al., 2012). In addition, specific recommendations were provided for situations and individual circumstances that are particularly hazardous and for which abstinence or only occasional light intake was advised (e.g., just before or during pregnancy, teenagers, people on medication). The guidelines also included tips for safer drinking and the definition of a standard drink. The 2011 LRDGs were a significant step to providing consistent information and messaging for minimizing the risk associated with drinking alcohol. They have provided the cornerstone for undertaking a variety of health promotion, prevention and education initiatives across the country (Paradis, 2016).

Still, there were important limitations with the research evidence used developing the 2011 LRDGs. In the LRDG technical report (Butt et al., 2011), the working group noted the under-reporting of personal alcohol use in self-reported surveys, the failure to take account of heavy drinking episodes in many epidemiological studies, the misclassification of former and occasional drinkers as lifetime abstainers, and the failure to control for confounding effects of personality and lifestyle factors independent of alcohol. In its quality appraisal, using the AGREE II instrument, the Public Health Agency of Canada (PHAC) further noted limitations, particularly with respect to the rigour of development and editorial independence, two domains that did not receive the minimum acceptable score of 60%. Consequently, the 2011 LRDGs received an overall assessment of 60.7% and so did not meet the criteria for high quality guidelines. They were recommended for use with modifications, and since then, it has been known that careful consideration would need to be paid to these limitations when developing alcohol guidelines.

Awareness and Adherence to the 2011 LRDGs of People Living in Canada

Since their publication, the 2011 LRDGs have been promoted at varying degrees across the country and adopted differently by key demographics. In 2012, just a few months after the release of the guidelines, a national survey indicated that a quarter (26%) of people living in Canada had seen or heard of the LRDGs. Since then, a few provincial studies have recorded people's awareness of the LRDGs. In 2017, Public Health Ontario surveyed 2,000 adults in Ontario aged 19 and older who consume alcohol and found that less than a fifth (17%) were aware of the 2011 LRDGs (Public Health Ontario, 2017a). In 2019–2020, the new Canadian Postsecondary Education Alcohol and Drug Use Survey (CPADS) surveyed students in colleges and universities in Canada about their knowledge of the 2011 LRDGs (Health Canada, 2021). Not surprisingly, within this young group, awareness was negligible with only 16% reporting to have heard about the guidelines and less than a third of those (28%), being able to accurately report what the guidelines were.

A study conducted by Institut national de santé publique du Québec found that 55% of Quebecers thought the 2011 LRDGs were adequate, while 37% believed they were too high, that is,

corresponding to larger amounts of alcohol than what they consider to be low-risk drinking (Bergeron et al., 2020).

According to the most recent data from the Canadian Alcohol and Drugs Survey Health Canada, 2019), a majority of people living in Canada indicated drinking within the 2011 LRDGs. In 2019, 83% of the people aged 15 years and older who consumed alcohol in the past year reported to drink within the guidelines for short-term risk and 77% within those for long-term risk. While more females than males reported to drink alcohol within the guidelines for short-term risk (85% vs 81%), the percentages were similar for the long-term risk guideline (76% for males vs 78% for females). Young adults between the ages of 20–24 were less likely than other age groups to drink within the guidelines. In 2019, three-quarters (74%) followed the guideline for short-term risk of injury and harm while 69% reported to follow the guidelines for long-term health risk.

Canada's 2011 LRDGs

The 2011 LRDGs recommended to reduce:

- Long-term health risk by drinking no more than 10 standard drinks a week for women, with no more than two drinks a day most days, or 15 standard drinks a week for men, with no more than two drinks a day most days.
- Short-term risk of injury and harm by drinking no more than three standard drinks for women or four standard drinks for men on any single occasion.

While the percentages seem to indicate general adhesion to the 2011 LRDGs, the reality may be otherwise. The CADS estimates are based on the alcohol consumption in the previous seven days, meaning that people who consumed alcohol in the past year but did not have a drink in the week preceding the survey are automatically considered as not exceeding the 2011 LRDGs. This seems very unlikely given Canada's time out culture where people drink to mark special occasions rather than on a regular daily basis. In fact, a study conducted in 2015 explored adherence to the LRDGs while attempting to adjust for the under-reporting of alcohol consumption (Zhao et al., 2015). It was found that 73% of people living in Canada over the age of 15 followed the weekly limits while 61% followed the daily limits recommended by the LRDGs. In Ontario, the Public Health Ontario survey found that 39% of people who used alcohol in the Ontario sample regularly exceeded the LRDG daily limits and 27% the weekly limits (Public Health Ontario, 2017a). According to CPADS , a majority (88%) of students who use alcohol reported following the guidelines for long-term risk, but only 36% indicated drinking within the recommendations for short-term risk (Health Canada, 2021). Zhao and colleagues (2015) also found that, after adjustment for under-reporting, more than 80% of all drinks consumed in Canada were consumed in a fashion inconsistent with the LRDGs.

Time to Update

There are no set criteria for updating health guidelines to ensure they remain current and evidence based, but an update is typically recommended when new evidence is identified that is relevant and important or could alter current guidelines (Vernooij et al., 2014). Over the last decade, several reasons that justify an update of the 2011 LRDGs have been identified.

First, knowledge on and estimates of relations between different dimensions of alcohol use and particular diseases, disorders or injuries have been evolving since 2011. Research now confirms the importance of alcohol use as a risk factor for an increasing number of diseases including at least seven types of cancers, dementia and sexually transmitted diseases (International Agency for Research on Cancer, 2012; Lu et al., 2017; Rehm et al., 2017). Second, more than 50% of alcohol-attributable cancer deaths in Canada are among former alcohol users and people using alcohol

within the 2011 LRDGs for long-term risks (Sherk et al., 2020). People living in Canada who use alcohol within the LRDG's weekly limits also account for 65% of hospital stays due to unintentional injuries and a substantial percentage of deaths due to digestive conditions (18%) and injuries (40%), suggesting that reducing the burden of disease requires revising the 2011 LRDGs (Sherk et al., 2020). Third, countries like the United Kingdom, France, Denmark, Holland and Australia recently reviewed new evidence on alcohol and health and released updated guidelines with limits significantly different from the 2011 LRDGs, with weekly limits ranging from the equivalent of 5.2 to 8.3 Canadian standard drinks for women and men alike.[2] Finally, given recent reports on the extent to which alcohol use causes social problems for individuals other than the drinkers themselves (Laslett et al., 2019), there has been curiosity as to what alcohol guidelines would be if, in addition to diseases, disorders and injuries, social and mental health harms were also included.

The Canadian 2011 LRDGs did not include an expiration date but given the limitations and in light of the new evidence, in early 2019, CCSA, Health Canada, PHAC and members of the Canadian 2011 LRDGs working group engaged in discussions to update the guidelines. In July 2020, Health Canada confirmed funding to CCSA to update Canada's LRDGs and make recommendations for knowledge mobilization to maximize dissemination and application of the updated guidelines. The mandate specified building on the guidelines from the United Kingdom (U.K. Chief Medical Officers, 2016) and Australia (National Health and Medical Research Council, 2020), which had provided access to the underlying evidence base supporting their alcohol guidelines. It was further agreed that CCSA would be responsible for overseeing and facilitating the updating process. Health Canada would provide advice, support and guidance through membership on the project's various committees, plus administrative support. PHAC would provide methodological advice and support.

Aim and Scope of This Report

In the interests of transparency and because the development of best practices for defining alcohol drinking guidelines remains a work in progress (Holmes et al., 2019), this report will describe the updating process, so that others can learn from the Canadian experience. The report is divided into three main parts:

1. The construction of experts' recommendations;
2. The evidence used by the experts; and
3. The experts' recommendations for updated alcohol guidelines in Canada.

Part 1: Development of Experts' Recommendations

To update the 2011 LRDGs, four committees were convened. An executive committee with members from federal, provincial and territorial governments, and national organizations was established to provide project oversight and advice. Three scientific expert panels were established to review the evidence for updating the guidelines and making recommendations on how best to effectively mobilize this new knowledge. One panel focused on the impacts of alcohol consumption on physical health, a second one on the social and mental health effects, and a third on knowledge mobilization.

[2] Around the world, what constitutes a standard drink ranges from 8 to 20 g of pure alcohol. In Canada, it is defined as 13.45 grams (Paula et al., 2020). Some say that Canada's particular standard drink was chosen because it corresponds to the measure of whisky traditionally available in Canadian bars (Miller et al., 1991). A more probable reason is that it corresponds to the amount of pure alcohol contained in 341 ml bottles of 5% beer, which has traditionally been the alcoholic beverage of choice in Canada.

To provide scientific support to members of scientific expert panels (hereafter referred to as the experts), CCSA further established an internal Evidence Review Working Group responsible for evaluating and summarizing evidence, leading consultations and conducting new research as needed.

Members of the executive committee and the experts were required to disclose affiliations and interest, as per (Schünemann et al., 2013). The list of potential conflicts of interest was published on CCSA's website in *Disclosure of Affiliations and Interests*.

1.1 Defining Research Questions

The general research question underlying the 2011 LRDGs update is: To minimize the risk of developing alcohol-related physical and mental health disorders and social problems, which level or pattern of use should be recommended to people living in Canada?

For this question to lead to evidence-based guidelines, three more specific questions were developed, each one specifying a particular target population, the level of exposure to alcohol and the type of outcomes being considered. (For more information, see *Update of Canada's Low Risk Alcohol Drinking Guidelines: Development of Research Questions*.) It is these three specific research questions that have guided this project's evidence collection, analyses and conclusions:

1. What are the short-term risks and benefits (physical and mental health, and social impact) associated with varying levels of alcohol consumption (including no alcohol use), in different contexts, associated with a single episode of drinking in the general population?
2. What are the long-term risks and benefits (physical and mental health, and social impact) associated with varying levels and patterns of alcohol consumption (including no alcohol consumption) in the general population?
3. What are the risks and benefits (physical and mental health, and social impact) associated with varying levels and patterns of alcohol consumption (including no alcohol consumption) during pregnancy or breastfeeding, for fetal, infant and child development?

The specific questions were formulated to encompass all effects, so that studies focusing on both positive and negative effects could be identified.

1.2 Estimating the Lifetime Risk of Alcohol-Related Death and Disability in the Canadian Population

From the outset of this project, there was a common understanding among experts that to update the 2011 LRDGs, the specific research questions would be answered through mathematical modelling. Modelling had previously been used to establish the 2011 LRDGs as well as alcohol guidelines in Australia (National Health and Medical Research Council, 2020), the U.K. (U.K. Chief Medical Officers, 2016) and France (Santé publique France & Institut national du cancer, 2017). Moreover, since 2016, the European Union Joint Action on Reducing Alcohol-Related Harm has recommended the use of cumulative lifetime risk of death from alcohol-related disease or injury as a common metric for assessing the risks from alcohol at the country level; the metric should also inform discussions by experts to establish alcohol guidelines (Broholm et al., 2016).

Modelling requires alcohol mortality risk functions for all disease or injury categories causally related to alcohol consumption. These risk functions can be found in meta-analyses that assess the dose–response relationship between alcohol and the risk of disease mortality. **The quality of modelling depends upon the quality of the risk functions and therefore on the identification of the highest**

quality meta-analyses. Such identification is a complex and lengthy process that could have gone over the 21 months allocated to update the 2011 LRDGs. However, the project's mandate stipulated that the update should be informed by the 2016 alcohol guidelines from the U.K. (U.K. Chief Medical Officers, 2016) and the 2020 Australian guidelines to reduce health risks (National Health and Medical Research Council, 2020). Therefore, a quality assessment of these alcohol guidelines was performed. (For more information, see *Updating Canada's Low-Risk Alcohol Drinking Guidelines: Evaluation of Selected Guidelines*.) With regards to its methodology for identifying and selecting evidence on the risks and benefits associated with alcohol consumption, the Australian guidelines received top ratings.

Hence, to update Canada's LRDGs, the global evidence review did not start from scratch, but rather built upon the rigorous and systematic work previously done by the Australian Alcohol Working Committee (AAWC), which covered the January 2017 to February 2021 period. (The overall process is explained in section 2.1.). Besides ensuring the quality of the modelling, the global evidence review on the risks and benefits associated with alcohol consumption identified areas where high quality systematic reviews were missing; for these areas, the experts agreed to commission additional reviews to formulate the updated guidelines for Canada.

1.3 The Evidence Base for Updating the Guidelines

A range of inputs was considered in updating the 2011 LRDGs:

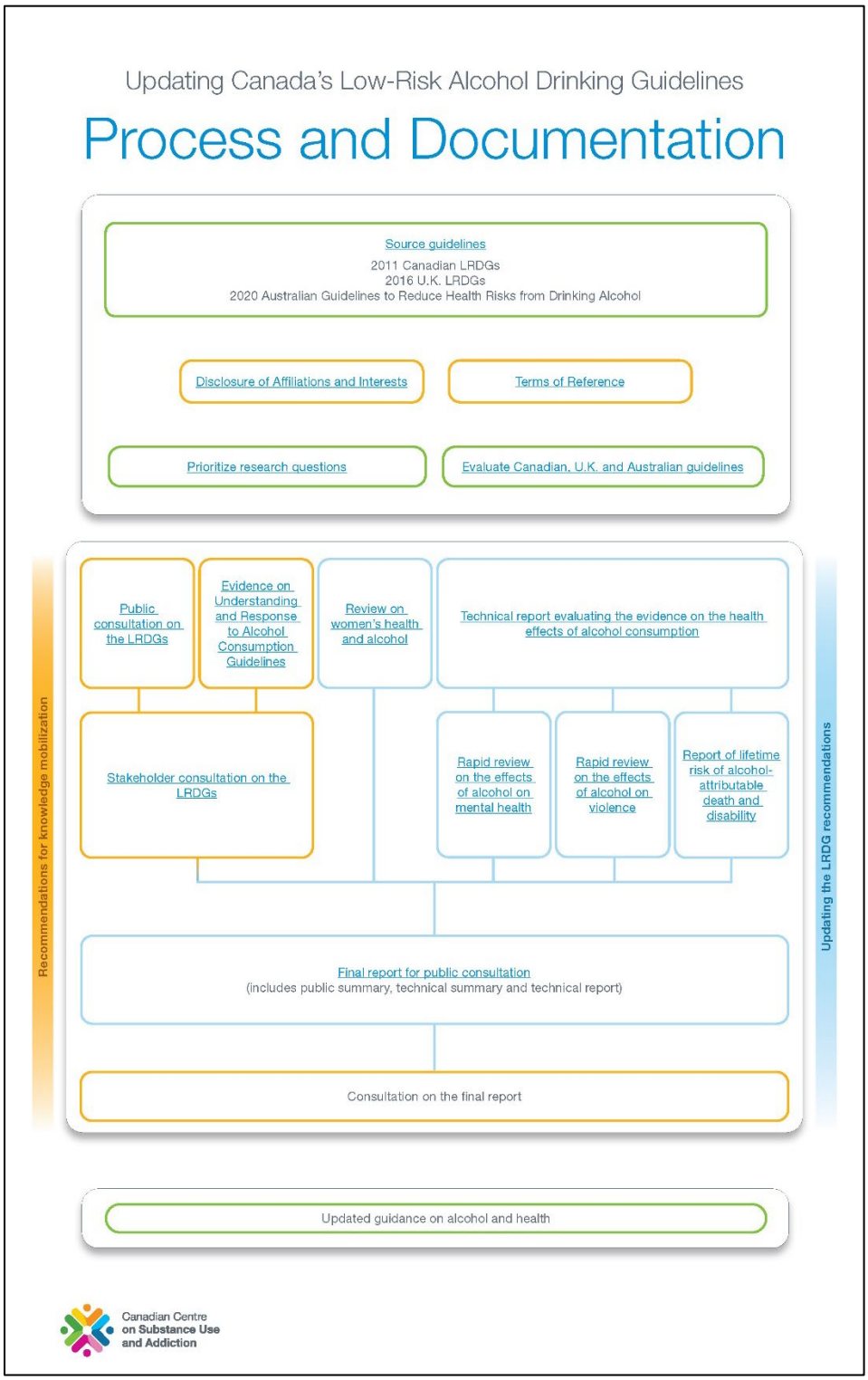
- Global evidence review on the effects of alcohol on health
- Mathematical modelling of the lifetime risk of death and disability for various levels of average alcohol consumption
- Rapid review on alcohol and mental health
- Rapid review on alcohol and violence
- Comprehensive multi-part review of recent literature on women's health and alcohol

This project's mandate also required recommendations for knowledge mobilization of the updated alcohol guidelines. To this end, a series of activities were undertaken to better understand people's views, preferences and expectations on alcohol guidelines. Discussions on formulation and presentation of the finalized guidelines were further informed by the following activities:

- *Summary Evidence on Understanding and Response to Alcohol Consumption Guidelines*;
- Public consultation to hear what alcohol, health and well-being issues matter most and what is most useful to people in Canada;
- Interviews with representatives from different health-related organizations that have an interest in alcohol-related issues; and
- Focused consultations with Indigenous People.

The overall process by which the recommendations were developed is illustrated in Figure 1.

Figure 1: Process for updating Canada's LRDGs



Note. For a PDF of this image, visit https://ccsa.ca/sites/default/files/2022-08/CCSA-LRDG-Lower-Risk-Drinking-Guidelines-Process-and-Documentation-2022-en.pdf.

Part 2: Evidence Used to Construct the Recommendations

The studies and evidence reviews informing the update to the 2011 LRDGs are available on the CCSA webpage dedicated to this project. Those interested in understanding in detail the types of evidence and the way they were used to update the guidelines are encouraged to visit the webpage to access the full reports. The following sections provide summaries of each report, to give readers an overview of the material reviewed by the experts to reach their conclusions.

2.1 Global Evidence Review on the Effects of Alcohol on Health

Several studies have quantified the risk relationships between alcohol use and the occurrence of and mortality from all disease or injury categories causally related to alcohol consumption. However, the quality of these studies vary greatly. To provide an answer to this project's three research questions and estimate the impact of alcohol consumption on individuals, a systematic search and review was performed of meta-analyses that reported alcohol dose–response curves between different average levels of alcohol use, disease and injuries. The aim was to identify the highest quality systematic reviews and meta-analyses using a standard set of quality criteria. (For the full report, see *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Evidence Review Technical Report*.)

2.1.1. Methods

A systematic electronic search was performed using PubMed, PsycNET, Embase, Cochrane Library, Database of Abstracts of Reviews of Effects, Health Technology Assessment Database, International Health Technology Assessment Database, Joanna Briggs Institute, Database of Systematic Reviews of Effects, and Epistemonikos. The search was limited to articles published from Jan. 6, 2017, to Feb. 17, 2021. It provided an update to the AAWC systematic review for 2007 to 2017. All articles included in the Australian's systematic review were also included in this review (National Health and Medical Research Council, 2020).

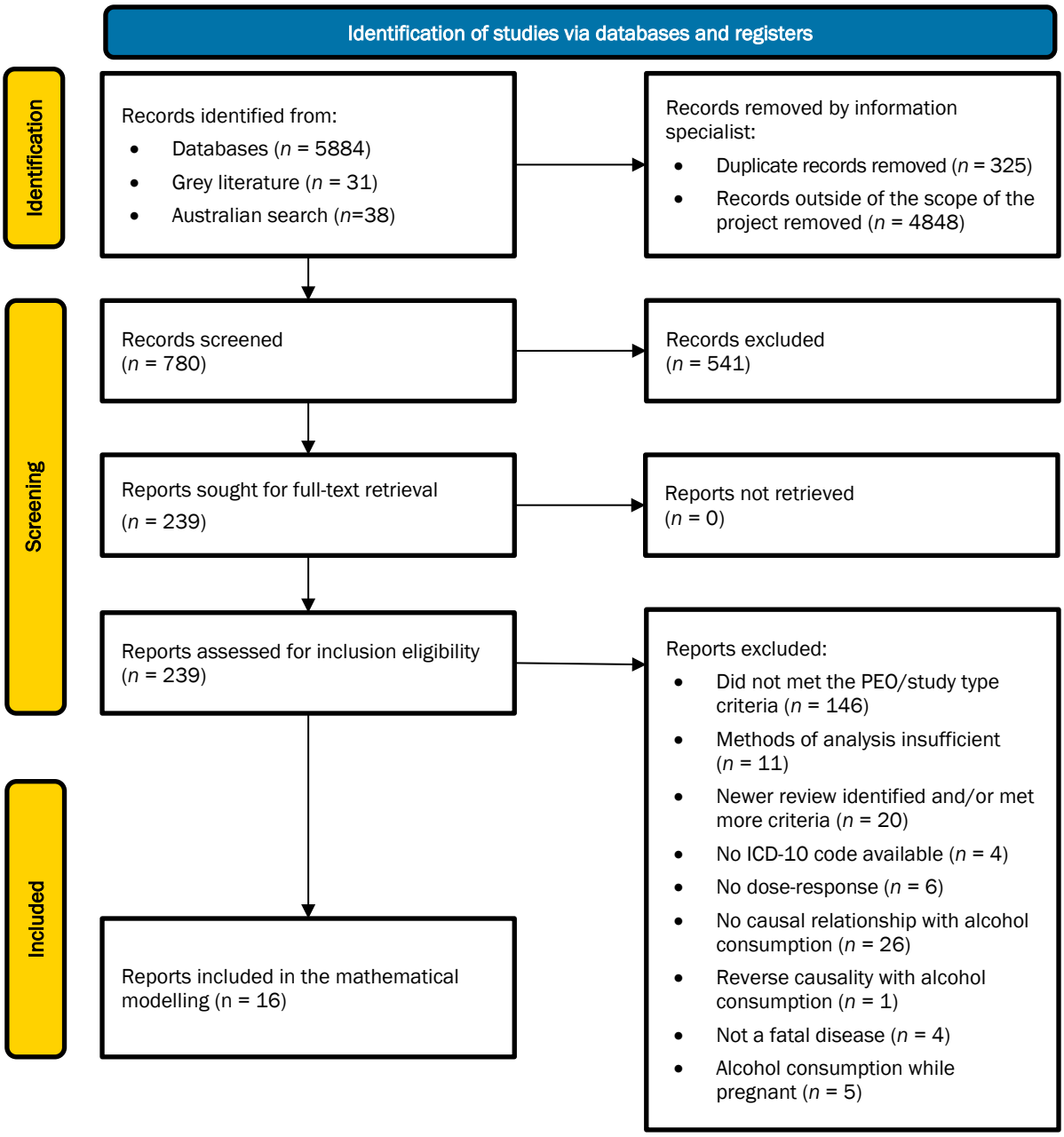
An information specialist screened the search results and removed duplicates and any articles that were clearly outside of the scope of the project based on titles and abstracts. Two independent investigators assessed articles for title and abstract, and subsequently for full-text eligibility against:

- The study design and the Population, Exposure, Comparator and Outcome (PECO) criteria;
- Methodological quality criteria selected from A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2; Shea et al., 2017) and Risk of Bias in Systematic Reviews (ROBIS; Whiting et al., 2013) tools;
- Methods of analyses criteria; and
- Mathematical modelling criteria.

If a particular disease or injury category was considered by more than one systematic review or meta-analysis, priority was given to the article that met the most methodological quality criteria. In the event that the same number of criteria were met, the most recent article was given priority.

Finally, the quality of each eligible systematic review and meta-analysis was assessed by two independent investigators using two international standard tools: A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2; Shea et al., 2017), and the Grading of Recommendations, Assessment, Development and Evaluations system (GRADE; Schünemann et al., 2013). Studies were also evaluated for the inclusion of sex- and gender-based analysis (Brabete et al., 2020).

Figure 2. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram



2.1.2 Results

In addition to the 38 systematic reviews already identified by the AAWC, **a total of 5,915 systematic reviews were initially retrieved from the updated search**. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram presented in Figure 2 illustrates that after removing duplicates and any articles that were outside of the scope of the project, **a subset of 780 systematic reviews were screened for title and abstract and a total of 239 systematic reviews (37 identified by the AAWC and 202 identified by this update) were subsequently screened for full-text eligibility**.

The 31 reports identified by the search of the grey literature were excluded as PECO and study design criteria were not met. Most of the grey literature items were found to be informative brochures, reports, fact sheets and books.

In the end, a total of 16 systematic reviews fulfilled all the inclusion criteria for this project for all three research questions and were selected for inclusion in the mathematical modelling.

Research Question 1: Short-Term Risks and Benefits

Twenty-nine systematic reviews on the short-term risks and benefits of alcohol were evaluated. **Two systematic reviews were selected for inclusion in the mathematical modelling.** One selected review focused on road injury (Taylor & Rehm, 2012) and the other on intentional and unintentional injuries (Taylor et al., 2010).

Research Question 2: Long-Term Risks and Benefits

A total of 154 systematic reviews across eight categories of diseases associated with the long-term health risks and benefits of alcohol were evaluated. **Fourteen reviews were selected for inclusion in the mathematical modelling.** The selected reviews assessed the relationship between alcohol use and liver cirrhosis (Roerecke et al., 2019), ischæmic heart disease (Zhao et al., 2017), hypertensive heart disease (Liu et al., 2020), breast cancer (Sun et al., 2020), liver cancer (World Cancer Research Fund International, 2018), pancreatitis (Samokhvalov et al., 2015), lower respiratory infections (Samokhvalov et al., 2010a;), epilepsy (Samokhvalov et al., 2010b) ischemic stroke (Larsson et al., 2016), intracerebral hemorrhage (Larsson et al., 2016),subarachnoid hemorrhage (Larsson et al., 2016), atrial fibrillation (Larsson et al., 2014), colon and rectum cancers (Vieira et al., 2017), diabetes mellitus (Knott et al., 2015), larynx cancer (Bagnardi et al., 2015), mouth and oropharynx cancers (Bagnardi et al., 2015), esophagus cancer (Bagnardi et al., 2015) and tuberculosis (Imtiaz et al., 2017).

Research Question 3: Pregnancy and Child Development Risks and Benefits

Twenty-five systematic reviews focusing on the risks and benefits associated with alcohol consumption during pregnancy or breastfeeding for fetal, infant and child development were evaluated. **None were selected for inclusion in the modelling** because none met the mathematical modelling criteria. The studies focused on alcohol-attributable mortality and morbidity to others rather than the person who consumes alcohol.

2.1.3 Implications

The global evidence review identified the most recent and highest quality systematic reviews and meta-analyses available to examine the relationship between alcohol consumption and the various outcomes covered by this project's research questions. The methodology used to select these systematic reviews is based on the Australian guidelines, which received a top score according to a previous evaluation, further strengthening our certainty that our results are based on the highest quality evidence. (For more information, see *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Evaluation of Selected Guidelines.*)

Through this work, we identified areas where high quality systematic reviews are currently missing (e.g., mental health, violence) and for which the experts agreed to commission additional reviews to complete the LRDG update (see section 2.4). A decision was also taken to commission a report on women's health and alcohol that would address, among other things, the issues of pregnancy.

2.2 Mathematical Modelling of the Lifetime Risk of Death for Various Levels of Average Alcohol Consumption

To establish alcohol guidelines, modelling the lifetime risk of death for various levels of average alcohol consumption has been recommended (Broholm et al., 2016; Rehm et al., 2014) and applied (e.g., in Australia, the U.K., France and Canada). Modelling allows for the estimation of the "excess risk" of mortality and disability associated with various levels of average consumption and the specification of the level of risk from negligible to high associated with each level of consumption. The aim of modelling is not to set a "threshold" of consumption below which there is no risk, but to provide "benchmarks" based on which recommendations can be formulated.

For this project, the lifetime risk approach was adopted to estimate the lifetime risk of death, premature death (< 75 years of age), years of life lost (YLLs) and disability-adjusted life years (DALYs) lost. A full report presenting all analyses is available in *Lifetime Risk of Alcohol-Attributable Death and Disability*. Every estimation and result presented in the report was subsequently the object of a shadow analysis that confirmed the accuracy of the primary analyses (Appendix 1).

Discussions among experts led to a decision to use risk thresholds associated with YLLs. Compared to using lifetime risk of death or premature death, YLLs allows researchers to consider the deaths of older individuals and, more importantly, factors the unequal health loss caused by death among people relatively younger in age. While DALYs can be an optimal outcome for the measurement of health loss attributable to alcohol, there is limited data on the DALYs alcohol cause and this project's analyses resulted in identical risk thresholds whether they were based on YLLs or DALYs.[3] Since DALYs is conceptually more difficult to understand than YLLs, the experts fixed their choice on YLLs estimations. Results are presented and discussed below, after a review of methodological principles.

[3] For example, there is evidence that DALYs can be influenced by mental disorders such as depression but because the evidence search did not identify high-quality systematic reviews assessing the relationship between alcohol use and mental health, it is likely that the current project underestimates alcohol-related DALYs.

2.2.1 Methodological Principles

Calculating Alcohol-Attributable Deaths

In epidemiology, the concept of an attributable fraction makes it possible to express the proportion of risk for a particular health event (in this case death), due to exposure to a particular cause (in this case alcohol consumption). An attributable fraction is classically calculated from the number of deaths that could be avoided if the exposure was eliminated.

The proportion depends on the risk of death according to sex and age but also on the "trajectory" of exposure, which is the history of alcohol consumption before the subject's death. Establishing alcohol-attributable deaths in the population requires access to the population's mortality rate and knowledge of the individuals' lifetime exposure to alcohol in standardized terms, such as average grams of alcohol per day. With this data, alcohol-attributable deaths can be calculated for various levels of consumption, provided that it is considered identical among individuals and constant over time for each of them until death. In this model, lifetime abstainers are the reference group in relation to which the risks associated with different average levels of alcohol consumption are calculated.

By varying the average level of consumption in such a scenario, it becomes possible to summarize the relationship between the risk due to alcohol and different levels of consumption. In return, this informs the benchmarks for different levels of risk.

Diseases and Injuries Included in the Modelling

A total of 34 cause categories for alcohol-related diseases, conditions and injuries and more than 200 three-digit International Classification of Disease, version 10 (ICD-10-CA) codes were included in the modelling of alcohol-attributable deaths. To be included, there were three criteria:

1. The disease or injury had to be causally related to alcohol use;
2. A dose–response risk function needed to be available for the risk relationship between alcohol consumption (measured in grams per day) and the disease or injury of interest that also passed the GRADE criteria; and
3. Either death or disability needed to be measured specifically for the disease or injury causally related to alcohol use.

What Evidence Has Changed Since the Release of the 2011 LRDGs?
• Animal, mechanistic and epidemiological evidence published since the publication of the Canadian LRDGs in 2011 has led to changes in the diseases that are known to be causally related to alcohol use. • Alcohol has been found to causally increase the risk of lower respiratory infections (Samokhvalov et al., 2010a). • Systematic reviews on the risk relationship between alcohol use and the diagnosis of and death from cancer have observed no lower risk threshold (Bagnardi et al., 2015; Sun et al., 2020; Vieira et al., 2017; World Cancer Research Fund, 2018). • The risk relationship between alcohol use and hypertensive heart disease has been observed to have no lower risk threshold (Liu et al., 2020).

- Risks for hemorrhagic stroke have been investigated further, with the risk functions for intracerebral hemorrhage showing protective at lower levels of alcohol use but for subarachnoid hemorrhage, detrimental effects at lower levels of alcohol use (Larsson et al., 2016)
- Alcohol's protective impact on ischemic heart disease at lower levels of alcohol use is more uncertain than previously estimated. The risk is modified by binge drinking (Roerecke & Rehm, 2010; Sundell et al., 2008) and genetics (Chikritzhs et al., 2015; Larsson et al., 2020) .

Data Sources

Several data sources were used to make the necessary calculations:

- Data on death and disability for 2017 to 2019 were obtained from Statistics Canada and the Institute for Health Metrics and Evaluation's Global Burden of Disease study (Institute for Health Metrics and Evaluation, 2018).
- Alcohol exposure data were obtained from the Canadian Alcohol and Drug Use Monitoring Survey and the Canadian Tobacco, Alcohol and Drugs Survey. Survey data were corrected for total consumption in Canada (adult *per capita* consumption) using data from Statistics Canada and the World Health Organization's Global Information System on Alcohol and Health (World Health Organization, 2021).
- Relative risk estimates for diseases and injuries were obtained following the evidence review (see previous section) that enabled us to identify the highest quality meta-analyses.

The calculations for this project are based on the health harms cause by ethanol in alcoholic beverages. They do not distinguish between harms caused by beer, wine, spirits and other alcoholic beverages. Harms caused by beer, wine, spirits and other alcoholic beverages are based mainly on ethanol content, regardless of the form in which ethanol is consumed. Alcohol poisonings, which are caused predominately by the consumption of spirits, are the one exception where the type of alcoholic beverage makes a difference (Rehm, Gmel Sr, et al., 2017)

2.2.2 Results and Implications

The relative risk estimates by cause of disease and average alcohol consumption are outlined in Table 1 for females and Table 2 for males. For most diseases and injuries alcohol had a net negative impact on health at all levels of alcohol use, with net impacts being defined by confidence intervals not crossing a zero effect. However, for diabetes mellitus (females only), ischemic heart disease, ischemic stroke, intracerebral hemorrhage and pancreatitis (females only), alcohol was neither associated with a negative nor protective net effect at lower alcohol use amounts. (Confidence intervals associated with increased risk of diseases and injuries are presented in Appendix 2.) Furthermore, the leading causes of death among those causes related to alcohol were ischemic heart disease, followed by colorectal cancer and unintentional injuries (excluding road injuries) for males, and breast cancer and unintentional injuries (excluding road injuries) for females.

Table 1. Increased risk of diseases and injuries for females based on average daily alcohol use

Disease or injury	Deaths per 100,000 people per year	Premature deaths per 100,000 people per year	Average alcohol intake (g/day)									
			5	10	15	20	25	30	35	40	45	50
Ischemic heart disease	72.1	16.7	-5.0%	-5.0%	-5.0%	-5.0%	4.0%	4.0%	4.0%	4.0%	7.0%	7.0%
Breast cancer	28.3	17.3	**4.7%**	**9.5%**	14.7%	20.0%	25.6%	31.5%	37.6%	44.0%	50.7%	57.7%
Other unintentional injuries	22.6	4.3	**4.0%**	**8.1%**	12.4%	16.8%	21.4%	26.3%	31.3%	36.5%	41.9%	47.5%
Lower respiratory infections	22.3	3.7	2.4%	**4.9%**	**7.4%**	10.0%	12.7%	15.4%	18.2%	21.0%	23.9%	26.9%
Colorectal cancer	21.0	9.2	**3.4%**	**7.0%**	10.7%	14.5%	18.4%	22.5%	26.7%	31.1%	35.6%	40.3%
Diabetes Mellitus	12.6	4.7	-21.6%	-26.9%	-30.0%	-31.9%	-33.2%	-34.0%	-34.4%	-34.6%	-34.6%	-34.4%
Hypertension	11.3	1.9	3.0%	**6.0%**	**8.9%**	11.8%	14.9%	18.0%	21.4%	24.8%	28.4%	32.0%
Atrial fibrillation and flutter	10.4	0.6	**3.3%**	**6.6%**	10.1%	13.7%	17.4%	21.2%	25.2%	29.2%	33.5%	37.8%
Intracerebral hemorrhage	8.6	2.4	-8.0%	-8.0%	-1.0%	-1.0%	25.0%	25.0%	25.0%	25.0%	25.0%	67.0%
Liver cirrhosis	6.9	5.5	109.5%	182.1%	254.9%	330.8%	411.2%	496.7%	588.0%	685.5%	789.6%	900.9%
Ischemic stroke	6.5	1.1	-10.0%	-10.0%	-8.0%	-8.0%	**8.0%**	**8.0%**	**8.0%**	**8.0%**	**8.0%**	14.0%
Liver cancer	6.0	3.2	**2.0%**	**4.0%**	**6.1%**	**8.2%**	10.3%	12.5%	14.7%	17.0%	19.3%	21.7%
Intentional injuries	5.8	5.9	13.3%	28.3%	45.4%	64.7%	86.6%	111.4%	139.4%	171.2%	207.3%	248.1%
Road injuries	2.8	2.5	**4.9%**	10.1%	15.5%	21.2%	27.1%	33.4%	39.9%	46.8%	54.0%	61.6%
Esophagus cancer	2.6	1.5	**6.8%**	14.1%	21.9%	30.2%	39.0%	48.4%	58.5%	69.1%	80.5%	92.5%
Subarachnoid hemorrhage	2.4	1.7	21.0%	21.0%	11.0%	11.0%	39.0%	39.0%	39.0%	39.0%	39.0%	82.0%
Oral cavity and pharynx cancer	2.2	1.2	13.1%	27.6%	43.6%	61.4%	81.0%	102.6%	126.3%	152.3%	180.8%	211.7%
Pancreatitis	1.2	0.5	-12.7%	-22.7%	-28.3%	-28.4%	-23.9%	-15.0%	-2.0%	14.8%	34.9%	58.4%
Epilepsy	0.7	0.4	**7.0%**	13.8%	21.0%	28.6%	36.8%	45.5%	54.7%	64.5%	74.9%	86.0%
Larynx cancer	0.3	0.2	**7.5%**	15.5%	24.0%	32.9%	42.3%	52.3%	62.8%	73.8%	85.4%	97.6%
Tuberculosis	0.2	0.1	**9.4%**	19.7%	30.9%	43.2%	56.7%	71.4%	87.6%	105.2%	124.5%	145.6%

Dark red > 50%; light red 20% to 50%; yellow 10% to < 20%; green < 10%

Bolded percentages indicate significant estimates

Table 2. Increased risk of diseases and injuries for males based on average daily alcohol use

Disease or injury	Deaths per 100,000 people per year	Premature deaths per 100,000 people per year	Average alcohol intake (g/day)									
			5	10	15	20	25	30	35	40	45	50
Ischemic heart disease	104.1	47.5	-5.0%	-5.0%	-5.0%	-5.0%	4.0%	4.0%	4.0%	4.0%	7.0%	7.0%
Colorectal cancer	25.6	13.9	**3.4%**	**7.0%**	10.7%	14.5%	18.4%	22.5%	26.7%	31.1%	35.6%	40.3%
Other unintentional injuries	23.2	9.8	**4.0%**	**8.1%**	12.4%	16.8%	21.4%	26.3%	31.3%	36.5%	41.9%	47.5%
Lower respiratory infections	19.3	5.1	**2.4%**	**4.9%**	**7.4%**	10.0%	12.7%	15.4%	18.2%	21.0%	23.9%	26.9%
Intentional injuries	18.0	17.9	13.3%	28.3%	45.4%	64.7%	86.6%	111.4%	139.4%	171.2%	207.3%	248.1%
Diabetes Mellitus	16.8	9.0	0.0%	0.2%	0.4%	0.6%	1.0%	1.4%	1.9%	2.4%	3.0%	3.6%
Liver cirrhosis	12.2	10.3	15.5%	32.9%	52.8%	75.7%	102.0%	132.3%	167.1%	207.1%	253.2%	306.1%
Liver cancer	11.1	7.5	**2.0%**	**4.0%**	**6.1%**	**8.2%**	10.3%	12.5%	14.7%	17.0%	19.3%	21.7%
Esophagus cancer	9.0	6.2	**6.8%**	14.1%	21.9%	30.2%	39.0%	48.4%	58.5%	69.1%	80.5%	92.5%
Hypertension	8.4	3.4	**7.2%**	15.0%	19.0%	23.2%	27.5%	32.0%	34.0%	35.9%	38.0%	40.0%
Intracerebral hemorrhage	8.2	3.3	-8.0%	-8.0%	-1.0%	-1.0%	25.0%	25.0%	25.0%	25.0%	25.0%	67.0%
Atrial fibrillation and flutter	6.6	1.0	**3.3%**	**6.6%**	10.1%	13.7%	17.4%	21.2%	25.2%	29.2%	33.5%	37.8%
Road injuries	6.0	5.6	**7.6%**	15.9%	24.7%	34.2%	44.5%	55.5%	67.4%	80.2%	93.9%	108.7%
Ischemic stroke	5.7	1.9	-8.0%	-8.0%	-8.0%	-8.0%	**8.0%**	**8.0%**	**8.0%**	**8.0%**	**8.0%**	14.0%
Oral cavity and pharynx cancer	5.2	3.6	13.1%	27.6%	43.6%	61.4%	81.0%	102.6%	126.3%	152.3%	180.8%	211.7%
Larynx cancer	1.8	1.1	**7.5%**	15.5%	24.0%	32.9%	42.3%	52.3%	62.8%	73.8%	85.4%	97.6%
Subarachnoid hemorrhage	1.6	1.2	21.0%	21.0%	11.0%	11.0%	39.0%	39.0%	39.0%	39.0%	39.0%	82.0%
Pancreatitis	1.5	0.9	**9.1%**	18.9%	29.7%	41.5%	54.3%	68.3%	83.5%	100.1%	118.3%	138.0%
Epilepsy	0.7	0.6	**7.0%**	13.8%	21.0%	28.6%	36.8%	45.5%	54.7%	64.5%	74.9%	86.0%
Tuberculosis	0.3	0.2	**9.4%**	19.7%	30.9%	43.2%	56.7%	71.4%	87.6%	105.2%	124.5%	145.6%

Dark red > 50%; light red 20% to 50%; yellow 10% to < 20%; green < 10

Bolded percentages indicate significant estimates

Lifetime Risk of Alcohol-Attributable Disability-Adjusted Years of Life Lost by Sex

Figure 3 presents lifetime risk of a YLL because of alcohol use, for both males and females, for average levels of alcohol intake varying from 0 to 40 grams of alcohol per day. In Canada, where a standard drink is 13.45 grams of pure alcohol, this corresponds to consuming zero to three (2.97) standard drinks per day in an average per week.

The modelling reveals that the number of YLLs increases as alcohol use increases among both males and females. Among males and females, a protective association was observed for those consuming 2 to 3 g/day (less than a fifth of a standard drink per day on average) when compared to people who engaged in lifetime abstention. In all cases, the 95% uncertainty intervals (UIs) crossed the null hypothesis threshold, which means there is not enough evidence to confirm the protective effect.

The risk threshold based on 17.5 YLL in 1,000 lifetimes would be:

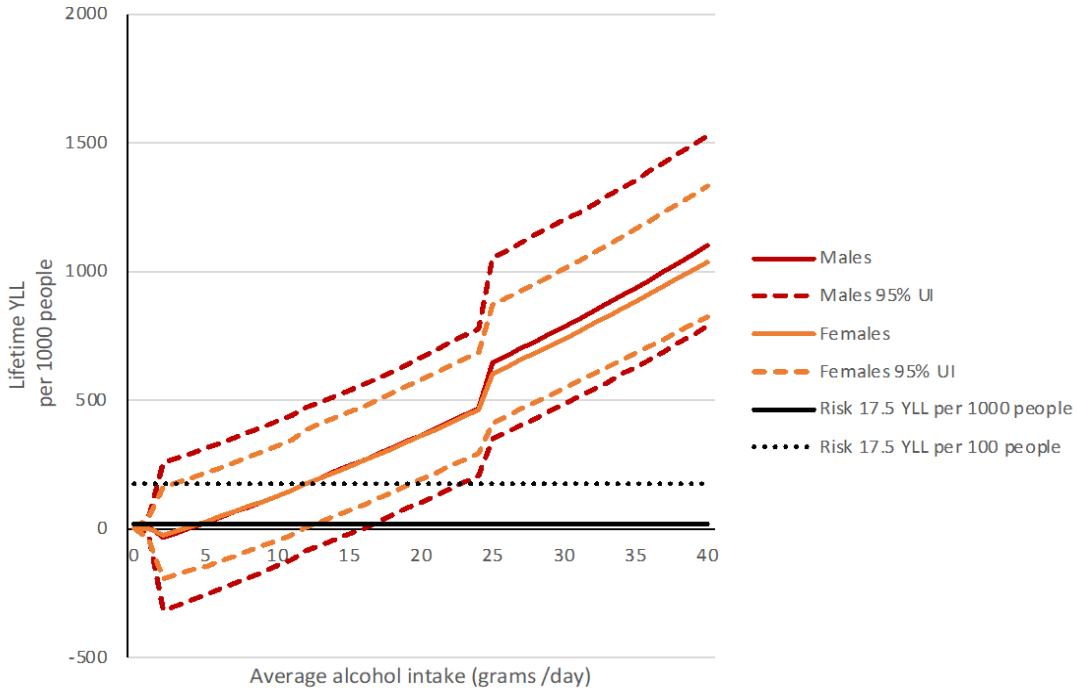
- 4 (95% UI: <1, 16) g/day for females
- 4 (95% UI: <1, 10) g/day for males

The risk threshold based on 17.5 YLL in 100 lifetimes would be:

- 11 (95% UI: 1, 22) g/day for females
- 11 (95% UI: 1, 19) g/day for males

Reported on a weekly basis, this means that for both females and males, the risk threshold based on 17.5 YLL in 1,000 lifetimes would be 28 g/week or two (exactly 2.08) standard drinks per week, while based on 17.5 YLL in 100 lifetimes, it would be 77 g/week or six (exactly 5.7) standard drinks per week.

Figure 3. Lifetime risk of a year of life lost (YLL) attributable to alcohol use at varying levels of average alcohol intake



Based on the systematic review of the published literature on the risk relationships between alcohol use and disease and injury occurrence, this study estimated that for people who live in Canada, **the lifetime risk of death and disability attributable to alcohol use increases as the amount of alcohol use increases**. The selected model did neither demonstrate a significant negative nor protective net effect at lower levels of alcohol use and, therefore, alcohol should not be promoted or used as a product to improve health.

As the lifetime risk of mortality and morbidity is similar for males and females, one guideline for alcohol consumption can be used for Canada. According to established definitions of acceptable risks and based on the risk thresholds of 17.5 YLL attributable to alcohol per 1,000 and 100 lifetimes, **risk thresholds for alcohol use should be set at either two or six standard drinks per week (four or 11 g/day) respectively, for both females and males in Canada**.

Canada's 2011 LRDGs pose higher risks in light of current evidence

To reduce the risk of long-term harm, Canada's 2011 LRDGs recommended consuming no more than 15 drinks a week among males (~29 g/day) and 10 drinks a week for females (~19 g/day). Based on today's data sources and the life course approach to estimate the risk of an alcohol-attributable death, the 2011 recommendations would be associated with the following risk thresholds:

- Consumption by males of 29 g/day would result in **757 YLL per 1,000 lifetimes**
- Consumption by females of 19 g/day would result in **336 YLL per 1,000 lifetimes**

Put differently, the 2011 LRDGs would be associated with a risk for males that is between 76 and 757 higher than established definitions of acceptable risk, and with a risk for females that would be between 34 and 336 higher than those definitions.

2.3 Alcohol Use per Occasion

The risks from alcohol use for most health outcomes (e.g., death, certain cancers, heart disease, injuries) are usually based on how much alcohol is consumed on average or the total amount consumed over the past week or month (see tables 1 and 2). That is why the mathematical modelling led to results expressed in an average number of standard drinks per week, that is, between two and six standard drinks per week, depending on which level of risk is considered.

However, most people do not drink their average amount every day: on days they use alcohol there is considerable variability in how much they use on different drinking "occasions." For this reason, many people who drink relatively low weekly or monthly amounts of alcohol may in fact drink large quantities on a single occasion, which may put them at risk for harm (Naimi et al., 2003). In the context of personal well-being, the experts discussed the latest evidence on alcohol use per drinking occasion to be able to advise people living in Canada on this particular issue.

With alcohol use during any drinking occasion, each drink increases one's blood alcohol concentration (BAC). An increased BAC is what leads to alcohol impairment (a reduced ability to think clearly or perform certain activities) and intoxication (which is the appearance or sensation of being drunk). The risk begins to increase with any use of alcohol, and with more than two standard drinks, most individuals will have a demonstrably increased risk of "acute" problems. For example, compared to no alcohol use, studies of injuries in emergency departments show increasing risk for each drink consumed for both men and women.(Cherpitel et al., 2015; Vinson et al., 2003) Similarly, studies of motor vehicle crash fatalities demonstrate increasing risk above a BAC of 0.02%,(Blomberg et al., 2009; Compton & Berning, 2015; Voas et al., 2012), which corresponds to about one drink. After about two standard drinks consumed within an hour, one's BACs may be approximately 0.05% (the level will differ on the basis of body mass and other factors). Above this level, risk gets progressively and substantially higher the more one drinks on any occasion and the higher one's BAC. It is important to recognize that people typically exhibit behaviour changes or become impaired starting at BAC levels below those at which they feel "drunk" or appear intoxicated (Midanik, 1999).

Binge drinking, usually defined as consuming five standard drinks or more for men, or four standard drinks or more for women, in one setting (National Institute of Alcohol Abuse & Alcoholism, 2004; Wechsler & Austin, 1998) is a common yet dangerous pattern of consumption that results in legal impairment (i.e., a BAC > 0.08%) for most persons, and is significantly associated with a range of alcohol-related health and social problems (Centers for Disease Control and Prevention, 2022; Fillmore & Jude, 2011).[4] Specifically, binge drinking and resulting BAC levels are well-established risk factors for death from any cause, including unintentional injuries (car crashes, drownings, falls), physical and sexual violence, cardiovascular disease (hypertension, myocardial infarction, stroke), inflammation of the gastrointestinal system (gastritis, acute pancreatitis), and the development of an alcohol use disorder (Alpert et al., 2022; Brewer & Swahn, 2005; Dawson et al., 2005; Devries et al., 2014; Dietary Guidelines Advisory Committee, 2020; Mukamal et al., 2005; Roerecke & Rehm, 2014).

Many of the complications arising from acute impairment and binge drinking involve second-hand effects that affect someone other than the person who drinks (e.g., domestic violence, child abuse and neglect). Because binge drinking is common and involves large volumes of use, binge drinking occasions account for a substantial proportion of all alcohol consumed in the population. As such, binge drinking is also an important contributor to long-term health problems like liver disease and

[4] Some scientists have questioned this criteria and suggested that a lowered standard defining impairment should be used for women (Canadian Centre on Substance use and Addiction, 2014; Thomas et al., 2014). Patterns of alcohol use among women of childbearing years in Canada: Implications for FASD prevention Public Health 2014, Toronto, On.

certain cancers (Llerena et al., 2015). Fortunately, effective alcohol control policies can reduce rates of binge drinking and related problems (Naimi et al., 2014; Wagenaar et al., 2009; Wagenaar et al., 2010). Although most persons who engage in binge drinking do not meet criteria for an alcohol use disorder, virtually all persons with an alcohol use disorder engage in binge drinking.

In sum, the evidence is clear and consistent: in terms of health, fewer standard drinks per drinking occasion means less risk of harms to the person consuming the alcohol and reduced risk of second-hand effects to those other than that person. Although some risk begins at one drink and increases more substantially, with more than two standard drinks, risks are higher and increase very rapidly at or above binge drinking levels (five or more standard drinks for men, four or more standard drinks for women). At all levels of per occasion use, consuming fewer standard drinks is better for health; the more standard drinks one consumes per occasion, the larger the benefits from reductions in use.

2.4 Rapid Reviews

At the beginning of this project, a public consultation was held to hear what alcohol, health and well-being issues mattered most and were most useful to people living in Canada. (We will return to this in section 2.6.) A key finding from the consultation was that from a list of eight topics, the one respondents asked to be prioritized in the updated guidelines was the impact of drinking alcohol on mental health. It was followed by the impact of drinking alcohol on physical health and how alcohol can impact people's lives via, for example, violence and sexual assaults.

Unfortunately, the updated evidence review on the effects of alcohol on health did not identify high quality-evidence systematic reviews on alcohol use and mental health nor on alcohol use and social harms. Not a single review met all the selection criteria. (See section 2.1 *and* *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Evidence Review Technical Report*. This means that the modelling presented in the previous section ignores the impact that alcohol may have on mental health and violence and therefore, on people's overall risk of death and disability. To overcome this blind spot, the experts agreed to commission two rapid reviews, one on the effects of alcohol on violence and another one on the effects of alcohol on mental health.

2.4.1 Association Between Alcohol Use, Aggression and Violence

In the absence of recent high quality systematic reviews or meta-analyses on alcohol and violence and to inform experts opinion, an overview of recent reviews of the literature on alcohol and aggression and violence (A/V) was commissioned.

Alcohol is associated with many health and social harms, including various forms of aggression and violence. Three common forms of A/V that have shown high rates of alcohol involvement and that experts agreed to consider to update Canada's 2011 LRDGs are intimate partner A/V (IPV), male-to-female sexual A/V (SV), and non-intimate and non-sexual A/V between adults or general A/V (GV). The role of alcohol in both A/V perpetration (being aggressive or violent toward another adult) and victimization (having an act of aggression or violence done toward them) was considered.[5] Relevant details about findings related to sex/gender differences are reported where available.[6]

[5] In the context of this overview, perpetrator refers to the person who was aggressive/violent toward another person or persons. Perpetration refers to the act of carrying out A/V. Victim refers to the person or persons to whom the aggressive/violent act was done (commonly referred to in the literature as the victim, target or survivor); that is, the person who was victimized by the perpetrator. Victimization refers to the process of being victimized. These terms are not meant to label those who experience violence. Use of terms "victim" or "victimization" is by no means intended to assign blame, imply weakness or guilt, or otherwise stigmatize those who experience A/V, nor is it meant to imply any particular response or impact of the A/V on the person.

[6] We use the term "sex/gender" in this overview because, while some studies restricted their analyses to sex (biological attributes), both alcohol consumption and A/V are inextricably linked to gender (socially constructed roles, norms, values and behaviours).

The full report, *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Overview of Reviews of the Association Between Alcohol Use and Aggression and Violence*, including references, is available on CCSA's LRDG 2022 webpage. A summary of the report is presented in this report.

Method

A comprehensive search was performed of the literature published from the year 2000 to January 2022, including systematic reviews (i.e., meta-analyses and narrative literature reviews), using the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE) and Excerpta Medica Database (Embase) using the OVID platform, PubMed, PsychINFO, PsychNET, Web of Science, Criminal Justice Abstracts, Cochrane CENTRA and other reviews from our collection.

- The search resulted in 3,826 records.
- After removal of duplicates, 2,744 titles and abstracts were retrieved.
- After screening by two independent screeners, 54 reviews were included (30 IPV, 10 SV and 14 GV). Results are reported separately for IPV, SV and GV, and separately for perpetration and victimization.

Key Findings

Alcohol and Intimate Partner Violence (IPV) Perpetration

Event-level alcohol consumption (i.e., having consumed alcohol at the time or prior to the A/V incident) was associated with perpetration of IPV, but the strength of the relationship varied by sample and sex/gender of perpetrator (larger for male than for female perpetrators). In terms of usual drinking pattern (e.g., usual number of standard drinks consumed per occasion, frequency of consumption over a specific time period, a regular pattern of drinking to intoxication), heavy episodic drinking (or binge drinking) and drinking to intoxication were positively associated with IPV perpetration, with weaker associations found for drinking frequency. As with event-level drinking, the relationship between usual drinking pattern and IPV perpetration was stronger for men than for women. Drinking problems and alcohol use disorders were positively associated with IPV perpetration, with stronger relationships for male than for female perpetrators (although some inconsistent findings were also reported). Some evidence suggested that alcohol use was also associated with more severe IPV perpetration.

Alcohol and IPV Victimization

Event-level drinking was associated with greater risk of being the victim of IPV. Findings were inconsistent relating to drinking pattern of the victim, but generally suggested that IPV victimization was associated with a pattern of heavy episodic drinking and intoxication, as well as drinking problems and alcohol use disorders. However, estimates of associations were usually smaller than were found for drinking by perpetrators, and some estimates were non-significant.

Alcohol and Male-to-Female Sexual Violence (SV) Perpetration

Small-to-medium effect sizes were found for the relationship between event-level alcohol consumption and male-to-female SV perpetration, although some experimental paradigms did not produce a significant effect of alcohol on SV. As well, moderating factors such as personality and attitudes were noted in the relationship. Associations were found between perpetration of SV and both drinking patterns and drinking problems, particularly for heavy episodic drinking. However, not

all studies found significant associations, especially when key variables such as past perpetration were controlled.

Alcohol and Male-to-Female SV Victimization

Consuming higher amounts of alcohol prior to SV was associated with greater severity of SV experienced by victims in some, but not all studies. This finding may relate to heavier drinking by the perpetrator because drinking by perpetrators and victims is highly correlated. Although there is relatively little research, some evidence suggested that women who engaged in a pattern of heavy episodic drinking, drinking to intoxication or problem drinking were more likely to be victims of SV.

Alcohol and General Violence (GV) Perpetration

Experimental, laboratory-based and other research indicates that alcohol increases aggressive behaviour (medium effect sizes), with variability related to how aggression was measured in the laboratory and sex/gender of aggressors. The research also identified important moderators of the association. Research suggests positive associations between GV perpetration by individuals and heavier drinking patterns as well as drinking problems. However, the evidence is less clear for usual quantity consumed per occasion (i.e., average number of drinks usually consumed) by individuals and frequency of drinking than for alcohol in the event (i.e., consumption during or prior to an A/V event), and the reviews in this area have methodological weaknesses.

Alcohol and GV Victimization

A large proportion of homicide victims tested positive for alcohol (larger for women than men), and many were defined as intoxicated (BAC > .08 or .10), although these studies found large variability in estimates. Homicide rate was found to be positively correlated with per capita consumption in some countries but not others. Emergency department studies indicated that patients with violence-related injuries were significantly more likely to have consumed alcohol than were non-violence-related injured patients, with some evidence suggesting the relationship was stronger for men than for women. There were insufficient data on drinking patterns of GV victims to draw conclusions about the relationship between alcohol consumption and being the victim of GV.

Discussion

Although the exact mechanisms by which alcohol is associated with A/V are unknown, there is overwhelming evidence that alcohol consumption, especially intoxication, is associated with perpetration of A/V, and some evidence indicates that alcohol may increase the severity of A/V. However, there are insufficient data to define the exact dose–response relationship. Thus, although existing research does not allow the calculation of a risk curve for alcohol and A/V, **it is reasonable to infer that individuals can reduce their risk of perpetrating A/V by limiting their alcohol consumption. Based on consistent evidence, it is highly likely that avoiding drinking to intoxication will reduce individuals' risk of perpetrating alcohol-related violence**. Therefore, efforts to reduce or eliminate alcohol-related A/V need to focus on reducing alcohol use, especially among those who may be likely to perpetrate A/V or get involved in violent incidents. Because A/V decreases with age and is perpetrated more by men than women, prevention efforts should focus on young adults, particularly young men. Overall, people should be encouraged to avoid drinking high levels of alcohol or avoid drinking altogether to reduce their risk of perpetrating violence. Persons who have a history of alcohol-related violence should avoid any consumption of alcohol.

The literature on the association between alcohol and A/V victimization is less clear. The findings suggest there is likely an association, but there are some mixed and null findings, and noteworthy limitations of this literature. Alcohol's role in victimization likely reflects many different mechanisms

that may work in combination, such as alcohol intoxication reducing the ability to avoid or escape danger, use of alcohol by victims due to trauma, increased exposure to risk in drinking settings, targeting by perpetrators of people who are intoxicated, and use of substances to control victims.

Attributing A/V victimization to alcohol contributes to beliefs that victims of A/V who had used alcohol are responsible or blameworthy for being victimized. Moreover, evidence suggests that interventions that place the burden to avoid risk of victimization on women and girls are ineffective. While alcohol might be a contributing factor in A/V victimization, we state unequivocally that drinking alcohol does not make a person responsible for A/V done toward them. Thus, we conclude that lower risk drinking guidelines should focus on reducing alcohol use by potential perpetrators.

2.4.2 Association Between Alcohol Use and Mental Health

In 2016, when Australia's National Health and Medical Research Council was asked to revisit their 2009 alcohol guidelines, their systematic review on the health effects of alcohol consumption revealed there was actually very little synthesized evidence on how different levels of alcohol consumption influence mental health (National Health and Medical Research Council, 2020). Because this question was of interest for drafting updated alcohol guideline recommendations, the Adelaide Health Technology Assessment, University of Adelaide, was contracted to conduct a systematic literature review on the latest and best scientific evidence on the mental health risks and benefits of alcohol consumption (Newton et al., 2018). The Newton et al. systematic review, plus six new systematic reviews on the association between alcohol consumption and mental health and substance use disorders were evaluated for the current project (See *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Evidence Review Technical Report*). None of the reviews met the criteria for inclusion.

Given the previously mentioned importance that people living in Canada expressed for the relationship between alcohol and mental health, the experts decided to commission Cochrane Canada, McMaster University, to conduct a rapid update of a systematic review of the effect of alcohol consumption on the development of depression, anxiety and suicidal ideation. The full report, *Effect of Alcohol Consumption on the Development of Depression, Anxiety and Suicidal Ideation: Update of a Systematic Review*, is available on CCSA's LRDG 2022 webpage.

Limitations of the Rapid Update and Experts' Decision

With this rapid update, the intention was to be able to pool together results across studies using statistical analyses. Unfortunately, as with the 2018 review prepared by Newton et al., thresholds and definitions for alcohol quantity or frequency varied across studies and so a statistical analysis could not be performed. In addition, studies often failed to report odds ratios with standard errors or confidence intervals so results could not be easily pooled. The review was also found that many studies did not report results that could be easily interpreted and even the most recently published studies provided little data that could be used to make healthcare decisions. Experts highlighted that just as was the case for many studies on the relationship between alcohol and physical health, many studies on alcohol and mental health misclassified abstainers. Specifically, to assess the impact of alcohol on mental health, the reference group against which those who use alcohol were compared were people who do not consume alcohol, including people who quit using alcohol because of health problems, such as mental health issues. In addition, the experts noted that the results of the review, which generally showed a null association between alcohol and mental health, contradicted the most recent WHO findings. The WHO review from 2019 found a close link between patterns of alcohol use and depression, between harmful alcohol use and anxiety disorders, and between harmful use of alcohol or dependence and self-harm or suicidal behaviour (World Health Organization, n.d.).

For all these reasons, the experts agreed that further work would be required for mental health outcomes to be considered when making alcohol guidelines recommendations. The experts were unanimous in opting to make the rapid review publicly available but agreed that it would not inform their final discussions on formulation and presentation of updated guidelines.

2.5 Women's Health and Alcohol

The mathematical modelling revealed identical risk thresholds for females and males at low levels of alcohol consumption. This was not unexpected. When the U.K. and Australia updated their alcohol guidelines, both made identical recommendations for men and women. Since 2017, France also recommends the same alcohol limits for both sexes and when Denmark released its new alcohol guidelines in spring 2022, they recommended the same amount for adult women and men alike, and no alcohol consumption for those under 18 years old.

The results obtained by our modelling align with the global trend to not differentiate between females and males when formulating alcohol guidelines. This conclusion is because at low levels of consumption the physiological differences between women and men have only a small impact on lifetime risk of death. However, above low risk, lifetime risk increases more steeply for women than for men.

The experts are mindful of the complexity of this reality and the necessity to describe it well. Proper understanding of sex-related and gender-related factors on women's health and reproductive issues is key to reach and inform audiences in a meaningful way. Updated alcohol guidelines need to be shared with the appropriate nuances. To this end, a comprehensive multi-part review of the recent literature on sex, gender, alcohol and health was commissioned.

The full report prepared by Galvanizing Equity, including references, is available here: *Sex, Gender and Alcohol: What Matters for Women in Low-Risk Drinking Guidelines?* and a short version is presented below. This section concludes with evidence-based key messages that health professionals and policy makers may want to consider in their programs, practices and communications about alcohol.

2.5.1 What Are Some Sex-Related Factors?

The four main categories of sex-related biological factors that are important to understanding how alcohol affects male and female bodies are hormones and enzymes, physiology and anatomy, genetics, and neurobiology. Within these, various sex-related differences, factors or processes exist. The absorption, distribution and metabolism of alcohol is affected by sex-related factors. For example, females absorb ethanol faster than males, and reach a higher BAC due to faster absorption and slower elimination. Significantly, females generally experience more risk of damage or disease, such as liver disease, at lower levels of alcohol consumption than do males. In general, males are more likely to develop alcohol use disorders, but females are more likely to develop organ and other bodily damage from drinking alcohol.

2.5.2 What Are Some Gender-Related Factors?

There are different impacts on women or men or gender and sexual minorities as a result of alcohol. The four main aspects of gender that account for these impacts are gender roles and norms, gender relations, gender identity and institutionalized gender. Gender identity matters in that the strength of adherence to masculinities or femininities affects style and volume of drinking behaviour, with men and sexual and gender minorities often drinking larger quantities of alcohol and more often than women as a group. Gendered relations often mean that women are influenced by a partner's

drinking and the impacts of alcohol reflect gender inequities such as vulnerability to sexual assault and violence. Gender roles lead to women using alcohol to cope with stresses of caregiving roles, trauma and IPV. Institutionalized gender differentially impacts women by applying increased stigma to women who drink, and barriers to treatment for women and mothers who use alcohol.

2.5.3 How Do Sex and Gender Interact and Intersect with Other Factors?

All these factors and processes are exacerbated by sex–gender interactions. For example, sex-related and gender-related factors coincide to create specific and heightened negative impacts of alcohol during pregnancy on both women's and fetal health. Pregnancy-related processes affect the pharmacokinetics of ingesting alcohol, while stigma and social policing are heightened during pregnancy. Vulnerability to sexual assault is enhanced in the context of being young, female and intoxicated, amid pervasive gender-based violence. Intersections, such as those with poverty, racialization, past trauma, or sexual and gender minority status merge to create more harms.

2.5.4 How Does Alcohol Affect Reproduction?

Women's and children's reproductive health is compromised by alcohol use, particularly during pregnancy and breastfeeding. Long-term damage to children can occur after being exposed to alcohol in the womb, and alcohol use during breastfeeding can reduce milk production. Furthermore, alcohol passes into breastmilk and therefore exposes the infant to alcohol. During pregnancy, increased water and blood volume, along with the impact of alcohol on glucose and insulin lipid metabolism, create complex effects on the body.

There is mixed evidence on the impact of alcohol on pregnancy and delivery outcomes, with possible increases in miscarriage and placental abnormalities. However, exposure to alcohol in the womb results in a well-established risk for learning, health and social effects that have a lifelong impact, including brain injury, birth defects, health problems and diseases. Recent reviews that considered low levels of exposure have also found some adverse effects, reinforcing the message that it is safest not to drink during pregnancy. Effects of alcohol consumption on breastfeeding include a decrease in milk production, early cessation of breastfeeding and effects on infant sleep patterns.

2.5.5 Discussion

Women are particularly susceptible to the negative effects of drinking alcohol. This is due to factors related to both sex (biological) and gender (social). The female body's response to alcohol results in faster intoxication and more damage from lesser amounts of alcohol, and in a shorter time. Gendered social and cultural factors about alcohol negatively affect girls and women via enhanced stigma, social pressures, exploitative marketing and increased vulnerability to sexual assault and IPV. Sex and gender, along with the determinants of health and intersecting factors, such as race, age, income and education, shape the overall impacts of alcohol, resulting in differential impacts on women, men and gender and sexual minorities. While all people living in Canada can benefit from nuanced information and messaging about alcohol use and safe drinking levels, it is especially important for women and girls.

Alcohol use also presents numerous sex- and gender-specific risks for reproductive processes such as fertility and conception, pregnancy, breastfeeding and childcare. Males and females experience differential alcohol-related reproductive risks and effects, at different life stages. Alcohol use during pregnancy is particularly unsafe, as it heightens the risk of fetal alcohol spectrum disorder (FASD) in offspring, often with lifelong disabilities and impacts. Gendered social attitudes about alcohol use

and reproduction mean that pregnant girls and women who use alcohol experience negative, punitive and stigmatizing attitudes. In some jurisdictions, these manifest as state sanctioned interventions, barriers to treatment or child apprehension.

2.5.6 What Are the Key Messages for Women?

The collective impact of sex, gender and interactive and intersectional factors on alcohol use has particular importance for girls and women. It is necessary to transmit this emerging and growing body of evidence to women, service providers, practitioners and policy makers to improve health literacy and inform more specific and tailored prevention, treatment and harm reduction efforts.

- Female bodies can be more damaged by drinking, compared to males.
- Sex-related (biological) factors enhance the impact of alcohol, causing more harm and faster intoxication in girls and women from lesser amounts.
- Gender-related (social) factors contribute to the negative impacts of alcohol in real life, increasing vulnerability to marketing exploitation, stigma, sexual assault and IPV.
- Sex, gender and factors such as trauma and poverty interact and make dependence on alcohol, treatment and recovery more difficult for women.
- Practitioners need to recognize both biological and social factors affecting alcohol use that create differential impacts on and require tailored responses for women, men and gender and sexual minorities.

2.6 Views, Preferences and Expectations About Guidelines of People Living in Canada

Throughout this project, there was a commitment to consider the views, preferences and expectations of people living in Canada about alcohol guidelines to improve the strength of updated recommendations. Therefore, as evidence was being gathered on alcohol and health, parallel activities were led to better understand people's views about guidelines and to obtain insight on alcohol, health and issues of well-being that matter most and are most useful to people living in Canada.

Three different types of evidence were collected to inform experts' deliberations and final decisions for the updated guidelines: an update of a systematic review, a public consultation, interviews with stakeholders.

2.6.1 Summary of Evidence on Understanding and Response to Alcohol Guidelines

To learn about the acceptability and feasibility of the updated guidelines, the systematic review previously prepared for the behavioural evidence expert group for the U.K. guidelines (Jones & Bellis, 2013) was updated with a focus on understandings and responses to official public health guidelines. The update was prepared by Cochrane Canada. (See the full report here: *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Summary of Evidence on Understanding and Response to Alcohol Consumption Guidelines*.) Some of the results have proven to be of great importance to the experts charged with making judgments about the acceptability and feasibility of recommendations.

- There appears to be little understanding among the public about what a standard drink is and most times people overestimated the standard drink size. The public also overestimated the number of daily and weekly standard drinks recommended in guidelines. Typically, people indicated that those recommendations were unrealistic and did not want to count standard drinks.
- Views about the amount of alcohol consumption that was not sensible or that was harmful were often associated with excessive intake or "problem drinking," but people often noted that their own drinking was not a problem.
- Less than half the people who responded to surveys were aware of the harms of alcohol intake, and there was less awareness in people who drink at high- or very high-risk levels. While some people were aware of the harms, they still had a positive attitude toward alcohol use, especially in social situations.
- People suggested that guidelines should include strategies to help apply the low-risk drinking recommendations, such as refusing drinks when not really wanted or eating while drinking.
- The applicability to their own lives of guidelines generally and guidelines specifically for low-risk drinking was questioned by the public with many reasons given for why guidelines might not be applicable. For example, individual tolerance levels and physical reactions to alcohol can differ, and the effects of different types of alcohol on an individual can also differ.
- While participants in the studies indicated that a health agency should provide recommendations, they preferred advice rather than strict rules or patronizing messages.
- Overall, the experts considered these findings to indicate that regardless of the scientific quality of the guidelines, to be credible updated guidelines must meet people where they are at. They would have to bridge the gap between the way people consume alcohol and the evidence on the health impacts by providing them with actionable guidance.

2.6.2 Public Consultation on Alcohol Guidelines

In spring 2021, CCSA held an online public consultation in which 4,845 people living in Canada participated. (See the full report here: *Update of Canada's Low-Risk Alcohol Drinking Guidelines: Summary of Findings from Public Consultation*.) The consultation focused on the experiences of people living in Canada with the current LRDGs and their needs and expectations for updated guidelines. The public consultation revealed alcohol-related topics of importance to people living in Canada that, in return, influenced the topics for which it was decided to conduct rapid reviews (see previous section). The experts also retained two major lessons in terms of the type of information to be emphasized and prioritized in the development of resources to promote the new guidelines:

- Among contributors who said they had used the 2011 LRDGs in the past, the most often cited challenge with using the guidelines was "not wanting to follow the LRDGs."
- The contributors shared an interest in understanding their risk of experiencing alcohol-related harms and receiving information about long-term risks and benefits of alcohol use.

Both these results point to the importance of not only informing people about the existence of the guidelines, but also about the reasons for their existence. Without fully understanding the risks associated with alcohol use, people are unlikely to understand why they should follow the guidelines.

2.6.3 Interviews with Stakeholders

To explore the familiarity and understanding of the 2011 LRDGs, and to discuss specific knowledge mobilization recommendations including ideal messaging and communication strategies, Leger was contracted to assist in the completion of eight virtual focus groups. A total of 48 persons representing various health-related organizations were interviewed. The summary report, *Commissioned Report: Update on Canada's Low-Risk Alcohol Drinking Guidelines: Summary of Stakeholder Focus Groups*. is available on CCSA's LRDG webpage.

Overall, stakeholders were familiar with the LRDGs. They mentioned frequently referencing the guidelines, which they found to be particularly useful to start a conversation about alcohol use and drinking patterns. Still, they mentioned that encouraging people to follow alcohol guidelines was challenging because awareness of the dangers of alcohol was low and people living in Canada tended to normalize consuming alcohol.

Stakeholders mentioned that the goal of the updated guidelines should be to get people rethinking their alcohol consumption. They requested a focus on the adverse effects of alcohol on overall health and wellness, including information on alcohol being a known teratogen and carcinogen, and its association with mental health and social harms. Messaging for teens and young adults should focus on the immediate short-term impacts of drinking. Finally, many participants mentioned the importance for updated guidelines to challenge the alcohol-centred culture and to include messaging promoting a non-drinking culture. Participants also mentioned keeping the guidelines as simple as possible and providing standard drink measurements that are easy to follow as the ideal approach to conveying the guidelines.

In terms of resources, stakeholders said they wanted a variety of different types of information. They also viewed infographics as important for communicating the updated guidelines. The guidelines should be kept as simple as possible and providing standard drink measurements that are easy to follow is viewed as the ideal approach to conveying them. In fact, the interviews further revealed a firm belief among stakeholders that the public should be provided with information about standard drink size, nutritional information and potential health risks related to consuming alcohol. Hence, they expressed support for the addition of mandatory enhanced alcohol container labels with a health message, drink guidelines, standard drink information and nutrition information.

Standard Drink Labelling: A necessary condition for the adoption of the Guidance on Alcohol and Health by the public

The concept of standard drink is central to understanding the Guidelines on Alcohol and Health. To adhere to the guidance and reduce the risk of negative consequences due to alcohol, consumers need consistent, easy-to-use information when serving alcohol to accurately track and monitor their drinking.

In Canada, a standard drink is 17.05 ml or 13.45 g of pure alcohol, which is equivalent to:

- A bottle of beer (12 oz., 341 ml, 5% alcohol)
- A bottle of cider (12 oz., 341 ml, 5% alcohol)
- A glass of wine (5 oz., 142 ml, 12% alcohol)
- A shot glass of spirits (1.5 oz., 43 ml, 40% alcohol)

In practice, people in Canada have a limited understanding of a standard drink (Osiowy et al., 2015; Public Health Ontario, 2017b). According to this project's public consultation (*Update of Canada's Low-Risk Alcohol Drinking Guidelines: Summary of Findings from Public Consultation*), 38% of contributors said they had previously heard of the 2011 LRDGs. Among those who reported using the guidelines, less than half (43%) said they were extremely familiar with the concept of standard drink. When asked about challenges associated with using the 2011 LRDGs, two of the three most popular answers were that it was not clear to them "what a standard drink is" and that the standard drinks in the guidelines did not represent the types of alcoholic beverages they typically drink. These results echo those of other studies showing that a lack of knowledge about standard drinks can preclude people from adhering to guidelines, even if they are aware of them and motivated to monitor and regulate their alcohol consumption (De Visser & Birch, 2012; Dowling et al., 2006; Hawks, 1999).

Percent alcohol by volume (%ABV) information is mandated on alcohol beverage containers in Canada. However, communicating alcohol content on beverage containers using %ABV information is problematic because alcohol drinking guidelines are expressed in terms of standard drinks. The inconsistency in messaging causes consumer confusion and creates barriers for consumers to adhere to alcohol guidance. Standard Drink Labelling (SDL) can help consumers to accurately monitor their alcohol use in terms of standard drinks (Osiowy et al., 2015; Wettlaufer, 2018). According to a 2022 systematic review of the impacts of alcohol container labels on consumer outcomes, the evidence consistently suggests that compared to %ABV labels, exposure to SDL results in more accurate estimates of the amount of alcohol in a standard drink, the number of standard drinks in an alcohol container, and the number of standard drinks to reach drink limit guidelines (Hobin et al., 2022). Evidence also indicates that by providing information at the point of pour, SDL better supports accurately pouring one standard drink of alcohol relative to %ABV labels (Brunk et al., 2020; Wettlaufer, 2018). In the only real-world experimental study testing alcohol container labels, results suggest when consumers are exposed to SDL, they are more likely to use the labels to drink within guidelines and accurately estimate the number of standard drinks in their preferred drink (Schoueri-Mychasiw et al., 2021).

Considering that:

- The concept of standard drink is central to understanding and following Canada's Guidance on Alcohol and Health;

- SDL can help consumers follow alcohol guidelines by monitoring their personal alcohol use; and
- A fundamental idea underlying this project is that people living in Canada have a right to clear information about alcohol;

A corollary of this project is a recommendation for Health Canada to require, through regulation, the mandatory labelling of all alcoholic beverages on the number of standard drinks in a container.

2.6.4 Focused Consultations with Indigenous People

Throughout the project, focused consultations were held with Indigenous people serving on the LRDG Executive Committee or Scientific Expert Panels. These experts included Dr. Carol Hopkins, Lenape Nation, Chief Executive Officer, Thunderbird Partnership Foundation; the late Harold Johnson, Nehiyaw lawyer and author; and Dr. Christopher Mushquash, Anishinabek Professor, Lakehead University, and Canada Research Chair in Indigenous Mental Health and Addiction.

The discussions began very broadly with regards to Indigenous peoples' historical relationship with alcohol (Johnson, 2016). The participants reflected on how alcohol has been used as a tool or weapon of colonization from its first introduction during the fur trade. They recalled that the negative impacts were so severe that the numbered treaties included a clause to ban alcohol from Indigenous territory and communities. This prohibition led to the criminalization of alcohol sales, transportation and consumption that in turn contributed to high levels of incarceration of Indigenous people, negative stereotyping, racism and stigma. In the frontier context, binge drinking and related harms like violence, injuries and accidents became pervasive (Ehrlander, 2010). Drinking alcohol became a coping mechanism for dealing with trauma and grief resulting from the losses of self-government, cultural practices, ceremonies, language and a viable economy, as well as the apprehension, isolation and abuse of children in the Indian Residential Schools. Indigenous people's situation illustrates that the effects of alcohol are not the same for all people and communities.

In this larger context it is important to recognize the bi-modal drinking pattern amongst Indigenous people. Compared to other adults in Canada, there are proportionately more First Nations adults who do not use alcohol (42.6%) or engage in binge drinking (50.5%) (First Nations Information Governance Centre, 2018). Using alcohol without binge drinking is uncommon (6.9%) and generally confined to those who are urban, and have more education and greater career responsibilities. In most communities, tribal councils and Indigenous organizations, the emphasis has been on abstinence-based treatment programs with a strong cultural content. The latter serves to reinforce Indigenous identity with the exploration of hope, belonging, meaning and purpose (Assembly of First Nations et al., 2011; Thunderbird Partnership Foundation, 2015). Nevertheless, pragmatic harm reduction strategies have also been embraced by Indigenous communities.

Because of the above considerations, the Indigenous experts questioned the relevance of the LRDGs for Indigenous people, in terms of the enormity of the challenges with alcohol, the inequity in resources to address alcohol at the community level, and the cultural and historical contexts regarding alcohol. They emphasized that in most Indigenous communities wellness is more oriented toward abstinence than low-risk alcohol use (Thunderbird Partnership Foundation, 2015). They further expressed concern that an Indigenous commentary or takeaway, without the correct context, would simply reinforce systemic racism, negative stereotyping and stigma. Instead, it was suggested that broad social determinants of health need to be recognized and linked to policies, like addressing epistemic racism through ensuring Indigenous culture is the foundation of policy and

programs, poverty reduction, income security, accessible employment and colonialism diminishment (Czyzewski, 2011).

On a smaller scale, Indigenous experts agreed that Indigenous peoples should be involved in developing knowledge mobilization practices for their people and the following initiatives should be prioritized for development:

- A risk-based approach to increase alcohol literacy, aligned with the culturally congruent focus on wellness;
- A harm reduction initiative to promote substance use health among those who choose to use alcohol, focused on how to reduce the harms of alcohol consumption to self, families and Indigenous communities; and
- Community-based alcohol interventions, framed as community-based alcohol strategies, with appropriate guidance, knowledge mobilization and resources.

A narrative approach identifying risk factors, resiliency and the success of different communities was encouraged. Evaluation resources should accompany the development of these initiatives to ensure they meet their intended goals. Each objective should be funded to ensure that alcohol issues are explored and addressed in the appropriate historical and cultural context, guided by an evidence-based, culturally relevant approach, and using enhanced community-based resources.

Part 3: Experts' Recommendations

Canada's LRDGs were originally published in November 2011 and the evidence since then on the association between drinking alcohol and physical, mental and social harms has continuously evolved. An update of the guidelines was required to take into account these advancements in what we know about the risks and benefits associated with alcohol. In July 2020, with the support of Health Canada, CCSA was mandated to update Canada's LRDGs. The project has been guided by a public health perspective and its stated focus has been to provide people living in Canada with the latest evidence-based advice on alcohol to support them in making informed decisions about its use.

When the update of Canada's LRDGs was initiated, it was anticipated that the new guidelines would set lower limits for alcohol use. This was, in part, due to several trends that have emerged since the guidelines were released in 2011: that alcohol use was a risk factor for an increasing number of diseases; an important proportion of alcohol-attributable deaths in Canada were among people adhering to the 2011 guidelines; and alcohol guidelines coming from other countries in recent years had all recommended limits below the 2011 Canadian guidelines. What was not anticipated was that the evidence review would reveal the extent to which even very small amounts of alcohol can be harmful to people's health and well-being. In this context, the experts have agreed to replace Canada's LRDGs with **Canada's Guidance on Alcohol and Health**.

3.1 Canada's Guidance on Alcohol and Health

Throughout the life course, there are established thresholds of mortality risk that people are willing to accept (BMJ Best Practice, n.d.; Starr, 1969). For voluntary activities like unprotected sexual practices or smoking cigarettes, that level is a 1 in 1,000 mortality risk (i.e., people are willing to accept a 1 in 1,000 risk of death when participating in these activities). For alcohol, people appear willing to accept a higher risk of death associated with consumption as compared with other voluntary activities. It is not uncommon for countries to base their guideline recommendations on a 1 in 100 mortality risk limit (e.g., Australia, France, U.K.). This project revealed that in Canada, the limit associated with a 1 in 1,000 chance of premature death related to an alcohol condition is two standard drinks per week, while the 1 in 100 risk limit is six standard drinks per week.

There is a continuum of risk whereby the risk for those who consume two standard drinks or less per week is negligible to low; it is moderate for those who consume between three and six standard drinks per week; and it is increasingly high for those who consume more than six standard drinks per week.

In light of results obtained through this project's knowledge mobilization activities and with a view to meet people where they are at, the experts are unanimous that instead of providing people with strict rules and recommendations, people living in Canada should be presented with a continuum of risk associated with various levels of alcohol use. The experts anticipate that a continuum of risk will allow people to situate themselves where they are on that continuum and understand in which risk zone their alcohol use places them. It is hoped that this will lead people to develop intentions to adopt healthier and safer behaviours (i.e., to move toward a less risky drinking zone along that continuum). Presenting people living in Canada with a continuum is also a direct response to stakeholders' wishes for the new guidance to be broadly relatable to all segments of the population, reflecting the different ways people living in Canada use alcohol and the unique health and social outcomes associated with those patterns of use.

The weekly number of standard drinks that delineate the continuum's risk zones align with weekly recommendations in the U.K. (8.3 standard drinks), Australia, Denmark, France (7.4 standard drinks) and the Netherlands (5.2 standard drinks). In Canada, among persons aged 15 and older, about a fifth of females (23%) and males (21%) do not drink alcohol, 27% of females and 16% of males usually consume less than two standard drinks per week; 19% of females and 15% of males consume three to six standard drinks per week on average and a third of females (32%) and half of males (49%) usually consume more than six standard drinks per week. These proportions are based on two data sources: World Health Organization (2021) and Statistics Canada (2018).

> Among people living in Canada aged 15 and older, one fifth (20%) do not drink alcohol, another fifth (21%) consume less than two standard drinks per week on average, 17% consume three to six standard drinks per week and 40% consume more than six standard drinks per week.

The continuum of risk is based on average quantities of alcohol people consume per week and the impact it has on their physical health. Therefore, the experts looked at other types of evidence to support people living in Canada who may wonder about the consequences of occasional drinking or immediate effects that could fall outside the realm of physical health. From that line or inquiry, there is a second takeaway: **On any occasion, the risk of a negative acute outcome begins to increase with any consumption, and with more than two standard drinks, most individuals will have an increased risk of injuries or other problems**.

It is not lost on the experts that this new Guidance on Alcohol and Health, which puts forward a continuum of risk, will be surprising and unsettling to large segments of the population, including the alcohol industry, media and policy makers. However, people living in Canada have a right to know. Alcohol is a carcinogen related to at least seven types of cancer, including common ones like colon and breast cancer. Furthermore, in contrast to common perceptions, current evidence shows that drinking a little alcohol does not decrease the risk of heart disease. In fact, alcohol consumption can lead to cardiovascular diseases and lower respiratory infections, as well as injuries resulting from violence and road crashes. Hence, this project has confirmed that **less is better when it comes to drinking alcohol** and from this fact, it is necessary to promote the message that **it is okay not to drink alcohol**.

An encouraging fact associated with this new evidence is that every standard drink counts and any reduction in alcohol use is beneficial. Research demonstrates that many harms related to chronic disease caused by alcohol are reversible. People who decrease their alcohol consumption experience improvements in liver function, insulin resistance, weight, blood pressure and cancer-related growth factors (Mehta et al., 2018; Thomes et al., 2021). Reductions in alcohol use further decrease hypertension (Roerecke et al., 2017) and reduce the risk of cancer, atrial fibrillation, stroke, diabetes, pancreatitis and liver cirrhosis (Heckley et al., 2011; Lee et al., 2021; Nikkola et al., 2013; Verrill et al., 2009; Voskoboinik et al., 2020; Wu et al., 2021). In addition, the risk of infectious diseases, epilepsy and injuries are affected by the acute effects of alcohol and reductions in alcohol use will immediately decrease the risk of these outcomes (Imtiaz et al., 2017; A. Samokhvalov et al., 2010a; Samokhvalov et al., 2010b; Taylor et al., 2010). Hence, it is never too late to reduce alcohol consumption.

Canada's Guidance on Alcohol and Health, Seven Key Takeaway Messages
1. All levels of alcohol consumption are associated with some risk, so drinking less is better for everyone. 2. Among healthy individuals, there is a continuum of risk for alcohol-related harms whereby the risk is: • Negligible to low for individuals who consume two standard drinks or less per week; • Moderate for those who consume between three and six standard drinks per week; and • Increasingly high for those who consume more than six standard drinks per week. 3. On any occasion, any level of consumption has risks, and with more than two standard drinks, most individuals will have an increased risk of injuries or other problems 4. Disproportionately more injuries, violence and deaths result from men's drinking. 5. Above low levels of alcohol consumption, the health risks increase more steeply for women than for men. 6. It is safest not to drink alcohol while pregnant and during the pre-conception period. 7. For women who are breastfeeding, it is safest not to use alcohol.

Another surprising finding of this project is that at low levels of consumption the physiological differences in the lifetime risk of death due to alcohol between women and men is minimal. However, the experts are unequivocal in stating that this should not distract from the evidence that **lifetime risk of harm increases more steeply for women than for men when we move above the lowest risk levels**. On the one hand, biological factors enhance the impact of alcohol, causing more harm and faster intoxication on lesser amounts in girls and women. On the other hand, girls and women suffer disproportionately from social factors that contribute to the negative impacts of alcohol in real life, such as increasing vulnerability to marketing exploitations, stigma, sexual assault and IPV.

On this note, the experts find it imperative to highlight that men's vulnerability to alcohol should not be overlooked. The work completed in this project has shown that men are more likely than women to experience and cause alcohol-related harms. Men drink more alcohol than women do and are more likely to drink in excess. As a consequence, they are more likely to be involved in alcohol-impaired driving collisions, to be treated in hospitals and hospitalized for alcohol-related medical emergencies and health problems, to be diagnosed with an alcohol use disorder, and to die from alcohol-related causes (Canadian Institute for Health Information, 2022; Canadian Substance Use Costs and Harms, 2020; Rehm et al., 2006; Statistics Canada, 2021). Alcohol is also more strongly associated with perpetration of violence for men then for women. **Disproportionately more injuries, violence and deaths result from men's drinking**.

Finally, reproductive health is compromised by alcohol use and people living in Canada need to be reminded that alcohol is a teratogen that can cause learning, health and social effects that have a lifelong impact, including brain injury, birth defects, behavioural problems, learning disabilities and other health problems. These adverse effects are observed at relatively low levels of exposure or short-term exposure to high levels of consumption, so **it is safest not to drink while pregnant and during the pre-conception period**.

Alcohol consumption can also negatively impact breastfeeding by causing a decrease in milk production, early cessation of breastfeeding and effects on infant sleep patterns. Alcohol enters breast milk through passive diffusion within 30 to 60 minutes following ingestion, so breastfeeding infants can be exposed to alcohol through breastmilk. However, infants are unable to metabolize alcohol. Therefore, **for women who are breastfeeding, it is safest not to use alcohol**.

3.2 Moving Forward

In light of the new Guidance on Alcohol and Health, as well as the fact that alcohol literacy in the population is low (Canadian Centre on Substance Use and Addiction, 2021), **substantial and sustained efforts will be required to develop messaging that speaks directly to the unique concerns of people with diverse backgrounds and personal experiences**. For example, novel work developed in parallel to this project has shown that alcohol consumers aged 18 to 30 may be more receptive to health messaging about the effects of their alcohol use on life expectancy, than to messages which simply present a guideline (Stockwell et al., 2022). Others may want to direct their prevention efforts toward young adults, particularly boys and young men since aggression and violence decreases with age and is perpetrated more by men than women. Recommendations and suggestions, particularly in relation to sex and gender, have also been prepared in connection with this project and are available to those who would like to build a campaign around them (Appendix 3).

Furthermore, the involvement of health professionals, family doctors and nurses, who are crucial allies with immense credibility in explaining the continuum of risks associated with alcohol to patients and the general public, will also be required. By doing so, they may make a valuable contribution to health care by reducing direct alcohol-related costs; we will return to this issue below.

People living in Canada should "Learn the facts. Parse the fictions. Act accordingly."[7] To do so, they will need more than plain and clear information, no matter how effective newly developed target campaigns will be. Alcohol, like tobacco or processed foods, has been termed a "sinful good," meaning that when people use it, they get the pleasure now and suffer the consequences later. To make wise decisions about such goods, people need encouragement (Thaler & Sunstein, 2008). People living in Canada who want to move toward the lower end of the continuum of alcohol-related risks need an environment that supports healthier and safer decisions. To move away from an *alcogenic culture* (Johnston, 2014), there needs to be a cultural shift. Therefore, **a corollary to the current project is the requirement for governments to design a healthier environment that will help people make difficult decision making about alcohol a little easier**.

First and foremost, for people living in Canada to adhere to the Guidance on Alcohol and Health, evidence shows consumers need consistent, easy-to-use information on alcohol containers to accurately track and monitor their alcohol use in terms of standard drinks. While beer remains the alcoholic beverage of choice for people living in Canada, the growing craft movement is resulting in a variety of alcohol content and sizes of cans and bottles being available for consumption at home. Now more than ever, to count how many standard drinks they consume, people need information at the point of pour. While Canada is a world leader in mandating enhanced labels on tobacco and cannabis packages, alcohol containers are exempt from these requirements. Enhanced alcohol container labels are an increasingly popular strategy for providing information to consumers, and a key recommendation by national and international health organizations (Jané-Llopis et al., 2020; Vallance et al., 2021; World Health Organization, 2022). A direct consequence of the current project

[7] The expression comes from an opinion letter entitled Drinking skyrocketed during COVID-19. Why's it so hard to learn the facts about alcohol? It was written by Alec Bruce and published in *The Globe and Mail* on Nov. 12, 2021. https://www.theglobeandmail.com/opinion/article-drinking-skyrocketed-during-covid-19-whys-it-so-hard-to-learn-the/

is a recommendation **for Health Canada to require, through regulation, the mandatory labelling of all alcoholic beverages on the number of standard drinks in a container**.

Many studies have shown that people are most likely to follow guidance if they know the reasons why they should (Pettigrew et al., 2021; Wakefield et al., 2018). Our public consultation revealed that without understanding the risks and benefits associated with alcohol use, people are unlikely to understand why they should follow the guidelines. Therefore, **the requirement for standard drink labelling should be followed by a requirement to label all alcoholic beverages with health warnings and nutrition information**. Labelling may be an important intervention in a more comprehensive alcohol strategy (Kokole et al., 2021). Evidence has shown that adding health warnings to alcohol labels can increase public awareness of the causal link with cancer and reduce per capita alcohol consumption. They can also strengthen public support for policies that are often unpopular but known to reduce population-level alcohol-caused harms (Weerasinghe et al., 2020).

To support people living in Canada who want to move toward the less risky end of the continuum, governments will need to be involved on other policy fronts. Cost-effective policies and feasible interventions that reduce the overall level of alcohol consumption are well documented at the global, national and provincial levels (Vallance et al., 2021; World Health Organization, 2022). For example, work conducted by the Canadian Alcohol Policy Evaluation committee and the National Alcohol Strategy Advisory Committee has highlighted that measures such as strengthened regulations of alcohol advertising and marketing, restrictions on the physical availability of alcohol, and the adoption of a minimum price for alcohol sold are all beneficial to public health. If the new Guidance on Alcohol and Health were to facilitate policy discussions and initiatives, the effects could be considerable and extend beyond the public health sphere to include economic benefits.

The Canadian Substance Use Costs and Harms study (Canadian Substance Use Costs and Harms, 2020) has revealed that the annual direct costs of alcohol are $16.7 billion, far more than the direct costs associated with tobacco ($12.3 billion), opioids ($5.9 billion) or cannabis ($3.2 billion), and far exceeding the value of the revenue produced by alcohol sales and taxation, which was last estimated to be $13.5 billion (Statistics Canada, 2021). Hence, by adopting policies to support healthier and safer decisions around alcohol use, government may save money and reduce per-person costs attributable to alcohol use in Canada, most recently estimated at $455 per year (Canadian Substance Use Costs and Harms, 2020).

3.2 Conclusion

The new Guidance on Alcohol and Health reflects the conclusions drawn from global evidence reviews, mathematical modelling, consultations with the public and experts, and discussions. It is hoped that this work will be useful to people living in Canada who are health conscious and want to know more about the effects of alcohol consumption on their well-being. The Guidance on Alcohol and Health was developed for them to make informed decisions about their alcohol use.

The Guidance on Alcohol and Health requires a cultural shift that, by and large, can only be orchestrated by governments through policies and collaboration with employers, healthcare providers and community stakeholders to make people aware and better at managing their risks. Hence, the evidence reviewed and presented here should influence provincial and federal governments to implement alcohol policies focused on reducing alcohol-related harms and promoting health and wellness. Information and advice are useful and necessary for people in Canada, but an environment supporting healthier and more informed-behaviour choices around alcohol is an absolute pre-requisite for a healthy society.

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Appendix 1

Lifetime Risk of Alcohol-Attributable Death and Disability: Shadow Analysis

Purpose

To inform decisions regarding the formation of Canadian drinking guidelines, a primary analysis was performed whose results were a collection of risk relationships that estimated the risk of death and disability as a function of average daily alcohol use by those who live in Canada.

Toward ensuring accuracy of the primary analysis, this shadow analysis process was designed and undertaken. The general objective of a shadow analysis is for the main and shadow analysts to come together and share the desired project input and broad methodology. The two analyses are conducted independently, in parallel, and results are compared to ensure accuracy of the primary collection of results.

Method

The primary and shadow researchers met several times to discuss strategy and determine raw input that would be shared by both analyses. Shared inputs were as follows:

- Relative risk function definitions: Each alcohol-attributable condition considered was assigned a dose–response relative risk function, and the source and definition of these risk functions was shared. Relative risk functions were prepared by the primary researcher.
- Prevalence and consumption data: Raw survey data for Canada was transformed into total and relative population alcohol consumption, where relevant population strata were sex and age. Prevalence and consumption data were prepared by the primary researcher.
- Deaths, years lived with disability, and incidence in the population, by condition: Raw data were aggregated and summarized into alcohol-attributable condition categories for each outcome category. Death data was prepared by the primary researcher and also the shadow researcher. Years lived with disability and incidence were prepared by the primary researcher.

The two analysts discussed the broad methodologies. The implementation of the lifetime risk methodology was then performed in R in both the primary and shadow analyses. Researchers wrote their scripts and/or packages independently. Primary and shadow analysis results were compared with an eye toward whether differences would have an impact on the quantitative guidelines endeavour.

Summary of the Comparison of Findings

The shadow analysis is a very near-match with the primary analysis, with differences accounted for by expected, random differentials in the model-building exercise, the random draws employed throughout the process and slight differences in methodological choices between analysts. Small differences between the shadow analyses and the primary analysis **are not expected to lead to differences in interpretations of results for the quantitative guidelines endeavour.**

Figures 1 and 2 compares the results of the primary and shadow analyses. Figure 1 displays lifetime deaths per 1,000 people at each level of consumption up to an average of 100 g ethanol/day. Figure 2 displays the same statistic on the range of up to an average of 40 g ethanol/day. In each

figure, the results of the primary analysis (and associated 95% confidence intervals [CIs]) are shown in red and the shadow analyses in blue. In Figure 2, it is clear that the shadow analysis produced results that would not lead to substantive differences in interpretation when designing alcohol use guidelines for people who live in Canada. A high similarity between the shadow and primary analysis is observed for all levels of average daily alcohol use, and in particular the match is near-perfect at levels of average daily alcohol use below 50 g ethanol/ day. This behaviour is consistent throughout the remainder of the shadow results, distributed separately.

Figure 1: Visual comparison between primary results and shadow results in the category of male death, range of average consumption of from 1 to 100 g ethanol/day

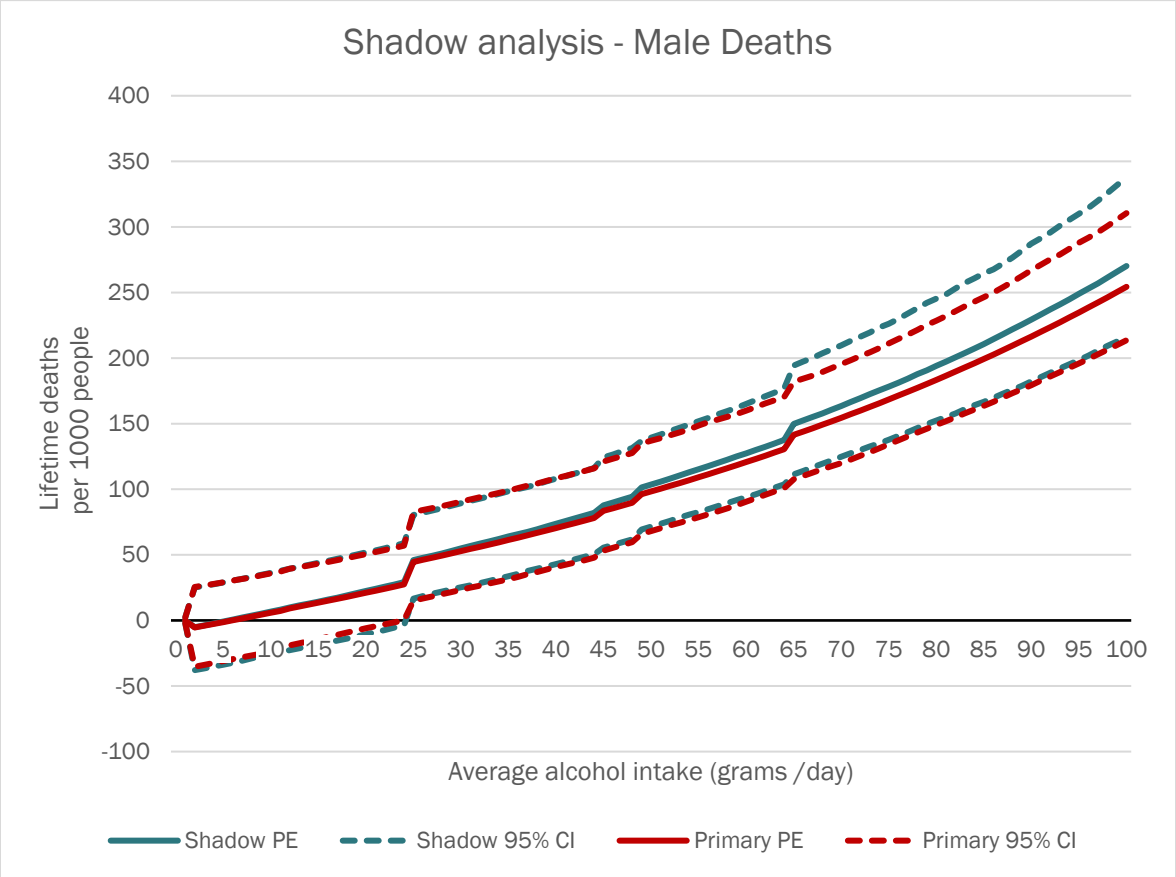
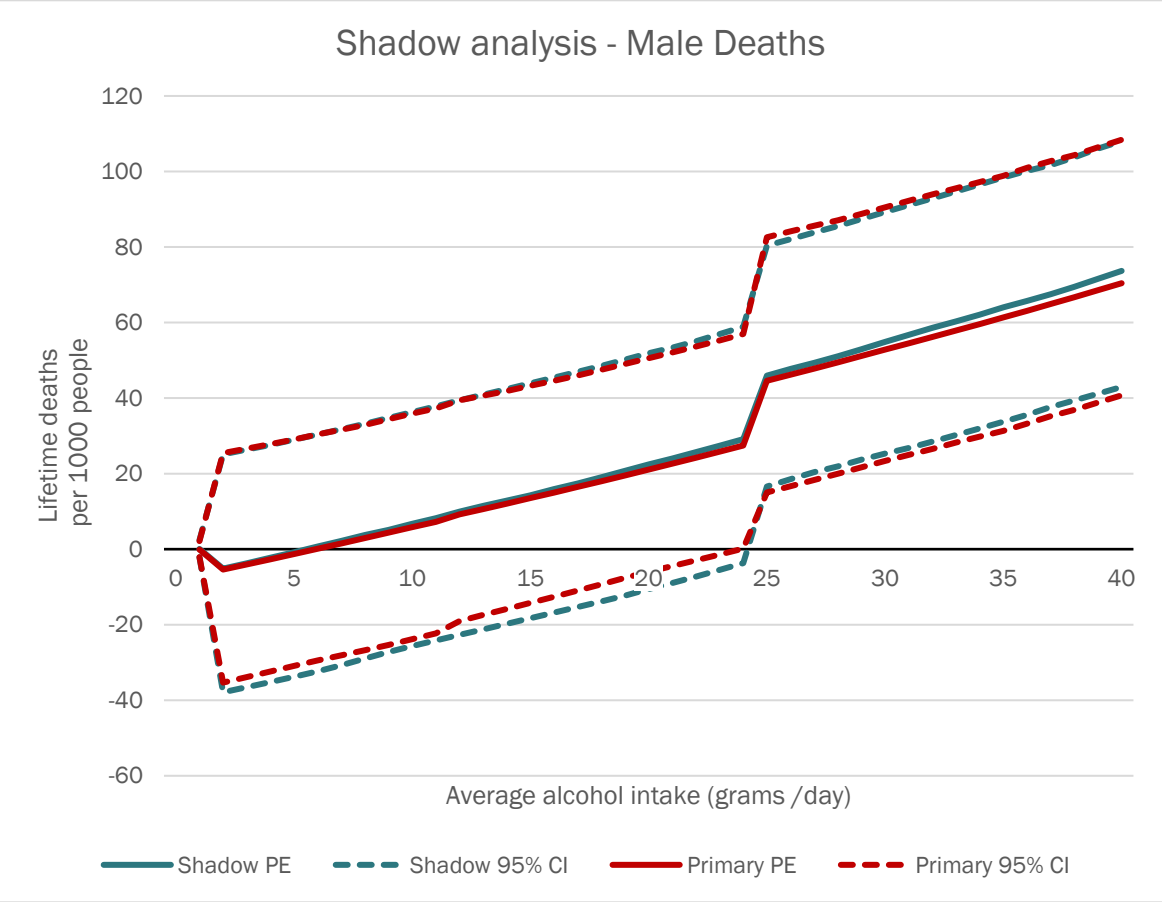


Figure 2: Visual comparison between primary results and shadow results in the category of male death, range of average consumption of from 1 to 40 g ethanol/day



Appendix 2

Table 1. Increased risk of diseases and injuries, with 95% confidence intervals, for females, based on average daily alcohol use

Sex / condition or injury	Alcohol intake (g/day)									
	5	10	15	20	25	30	35	40	45	50
Tuberculosis	1.09 (1.02, 1.17)	1.20 (1.03, 1.38)	1.31 (1.05, 1.62)	1.43 (1.07, 1.90)	1.57 (1.09, 2.23)	1.71 (1.11, 2.62)	1.88 (1.12, 3.08)	2.05 (1.14, 3.61)	2.24 (1.16, 4.24)	2.46 (1.18, 4.98)
Lower respiratory infections	1.02 (1.00, 1.04)	1.05 (1.01, 1.09)	1.07 (1.01, 1.13)	1.10 (1.02, 1.18)	1.13 (1.02, 1.23)	1.15 (1.03, 1.28)	1.18 (1.04, 1.33)	1.21 (1.04, 1.39)	1.24 (1.05, 1.45)	1.27 (1.05, 1.51)
Oral cavity and pharynx cancer	1.13 (1.11, 1.15)	1.28 (1.23, 1.31)	1.44 (1.36, 1.50)	1.61 (1.51, 1.71)	1.81 (1.67, 1.94)	2.03 (1.84, 2.20)	2.26 (2.03, 2.49)	2.52 (2.24, 2.80)	2.81 (2.46, 3.15)	3.12 (2.70, 3.54)
Esophagus cancer	1.07 (1.06, 1.07)	1.14 (1.13, 1.15)	1.22 (1.21, 1.23)	1.30 (1.28, 1.32)	1.39 (1.37, 1.41)	1.48 (1.45, 1.52)	1.58 (1.55, 1.62)	1.69 (1.64, 1.74)	1.80 (1.75, 1.86)	1.93 (1.86, 1.99)
Colorectal cancer	1.03 (1.02, 1.04)	1.07 (1.05, 1.09)	1.11 (1.07, 1.14)	1.14 (1.10, 1.19)	1.18 (1.13, 1.24)	1.23 (1.15, 1.30)	1.27 (1.18, 1.36)	1.31 (1.21, 1.42)	1.36 (1.24, 1.48)	1.40 (1.27, 1.54)
Liver cancer	1.02 (1.01, 1.03)	1.04 (1.02, 1.06)	1.06 (1.03, 1.09)	1.08 (1.04, 1.12)	1.10 (1.05, 1.16)	1.12 (1.06, 1.19)	1.15 (1.07, 1.23)	1.17 (1.08, 1.26)	1.19 (1.09, 1.30)	1.22 (1.10, 1.34)
Breast cancer	1.05 (1.04, 1.06)	1.10 (1.07, 1.12)	1.15 (1.11, 1.19)	1.20 (1.15, 1.25)	1.26 (1.19, 1.33)	1.31 (1.23, 1.40)	1.38 (1.28, 1.49)	1.44 (1.32, 1.57)	1.51 (1.37, 1.66)	1.58 (1.42, 1.76)
Larynx cancer	1.08 (1.06, 1.09)	1.16 (1.11, 1.19)	1.24 (1.18, 1.30)	1.33 (1.24, 1.42)	1.42 (1.31, 1.54)	1.52 (1.38, 1.67)	1.63 (1.46, 1.80)	1.74 (1.54, 1.95)	1.85 (1.62, 2.11)	1.98 (1.70, 2.28)
Pancreatitis	0.87 (0.78, 0.98)	0.77 (0.62, 0.97)	0.72 (0.53, 0.99)	0.72 (0.50, 1.05)	0.76 (0.51, 1.15)	0.85 (0.55, 1.31)	0.98 (0.62, 1.56)	1.15 (0.69, 1.94)	1.35 (0.75, 2.45)	1.58 (0.82, 3.17)
Diabetes Mellitus	0.78 (0.72, 0.85)	0.73 (0.65, 0.82)	0.70 (0.61, 0.80)	0.68 (0.59, 0.79)	0.67 (0.57, 0.79)	0.66 (0.55, 0.78)	0.66 (0.54, 0.79)	0.65 (0.53, 0.80)	0.65 (0.53, 0.81)	0.66 (0.52, 0.81)
Liver cirrhosis	2.09 (1.89, 2.31)	2.82 (2.44, 3.24)	3.55 (2.98, 4.20)	4.31 (3.52, 5.23)	5.11 (4.07, 6.35)	5.97 (4.65, 7.56)	6.88 (5.26, 8.88)	7.85 (5.90, 10.32)	8.90 (6.56, 11.89)	10.01 (7.27, 13.58)
Atrial fibrillation and flutter	1.03 (1.02, 1.04)	1.07 (1.05, 1.08)	1.10 (1.08, 1.13)	1.14 (1.10, 1.17)	1.17 (1.13, 1.22)	1.21 (1.16, 1.27)	1.25 (1.19, 1.32)	1.29 (1.22, 1.38)	1.33 (1.25, 1.43)	1.38 (1.28, 1.49)

Sex / condition or injury	Alcohol intake (g/day)									
	5	10	15	20	25	30	35	40	45	50
Hypertension	1.03 (1.00, 1.05)	1.06 (1.01, 1.11)	1.09 (1.03, 1.15)	1.12 (1.05, 1.19)	1.15 (1.06, 1.24)	1.18 (1.07, 1.30)	1.21 (1.10, 1.34)	1.25 (1.12, 1.39)	1.28 (1.14, 1.43)	1.32 (1.16, 1.50)
Ischemic heart disease	0.95 (0.76, 1.19)	0.95 (0.76, 1.19)	0.95 (0.76, 1.19)	0.95 (0.76, 1.19)	1.04 (0.80, 1.35)	1.04 (0.80, 1.35)	1.04 (0.80, 1.35)	1.04 (0.80, 1.35)	1.07 (0.83, 1.37)	1.07 (0.83, 1.37)
Ischemic stroke	0.90 (0.85, 0.95)	0.90 (0.85, 0.95)	0.92 (0.87, 0.97)	0.92 (0.87, 0.97)	1.08 (1.01, 1.16)	1.08 (1.01, 1.16)	1.08 (1.01, 1.16)	1.08 (1.01, 1.16)	1.08 (1.01, 1.16)	1.14 (1.01, 1.28)
Intracerebral hemorrhage	0.92 (0.77, 1.10)	0.92 (0.77, 1.10)	0.99 (0.83, 1.19)	0.99 (0.83, 1.19)	1.25 (0.92, 1.69)	1.25 (0.92, 1.69)	1.25 (0.92, 1.69)	1.25 (0.92, 1.69)	1.25 (0.92, 1.69)	1.67 (1.26, 2.25)
Subarachnoid hemorrhage	1.21 (0.48, 3.06)	1.21 (0.48, 3.06)	1.11 (0.33, 3.90)	1.11 (0.33, 3.90)	1.39 (0.32, 5.94)	1.39 (0.32, 5.94)	1.39 (0.32, 5.94)	1.39 (0.32, 5.94)	1.39 (0.32, 5.94)	1.82 (0.38, 10.12)
Epilepsy	1.07 (1.05, 1.09)	1.14 (1.10, 1.17)	1.21 (1.16, 1.26)	1.29 (1.21, 1.36)	1.37 (1.27, 1.47)	1.45 (1.33, 1.58)	1.55 (1.40, 1.71)	1.64 (1.46, 1.84)	1.75 (1.54, 1.98)	1.86 (1.61, 2.14)
Road injuries	1.05 (1.02, 1.08)	1.10 (1.04, 1.16)	1.15 (1.07, 1.25)	1.21 (1.09, 1.35)	1.27 (1.11, 1.45)	1.33 (1.14, 1.57)	1.40 (1.16, 1.69)	1.47 (1.19, 1.82)	1.54 (1.22, 1.96)	1.62 (1.24, 2.11)
Other unintentional injuries	1.04 (1.03, 1.05)	1.08 (1.06, 1.10)	1.12 (1.09, 1.16)	1.17 (1.12, 1.22)	1.21 (1.15, 1.28)	1.26 (1.18, 1.35)	1.31 (1.21, 1.42)	1.36 (1.25, 1.49)	1.42 (1.28, 1.56)	1.47 (1.32, 1.64)
Intentional injuries	1.13 (1.10, 1.16)	1.28 (1.21, 1.36)	1.45 (1.34, 1.58)	1.65 (1.47, 1.84)	1.87 (1.62, 2.15)	2.11 (1.79, 2.50)	2.39 (1.97, 2.91)	2.71 (2.17, 3.39)	3.07 (2.39, 3.95)	3.48 (2.63, 4.60)

Table 2. Increased risk of diseases and injuries, with 95% confidence intervals, for males, based on average daily alcohol use

Sex / condition or injury	Alcohol intake (g/day)									
	5	10	15	20	25	30	35	40	45	50
Tuberculosis	1.09 (1.02, 1.18)	1.20 (1.04, 1.38)	1.31 (1.06, 1.63)	1.43 (1.08, 1.91)	1.57 (1.10, 2.25)	1.71 (1.12, 2.64)	1.88 (1.15, 3.11)	2.05 (1.17, 3.66)	2.24 (1.19, 4.30)	2.46 (1.21, 5.05)
Lower respiratory infections	1.02 (1.01, 1.05)	1.05 (1.01, 1.09)	1.07 (1.02, 1.14)	1.10 (1.02, 1.19)	1.13 (1.03, 1.25)	1.15 (1.03, 1.30)	1.18 (1.04, 1.36)	1.21 (1.04, 1.42)	1.24 (1.05, 1.48)	1.27 (1.05, 1.55)
Oral cavity and pharynx cancer	1.13 (1.11, 1.15)	1.28 (1.24, 1.32)	1.44 (1.37, 1.51)	1.61 (1.52, 1.72)	1.81 (1.68, 1.95)	2.03 (1.86, 2.22)	2.26 (2.05, 2.51)	2.52 (2.25, 2.83)	2.81 (2.48, 3.18)	3.12 (2.73, 3.58)
Esophagus cancer	1.07 (1.06, 1.07)	1.14 (1.13, 1.15)	1.22 (1.21, 1.23)	1.30 (1.28, 1.32)	1.39 (1.36, 1.42)	1.48 (1.45, 1.52)	1.58 (1.54, 1.63)	1.69 (1.64, 1.74)	1.80 (1.75, 1.87)	1.93 (1.86, 2.00)
Colorectal cancer	1.03 (1.03, 1.04)	1.07 (1.05, 1.09)	1.11 (1.08, 1.14)	1.14 (1.11, 1.19)	1.18 (1.13, 1.24)	1.23 (1.16, 1.30)	1.27 (1.19, 1.35)	1.31 (1.22, 1.41)	1.36 (1.25, 1.48)	1.40 (1.29, 1.54)
Liver cancer	1.02 (1.01, 1.03)	1.04 (1.02, 1.06)	1.06 (1.03, 1.09)	1.08 (1.04, 1.12)	1.10 (1.05, 1.16)	1.12 (1.06, 1.19)	1.15 (1.07, 1.23)	1.17 (1.08, 1.26)	1.19 (1.09, 1.30)	1.22 (1.11, 1.34)
Breast cancer	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
Larynx cancer	1.08 (1.06, 1.09)	1.16 (1.11, 1.20)	1.24 (1.18, 1.30)	1.33 (1.24, 1.42)	1.42 (1.31, 1.54)	1.52 (1.38, 1.67)	1.63 (1.45, 1.82)	1.74 (1.53, 1.97)	1.85 (1.62, 2.13)	1.98 (1.70, 2.29)
Pancreatitis	1.09 (1.05, 1.13)	1.19 (1.10, 1.28)	1.30 (1.16, 1.44)	1.41 (1.21, 1.63)	1.54 (1.27, 1.85)	1.68 (1.34, 2.09)	1.84 (1.40, 2.36)	2.00 (1.47, 2.67)	2.18 (1.54, 3.02)	2.38 (1.62, 3.41)
Diabetes Mellitus	1.00 (1.00, 1.00)	1.00 (1.00, 1.01)	1.00 (0.99, 1.02)	1.01 (0.98, 1.03)	1.01 (0.98, 1.05)	1.01 (0.97, 1.06)	1.02 (0.97, 1.08)	1.02 (0.97, 1.09)	1.03 (0.97, 1.10)	1.04 (0.97, 1.11)
Liver cirrhosis	1.16 (1.13, 1.18)	1.33 (1.28, 1.38)	1.53 (1.45, 1.62)	1.76 (1.63, 1.90)	2.02 (1.84, 2.22)	2.32 (2.08, 2.60)	2.67 (2.35, 3.05)	3.07 (2.66, 3.57)	3.53 (3.00, 4.19)	4.06 (3.39, 4.91)
Atrial fibrillation and flutter	1.03 (1.02, 1.04)	1.07 (1.05, 1.08)	1.10 (1.08, 1.13)	1.14 (1.10, 1.17)	1.17 (1.13, 1.22)	1.21 (1.16, 1.27)	1.25 (1.19, 1.32)	1.29 (1.21, 1.37)	1.33 (1.24, 1.42)	1.38 (1.27, 1.48)

Sex / condition or injury	Alcohol intake (g/day)									
	5	10	15	20	25	30	35	40	45	50
Hypertension	1.07 (1.04, 1.10)	1.15 (1.09, 1.22)	1.19 (1.13, 1.26)	1.23 (1.16, 1.32)	1.28 (1.20, 1.37)	1.32 (1.23, 1.43)	1.34 (1.25, 1.46)	1.36 (1.27, 1.48)	1.38 (1.28, 1.50)	1.40 (1.30, 1.53)
Ischemic heart disease	0.95 (0.76, 1.20)	0.95 (0.76, 1.20)	0.95 (0.76, 1.20)	0.95 (0.76, 1.20)	1.04 (0.81, 1.36)	1.04 (0.81, 1.36)	1.04 (0.81, 1.36)	1.04 (0.81, 1.36)	1.07 (0.82, 1.41)	1.07 (0.82, 1.41)
Ischemic stroke	0.92 (0.87, 0.97)	0.92 (0.87, 0.97)	0.92 (0.87, 0.97)	0.92 (0.87, 0.97)	1.08 (1.02, 1.15)	1.08 (1.02, 1.15)	1.08 (1.02, 1.15)	1.08 (1.02, 1.15)	1.08 (1.02, 1.15)	1.14 (1.01, 1.27)
Intracerebral hemorrhage	0.92 (0.78, 1.11)	0.92 (0.78, 1.11)	0.99 (0.82, 1.19)	0.99 (0.82, 1.19)	1.25 (0.93, 1.68)	1.25 (0.93, 1.68)	1.25 (0.93, 1.68)	1.25 (0.93, 1.68)	1.25 (0.93, 1.68)	1.67 (1.24, 2.22)
Subarachnoid hemorrhage	1.21 (0.51, 2.81)	1.21 (0.51, 2.81)	1.11 (0.32, 4.00)	1.11 (0.32, 4.00)	1.39 (0.25, 6.42)	1.39 (0.25, 6.42)	1.39 (0.25, 6.42)	1.39 (0.25, 6.42)	1.39 (0.25, 6.42)	1.82 (0.32, 10.36)
Epilepsy	1.07 (1.06, 1.09)	1.14 (1.11, 1.17)	1.21 (1.16, 1.26)	1.29 (1.22, 1.36)	1.37 (1.28, 1.47)	1.45 (1.35, 1.59)	1.55 (1.41, 1.71)	1.64 (1.48, 1.85)	1.75 (1.56, 1.99)	1.86 (1.64, 2.15)
Road injuries	1.08 (1.06, 1.09)	1.16 (1.12, 1.20)	1.25 (1.19, 1.31)	1.34 (1.26, 1.43)	1.44 (1.34, 1.56)	1.56 (1.42, 1.71)	1.67 (1.50, 1.87)	1.80 (1.60, 2.04)	1.94 (1.69, 2.23)	2.09 (1.79, 2.44)
Other unintentional injuries	1.04 (1.03, 1.05)	1.08 (1.06, 1.10)	1.12 (1.09, 1.16)	1.17 (1.12, 1.22)	1.21 (1.15, 1.28)	1.26 (1.18, 1.35)	1.31 (1.22, 1.42)	1.36 (1.25, 1.49)	1.42 (1.28, 1.56)	1.47 (1.32, 1.64)
Intentional injuries	1.13 (1.10, 1.16)	1.28 (1.21, 1.36)	1.45 (1.33, 1.58)	1.65 (1.47, 1.84)	1.87 (1.62, 2.14)	2.11 (1.78, 2.49)	2.39 (1.96, 2.90)	2.71 (2.16, 3.38)	3.07 (2.38, 3.93)	3.48 (2.62, 4.58)

Appendix 3

Specific messages for girls and women to supplement the Guidance on Alcohol and Health

It is important for girls and women to know:

- There are risks of alcohol use for both men and women, but it is not a level playing field, as alcohol affects women 's bodies more negatively
- Alcohol is processed by women's bodies differently, causing more negative health effects, earlier, after lesser amounts of alcohol
- Women become intoxicated faster after drinking less than men due to smaller bodies and organs, less body water, hormonal effects, and different enzyme actions that break down alcohol
- Alcohol has more serious health effects on females than males, due to body size, body fat/water ratio, hormonal effects and differing actions of enzymes that break down alcohol
- Alcohol consumption increases risk of breast cancer, a very common cancer in Canadian women
- Women experience more liver injuries on lower levels of alcohol, compared to men

It is important for girls and women to know:

- Perpetrators of sexual assault often target someone who has been drinking alcohol or is intoxicatedWomen often use alcohol to cope with the stress of trauma, IPV and caregiving, which can lead to poorer, not better health
- Girls and women with histories of childhood abuse progress more quickly from starting to drink to becoming alcohol dependent

And some ideas for the pregnancy-related messages:

- Alcohol use in pregnancy negatively affects both women's and fetal health
- There is no safe level of alcohol use in pregnancy, so it is safest not to drink at all while pregnant
- The more alcohol consumed, the greater the risk of harm for women's and fetal health
- Alcohol use in pregnancy especially when combined with poor nutrition and tobacco use can result in infant death, birth defects, and lifelong behavioural and cognitive problems
- Alcohol use in pregnancy can increase the risk of miscarriage.