Assessment of the burden of diseases and injuries attributable to risk factors in Canada from 1990 to 2016

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ABSTRACT

Background: An understanding of the risk factors contributing to significant health issues in Canada is critical for informing national health policy.

Methods: We conducted a systematic analysis of the epidemiology describing disease states and injuries in relation to risk factors in Canada as part of the Global Burden of Disease study. Disease burden (metrics were disability-adjusted life years [DALYs, "healthy years of life lost"], total deaths, and years lived with disability [YLDs]) attributable to each metabolic, environmental, and behavioural risk factor was determined and ranked for the year 2016, with further examination of changes over time from 1990 to 2016.

Results: In 2016, for all Canadians combined, the risk factors accounting for the largest percentage of DALYs were (1) tobacco, (2) diet, (3) high body-mass index (BMI), (4) high fasting plasma glucose (FPG), (5) high systolic blood pressure, (6) alcohol and drug use, (7) occupational risks, (8) high total cholesterol, (9) impaired kidney function, and (10) air pollution. Rankings of the top risk factor rates remained similar from 1990 to 2016 despite some substantial declines in the burden attributable to these risks, including a 47% decline in the age-standardized DALY rate attributable to tobacco since 1990. Risk factors with increasing contribution to DALY rates from 1990 to 2016 include high BMI, high FPG, and alcohol and drug use.

Interpretation: Metabolic and behavioural risk factors, including modifiable factors such as tobacco use and diet, remain the leading risk factors contributing to the burden of diseases and injuries in Canada since 1990.

INTRODUCTION

In Canada, modifiable behavioural factors such as smoking, diet, and physical activity are major determinants of life expectancy,[1] indicating that actionable preventive strategies can lead to improved health outcomes. An understanding of Canada's foremost health problems, their risk factors, and how both are changing over time is crucial to inform national health policy and programs. However, disease burden has traditionally been defined in terms of mortality alone, which misses additional health burden, such as living with a disability. It is difficult for policymakers and researchers to set priorities when disparate diseases and injuries affect population health in diverse ways, and the measurement of their contributions to health burden is not standardized. Therefore, an analysis that examines health loss from both disability and death on the same scale in relation to attributable risk factors is warranted.

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) is a systematic, scientific effort to quantify the comparative magnitude of health loss due to disease, injuries, and risk factors throughout the world to inform evidence-based policymaking.[2] In the GBD, the goal is not just to measure which diseases or injuries cause death, but also to measure which diseases and injuries prevent someone from living a productive, active, and full life.[3]

Worldwide, life expectancy is increasing, and the burden of disease is shifting from infectious to chronic diseases; changes in the distribution of risk factors are one of the factors driving this shift, especially among high-income countries.[4] GBD estimates have recently been summarized for some countries, including the US[5] and the UK.[6] However, the estimates for Canada have not yet been similarly presented. The objective of this paper is to identify the leading risk factors associated with the burden of diseases and injuries in Canada from 1990 to 2016.

METHODS

We examined GBD data for Canada from 1990 to 2016. The GBD study is led by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington with the goal of systematically quantifying the global health loss due to diseases, injuries, and risk factors to inform evidence-based policymaking.[7] The key principles, methodologies, and assumptions of the GBD study have been reported elsewhere;[8-13] a brief overview of the strategy for comparative risk assessment is provided below.

For each disease, injury, and risk factor, GBD estimates the relative risk and risk factor exposure frequencies by collecting and analyzing a continuous stream of the most up-to-date data available from over 20,000 randomized controlled trials, cohorts, household surveys, census data, vital registration data, satellite data, and other resources.[14] The GBD analytic team extracts data into centralized databases to model specific diseases, injuries, and risk factors. The Canadian data are pooled from over 600 sources of data, of which 133 were used for the risk factors assessment (listed in **Supplementary Table 1**). Details of the statistical models used to pool data, adjust for bias, and incorporate covariates have been published elsewhere.[14] The GBD study is compliant with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER), a set of guidelines that promote best practices in reporting health estimates.[15] Figures are generated using the GBD Compare data visualization tool, which is publicly available (http://vizhub.healthdata.org/gbd-compare).[16] Burden estimates are accompanied by 95% uncertainty intervals that incorporate both sampling error and error from model estimation.

Measurement of burden

This paper measures and reports health loss through three well-established metrics previously described:[9,11] (1) a summation of premature death and disability (disability-adjusted life years [DALYs]); (2) death (total deaths); and (3) disability (years of life lived with disability [YLDs][17-19]). One DALY is equivalent to one year of healthy life (free of disease, injury, or disability) lost.[9]

Selection of risk factors

In the GBD study, a risk is an attribute, behaviour, exposure, or another factor causally associated with an increased probability of developing a disease or experiencing an injury. The GBD risk factors team evaluated 2,579 studies to establish causality for 481 risk-outcome pairs that met the World Cancer Research Fund evidence grading criteria for evidence[15] that is biologically plausible and shows consistent associations between exposure and disease, with little or no evidence to the contrary. The primary sources of evidence were independent prospective studies, such as randomized controlled trials, non-randomized interventions, and cohort studies.[15]

We used a comparative risk assessment (CRA) conceptual framework that employs a causal web in which the risks that are responsible for the health outcomes are organized into four hierarchical, mutually exclusive and collectively exhaustive levels.[20,14] Level 1 includes three categories of risk factors (behavioural, environmental and occupational, and metabolic) that distribute into 17 Level 2 risk factors as either single risks or risk clusters (**Supplementary Table 2**). While not included within the scope of this present paper, Levels 3 and 4 have 50 and 67 risk factors, respectively.

Attributable burden estimation

The calculation of attributable burden for a risk factor has four components: exposure levels for the risk, the relative risk of a health outcome related to the risk exposure, a counterfactual (in this case, optimal) level of risk factor exposure, and the burden metric (DALYs, number of deaths, or YLDs).[14] For example, to estimate the burden of diabetes due to high body-mass index (BMI), the exposure level will be the mean, standard deviation, and shape of BMI distribution by age, sex, country, and year. The relative risk is the incidence and mortality due to diabetes per level increase in BMI. The counterfactual level of the risk factor exposure is the optimal BMI exposure level that minimizes risk for everyone in the population, called theoretical minimum risk exposure level (TMREL). These input data are used to estimate the population attributable fraction (PAF), which is the proportion of the disease burden that could have been prevented if the BMI was at the TMREL or optimal level. The PAF is then multiplied by the disease-specific burden metric to obtain attributable disease burden for each risk-outcome pair.

Decomposition analysis

To explain the drivers of our observed trends in Canada's risk-attributable disease and injury burden, we conducted a decomposition analysis to examine the percentage change in Canada's risk-attributable DALYs over time due to (1) population growth; (2) population aging; (3) risk-deleted mortality rates (the expected mortality that would be observed if all risk factors included in GBD 2016 were removed); and (4) exposure to all risk factors included in GBD 2016. Methods were based on those of Das Gupta[21] and adapted for GBD as described elsewhere.[12]

RESULTS

In Canada 39.6% (36.9–42.3) of DALYs, 56.0% (53.6–58.2) of deaths, and 24.2% (22.7–25.8) of YLDs could be attributed to risk factors assessed in 2016.

Top 10 risk factors for attributable DALYs

In 2016, the 10 leading risk factors in Canada contributing to DALYs (% of total DALYs [95% UI]) were tobacco (10.6% [9.4–11.9]), dietary risks (9.4% [7.7–11.2]), high BMI (9.0% [6.2–11.8]), high FPG (7.3% [5.8–9.2]), high systolic blood pressure (SBP, 7.1% [6.0–8.2]), alcohol and drug use (6.9% [5.8–8.1]), occupational risks (4.8% [4.4–5.3]), high total cholesterol (3.7% [2.9–4.6]), impaired kidney function (2.1% [1.9–2.3]), and air pollution (1.3% [1.0–1.7]) (**Figure 1**). Women and men were similar in the leading risk factors related to DALYs, except for alcohol and drug use (ranked higher for men) and high SBP (ranked higher for women). Stratification by age group also revealed differences in risk factor attribution (Supplementary Figures 7 and 8).

Top five risk factors for attributable deaths and YLDs

In terms of total deaths in Canada, the five leading attributable risk factors (% of total deaths [95% UI]) were dietary risks (17.6% [14.7–20.5]), tobacco (17.5% [16.6–18.5]), high SBP (14.7% [12.3–17.2]), high FPG (11.2% [7.9–15.3]), and high BMI (10.8% [6.9–15.0]) (**Figure 2**). Dietary and tobacco risk factors were the largest contributors to deaths in Canada, responsible for 47,947 (95% UI: 39,935–56,181) and 47,737 (44,704–51,114) deaths,

respectively. High BMI was the top risk factor contributing to YLDs in Canada (7.3% [5.1–9.4]), followed by high FPG (5.5% [4.8–6.3]) and alcohol and drug use (5.4% [4.5–6.5]) (**Figure 3**).

Trends from 1990 to 2016 for DALYs, deaths, and YLDs

Since 1990, exposure to tobacco has continued to be the leading risk factor for DALYs even though a 26% decline in the attributable all-age DALY rate and a 47% decline in the age-standardized DALY rate were observed over the last 26 years (**Figure 4**). High BMI and high FPG have both increased in ranking to become the third and fourth leading risk factors. Alcohol and drug use attributable all-age and age-standardized DALY rates have increased by 13% and 9% since 1990. The all-age attributable DALY rate for high SBP and high cholesterol have decreased by 34% and 44% since 1990, leading to improvements in their respective rankings.

Among the leading risk factors contributing to total deaths, the only risk factor contributing to a substantial increase in the death rate from 1990 to 2016 was high BMI, which increased by 22% (**Figure 5**). Alcohol and drug use ranked ninth as an attributable risk for deaths, but its contribution to the all-age and age-standardized death rates has risen by 66% and 36%, respectively, since 1990. The risk factors contributing to YLDs have changed from 1990, with high BMI and high FPG becoming the top two risk factors, reflecting a 61% and 40% increase in the all-age attributable YLD rates associated with these risk factors (**Figure 6**).

Drivers of observed trends in risk-attributable DALYs

Our decomposition analysis separated out the relative contributions of risk factors from those of population growth, aging, and risk-deleted mortality rate, revealing that risk factor exposure related to communicable and non-communicable diseases is on the decrease in Canada,

while the percentage of injuries due to risk factor exposure is increasing (**Figure 7**). For all ages together, exposure to risk factors is accountable for a decreasing percentage of health burden in Canada. However, stratification by age group reveals that exposure to risk factors is accountable for an increasing percentage of health burden in Canadians aged 5-9 and 20-39 years.

INTERPRETATION

Of the risk factors included in our GBD study data, the top two risk factors related to health burden in Canada are tobacco and diet. We observed that this ranking has remained relatively unchanged since 1990, despite simultaneously detecting a substantial decline in burden due to diet and especially tobacco in the last 26 years. Although still a leading risk factor, tobacco exposure as a burden for DALYs was much lower in Canadians younger than 49 years, which is consistent with historical patterns of tobacco use and the longer latency period of lung cancer and other tobacco-related diseases.[22,23] Dietary risk has remained the second highest risk factor over the last two decades, contributing to large amounts of DALYs caused by ischemic heart disease, stroke, and diabetes in Canada,[16] and relating to intermediary risk factors including high BMI and high FPG,[12] which are now the third and fourth most significant causes of health loss. High SBP and high total cholesterol have decreased, but they remain important risk factors, along with alcohol and drug use.

Comparison to previous studies

Few previous studies have undertaken the task of identifying the top attributable risk factors to disease burden in Canada, and those that did focused primarily on mortality as an outcome. For example, the results of the present study are comparable to recently published

findings from the Mortality Population Risk Tool (MPoRT), which reported that 50% of deaths in Canada could be attributed to the four behavioural risk factors they assessed (smoking, unhealthy alcohol consumption, physical inactivity, and poor diet).[1] Similar to results from our analysis, smoking was the leading unhealthy behaviour contributing to deaths for men, despite a continuing decrease in the prevalence of smoking in Canada.[1] Steensma *et al*. also demonstrated significant health loss in the Canadian population associated with high BMI.[24] A 2006 analysis reported that alcohol is a major contributor to mortality in Canada,[25] as we also observed in the present study, and as was reported in a previous (2005) GBD analysis of the premature mortality attributable to alcohol consumption in Canada.[26] Recent analyses of the American GBD study data[5] and UK GBD study data[6] also reported that the two leading risk factors contributing to health burden were tobacco and dietary factors.[5]

Limitations

A study of this size and scope has several limitations, many of which have been previously addressed in other GBD publications.[2,17] The present analysis used Canadian data from numerous sources across the country; however, important sources of data may not have been included in the GBD study yet. Our aim is that this current analysis will be the first in an ongoing assessment of the burden of disease in Canada and that with each iteration, our analysis will benefit from newly identified or collected data sources. One major limitation to the interpretation of our study's findings is that we could not incorporate data on the social determinants of health (such as housing, income, ethnicity, and education) that strongly influence risk factors[27,28] and differ vastly by community.[29,30] Obtaining such adequately detailed data is a future goal of ours, given that social determinants of health have been shown to be crucially

important to population health.[31,32,33] There may also be other risk factors that are important but not included in the GBD, including psychosocial factors such as social isolation and loneliness.[34,35] Another limitation is that some diseases, such as depression and migraines, have high burden and prevalence, but little to no risk factor attributions in the present analysis. The present study did not assess why risk factors rose or fell in their rankings, which could represent a worsening scenario or an improvement in other areas.

Conclusion and future directions

The present GBD Canada study, with its multiple countrywide data sources and comprehensive analysis of both disability and premature death on the same scale in relation to risk factors, provides a unique assessment and ranking of the risk factors attributable to health loss in Canada. Modifiable metabolic and behavioural risk factors such as tobacco and diet have remained the leading risk factors in Canada for the last 26 years, identifying opportunities for reducing Canada's health burden. These findings stand despite some substantial declines in risk factor exposure, indicating that risk factors can influence the population for a substantial length of time, and that decreasing health burden for Canadians requires a long-term commitment to risk reduction. Future analyses are warranted that focus on specific risk factors, detailing their complexities. For example, our present analysis did not specify the precise dietary factors (such as lack of fruit, excess sweetened beverages) that contribute to health burden and could be a target for new policy. Another area of high burden where a future detailed analysis could lead to enhanced action for population health benefits is drug use, especially given the recent opioid-related burden and incoming cannabis legalization. Canadian GBD data provide inimitable insight into the relative magnitude of many important risk factors' contribution to health loss and

can guide decision-makers as they identify the priorities and opportunities for reducing premature death and disability burden among Canadians.

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FIGURE TITLES

Please note: *Figures 1-3 share the same set-up and legend and work well as one 3-part figure to save considerable space and have a nice visual comparison (this figure would be entitled 'Burden of disease attributable to leading risk factors for all Canadians in 2016 expressed as a percentage of (A) disability-adjusted life years (DALYs), (B) total deaths, and (C) years lived with disability (YLDs)'. Similarly, figures 4-6 share the same set-up and legend and could nicely be made as 1 figure with parts A, B, and C to save space and have a visual comparison. We have these figures listed separately as 6 figures in this version so that you can match the corresponding supplementary figures which are stratified into men and women. However, we could have less figures and less supplementary figures, if you would prefer.*

Figure 1. Burden of disease attributable to leading risk factors for all Canadians in 2016 expressed as a percentage of disability-adjusted life years (DALYs).

Figure 2. The burden of disease attributable to leading risk factors for Canadians in 2016 expressed as a percentage of total deaths.

Figure 3. The burden of disease attributable to leading risk factors for Canadians in 2016 expressed as a percentage of years lived with disability (YLDs).

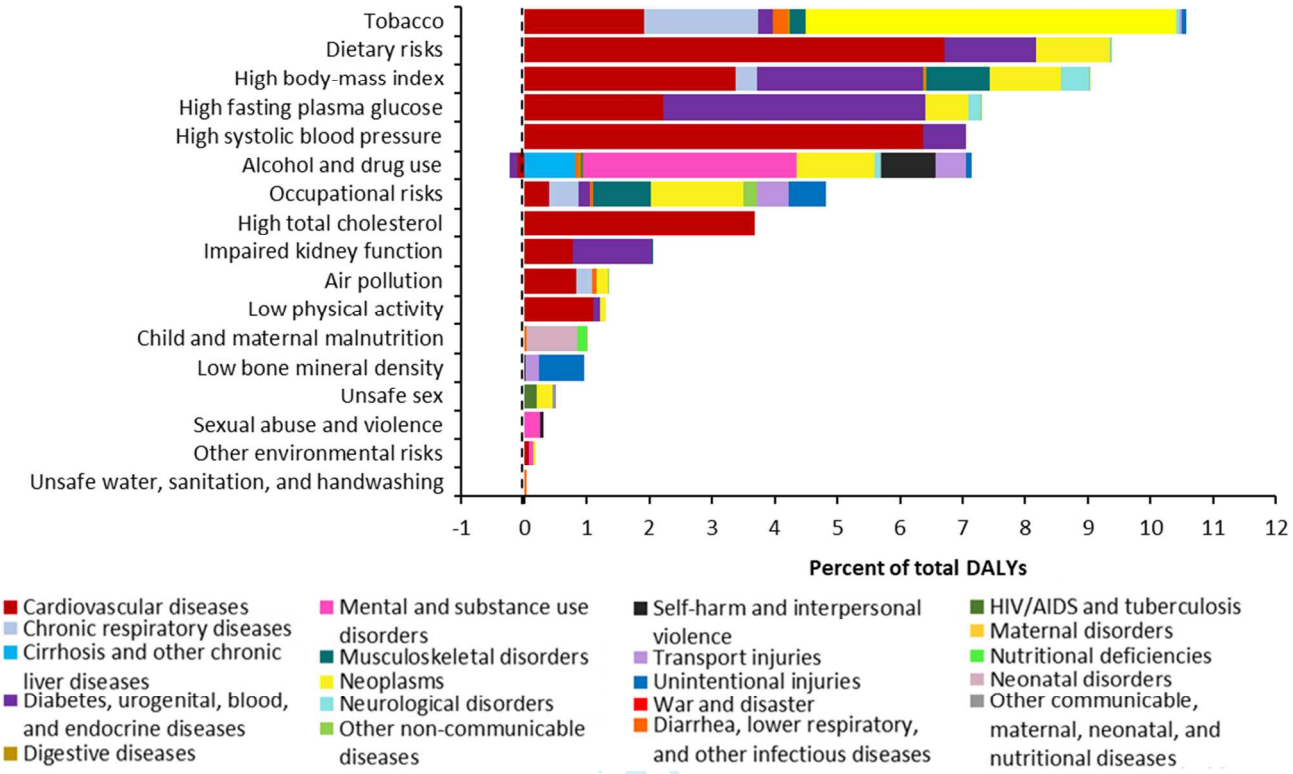
Figure 4. Rank changes in disability-adjusted life years (DALYs) attributable to leading risk factors and percent change in all-age and age-standardized DALY rates in Canada from 1990-2016.

Figure 5. Rank changes of total deaths attributable to leading risk factors and percent change in all-age and age-standardized death rates in Canada between 1990-2016 for females and males combined.

Figure 6. Rank changes of years lived with disability (YLDs) attributable to leading risk factors and percent change in all-age and age-standardized YLD rates in Canada between 1990-2016 for females and males combined.

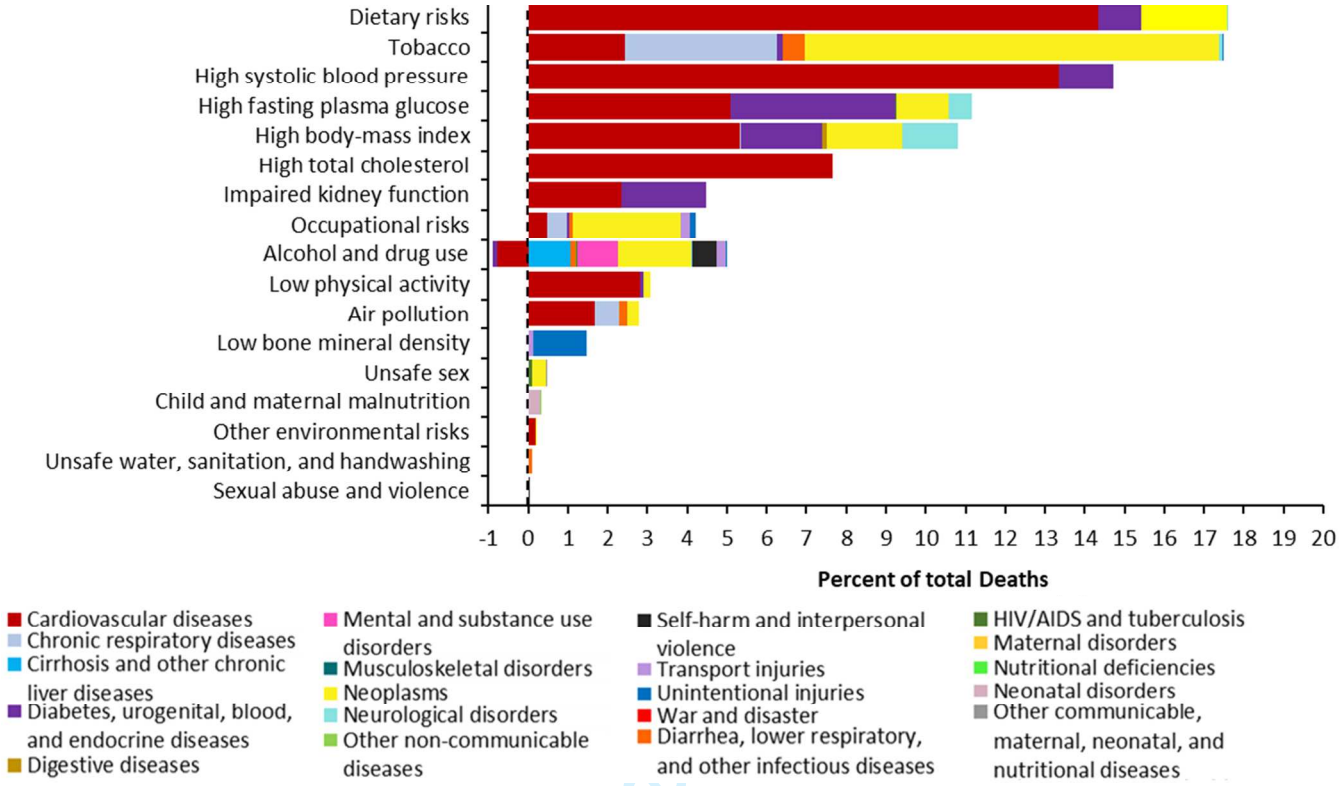
Figure 7. Drivers of percent changes in Canada's risk-attributable disease and injury burden from 2006 to 2016 due to population growth, population aging, risk-deleted mortality, and exposure to risk factors expressed as (A) disability-adjusted life years (DALYs) for all ages, (B) deaths for all ages and (C) DALYs by age group.

Figure 1. Burden of disease attributable to leading risk factors for all Canadians in 2016 expressed as a percentage of disability-adjusted life years (DALYs)



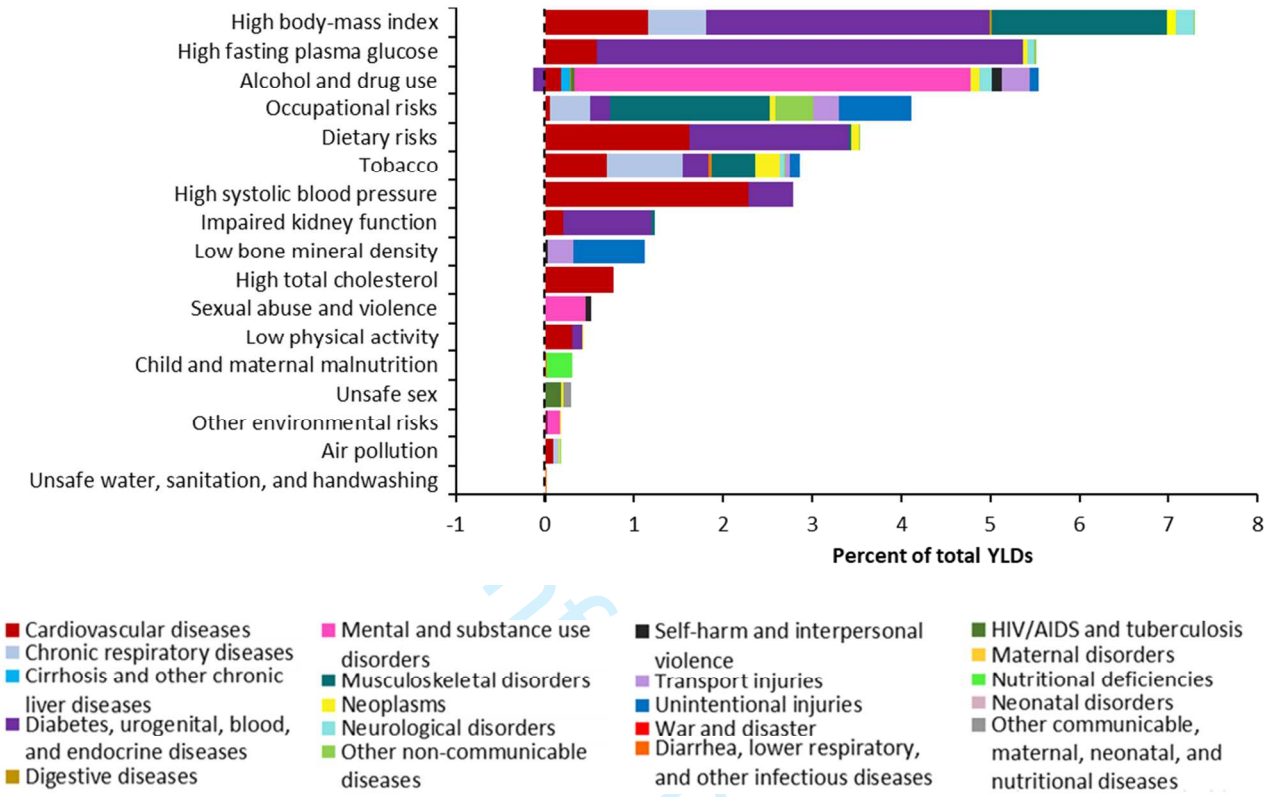
One DALY is equivalent to one year of healthy life (free of disease, injury, or disability) that has been lost.

Figure 2. The burden of disease attributable to leading risk factors for Canadians in 2016 expressed as a percentage of total deaths



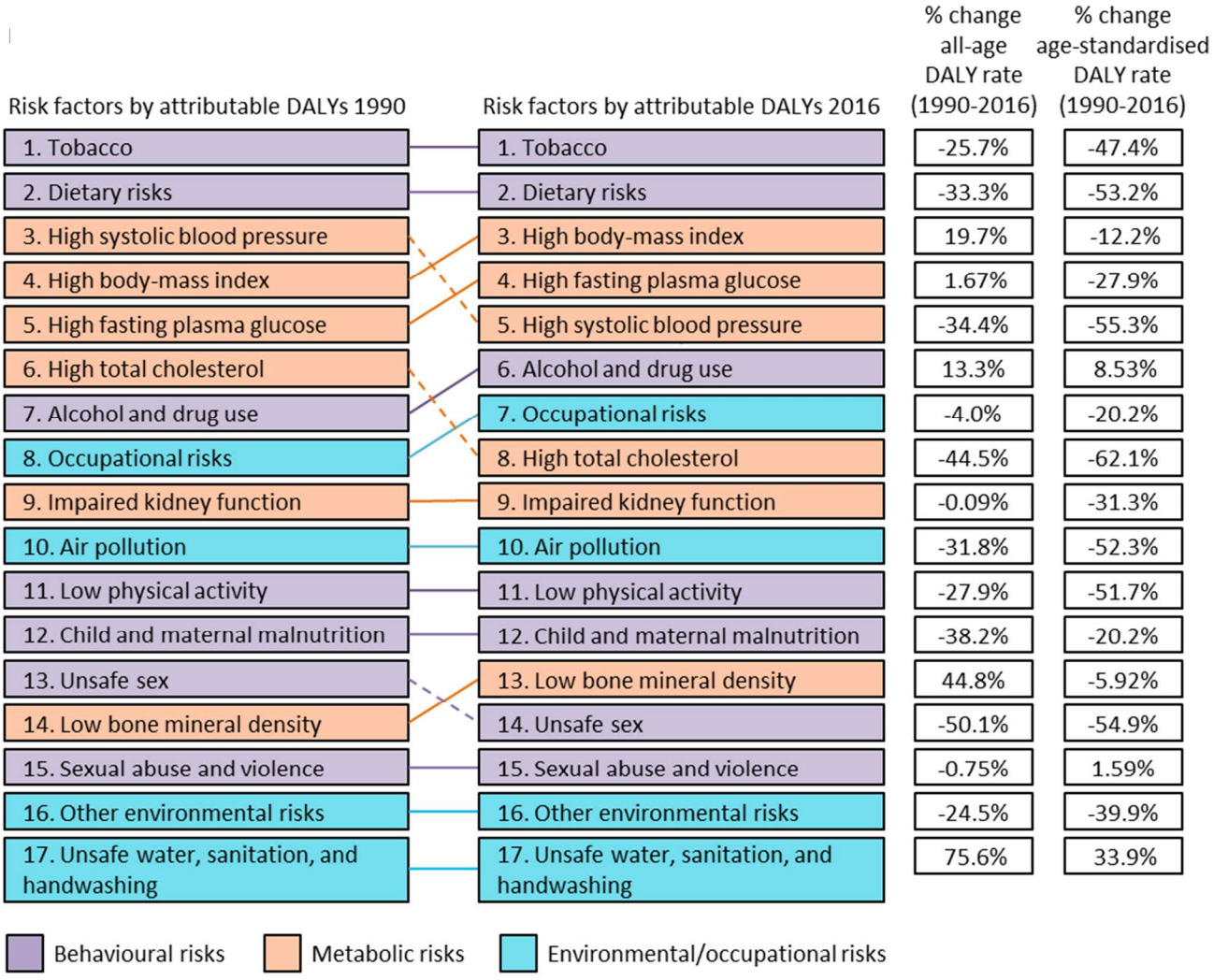
The negative percentage for alcohol is the protective effect of mild alcohol use on risk of cardiometabolic disease.

Figure 3. The burden of disease attributable to leading risk factors for Canadians in 2016 expressed as a percentage of years lived with disability (YLDs)



The negative percentage for alcohol is the protective effect of mild alcohol use on risk of cardiometabolic disease.

Figure 4. Rank changes in disability-adjusted life years (DALYs) attributable to leading risk factors and percent change in all-age and age-standardized DALY rates in Canada from 1990 to 2016



One DALY is equivalent to one year of healthy life (free of disease, injury, or disability) that has been lost.

Figure 5. Rank changes of total deaths attributable to leading risk factors and percent change in all-age and age-standardized death rates in Canada between 1990 and 2016 for females and males combined

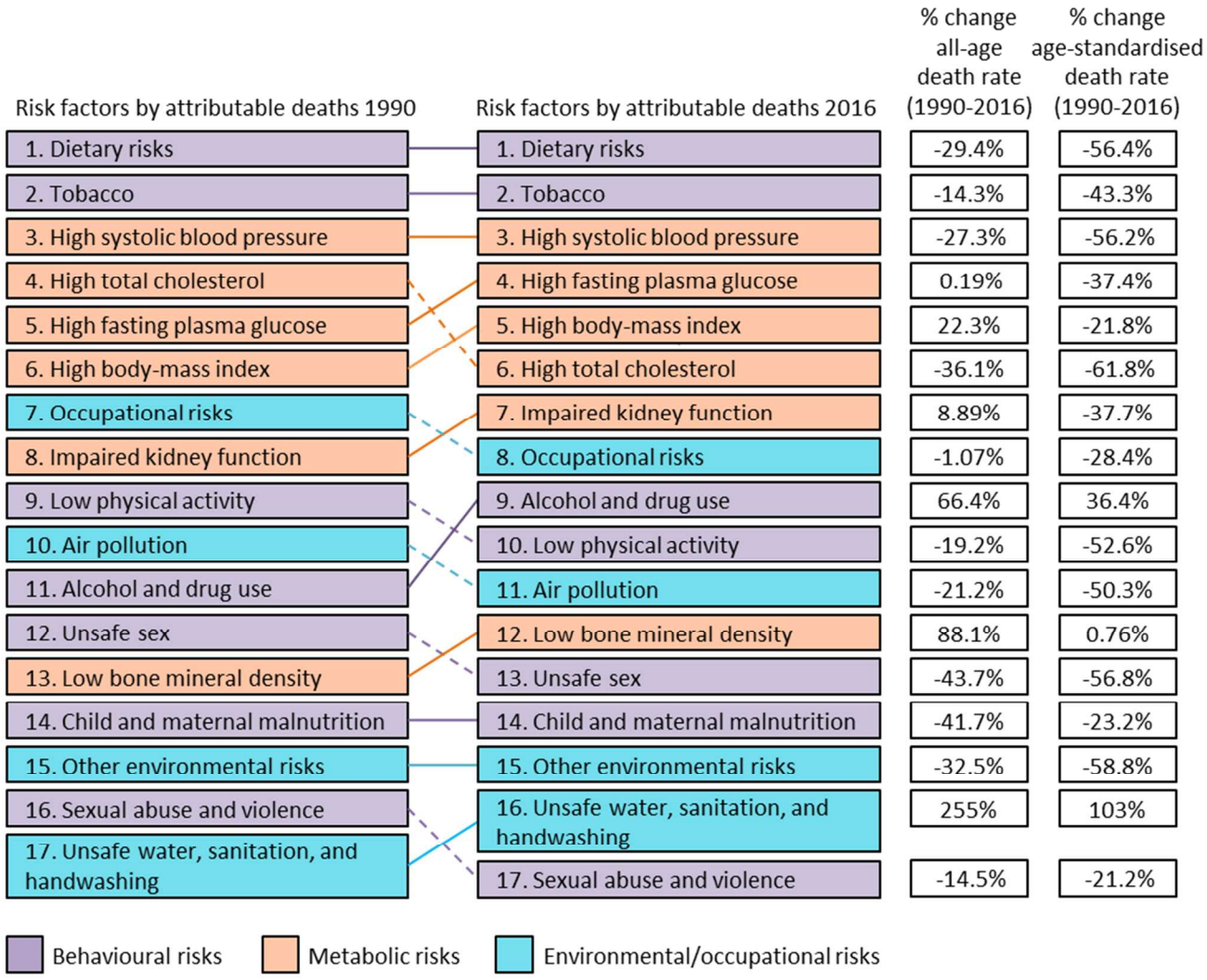
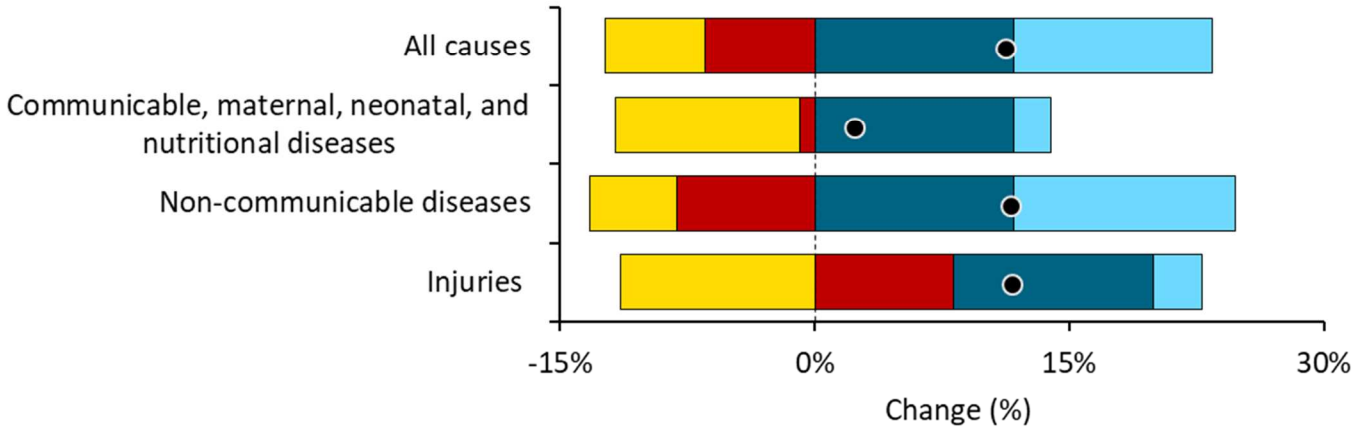


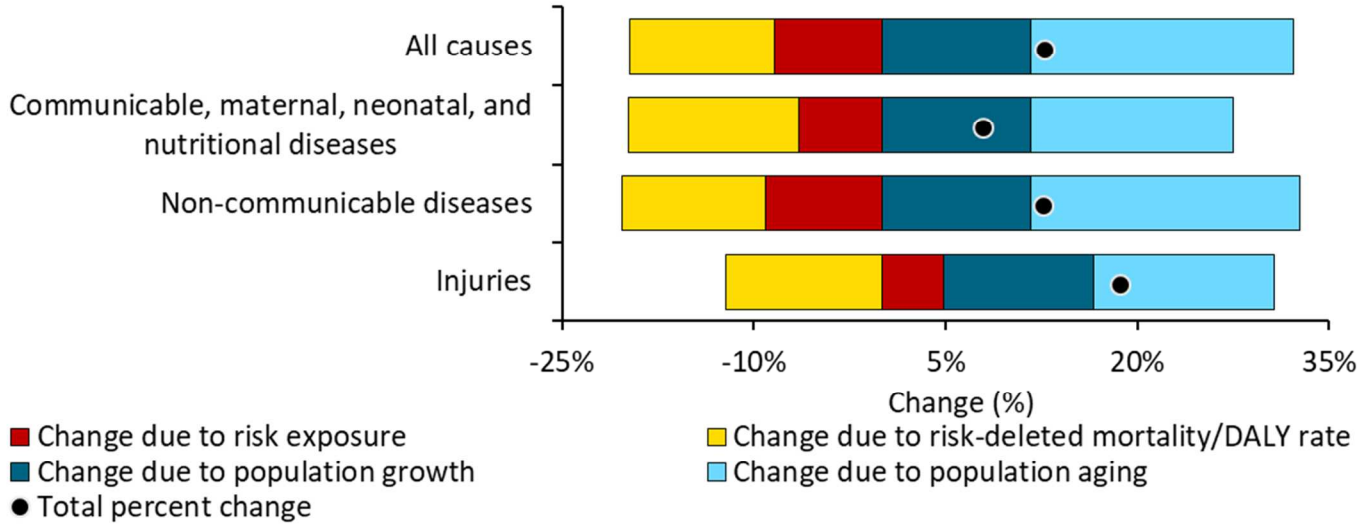
Figure 6. Rank changes of years lived with disability (YLDs) attributable to leading risk factors and percentage change in all-age and age-standardized YLD rates in Canada between 1990 and 2016 for females and males combined

Figure 7. Drivers of percentage changes in Canada's risk-attributable disease and injury burden from 2006 to 2016 due to population growth, population aging, risk-deleted mortality, and exposure to risk factors expressed as (A) disability-adjusted life years (DALYs) for all ages, (B) deaths for all ages, and (C) DALYs by age group

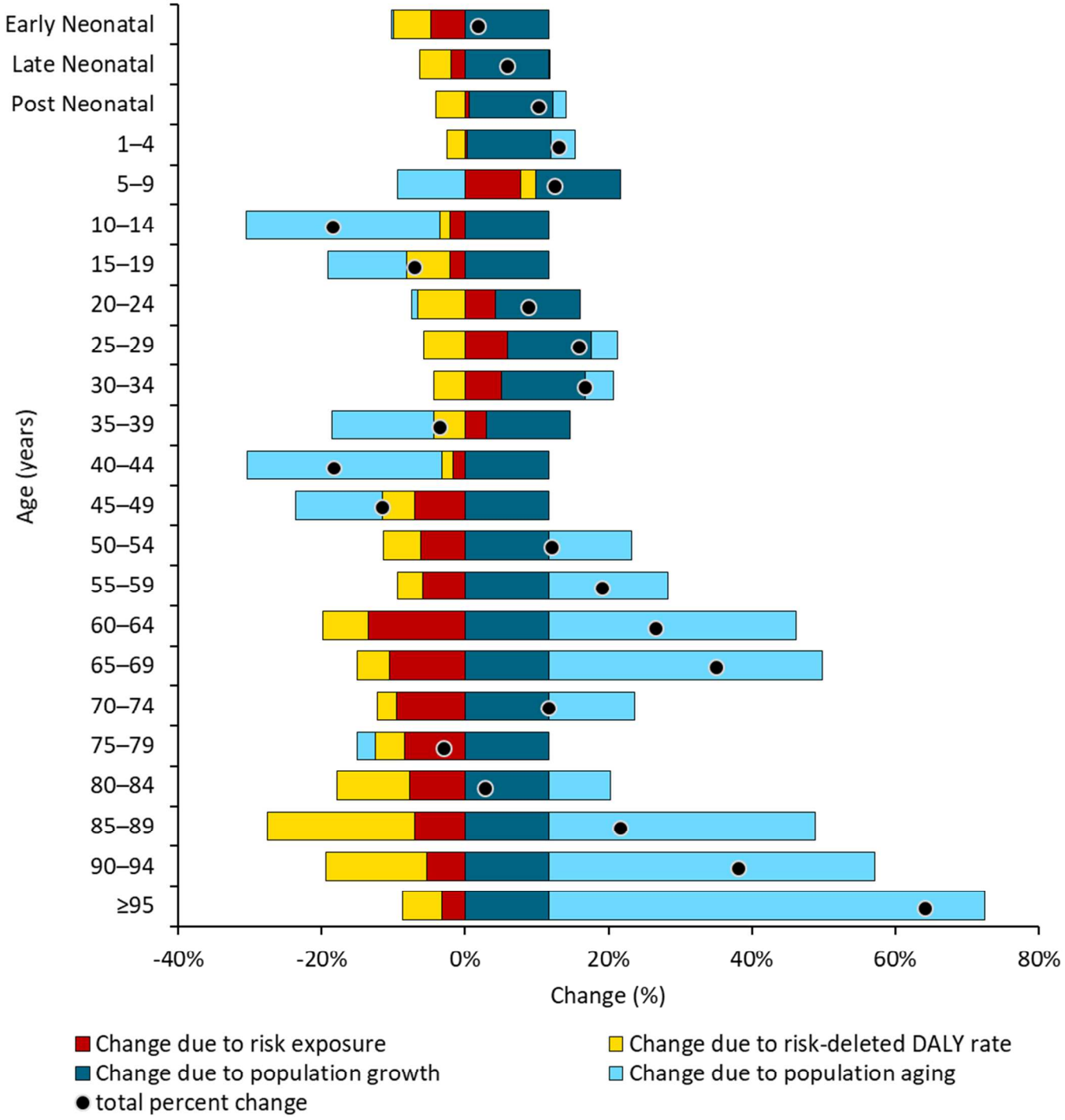
A. DALYs, all ages



B. deaths, all ages



C. DALYs, by age group



One DALY is equivalent to one year of healthy life (free of disease, injury, or disability) that has been lost.

Supplementary Table 1. Canadian dataset records used in the Global Burden of Disease Study 2016, organized by type of data

Data type	Number of records	Examples of type of record
Administrative records	25	Canada Discharge Abstract Database 1994 to 2010 Canada National ambulatory care reporting system 2002–2010 The Canadian Neonatal Network Annual Report 2014
Census	7	Canada Population Estimates 2012, 2014 Canada population and housing census 2011 Canada Census 1991, 2001
Disease registry	163	Canada-BC/Alberta Congenital Anomalies Surveillance System Data Canadian Organ Replacement Register Annual Statistics 2001–2017 Provincial cancer registry since 1991
Epi surveillance	49	WHO Global Health Observatory Interactive Graph – Number of Cases of Cutaneous Leishmaniasis Reported 1998 to 2015 WHO Global Health Observatory Interactive Graph – Number of Cases of Visceral Leishmaniasis Reported 1998 to 2015 Zika cases – 2016 HIV in Canada: Surveillance Summary Tables, 2014–2015 Number of Reported Cases of Dengue and Severe Dengue (SD) in the Americas, by Country 2006 to 2014 Canada Reported Cases of Syphilis by Age and Sex Canada Reported Cases of Gonorrhea by Age and Sex Canada Reported Cases of Chlamydia by Age and Sex
Financial record	16	Canada Rotary Committee for International Development Financial Statement 2006 to 2008 World University Service Canada Annual Report 2005 to 2007 Center for International Studies and Cooperation Annual Report 2000 to 2007
Natural phenomena	3	SPARTAN Global Particulate Matter Network Chemical Speciation Data Canada National Air Pollution Surveillance Network $PM_{2.5}$ Data 2013 Canada Air Quality Annual $PM_{2.5}$ and PM_{10} Data 1990, 1995, 2000, 2005, 2010, 2012
Other publications	2	Operation Iraqi Freedom – Iraq Coalition Casualties: Fatalities By Year

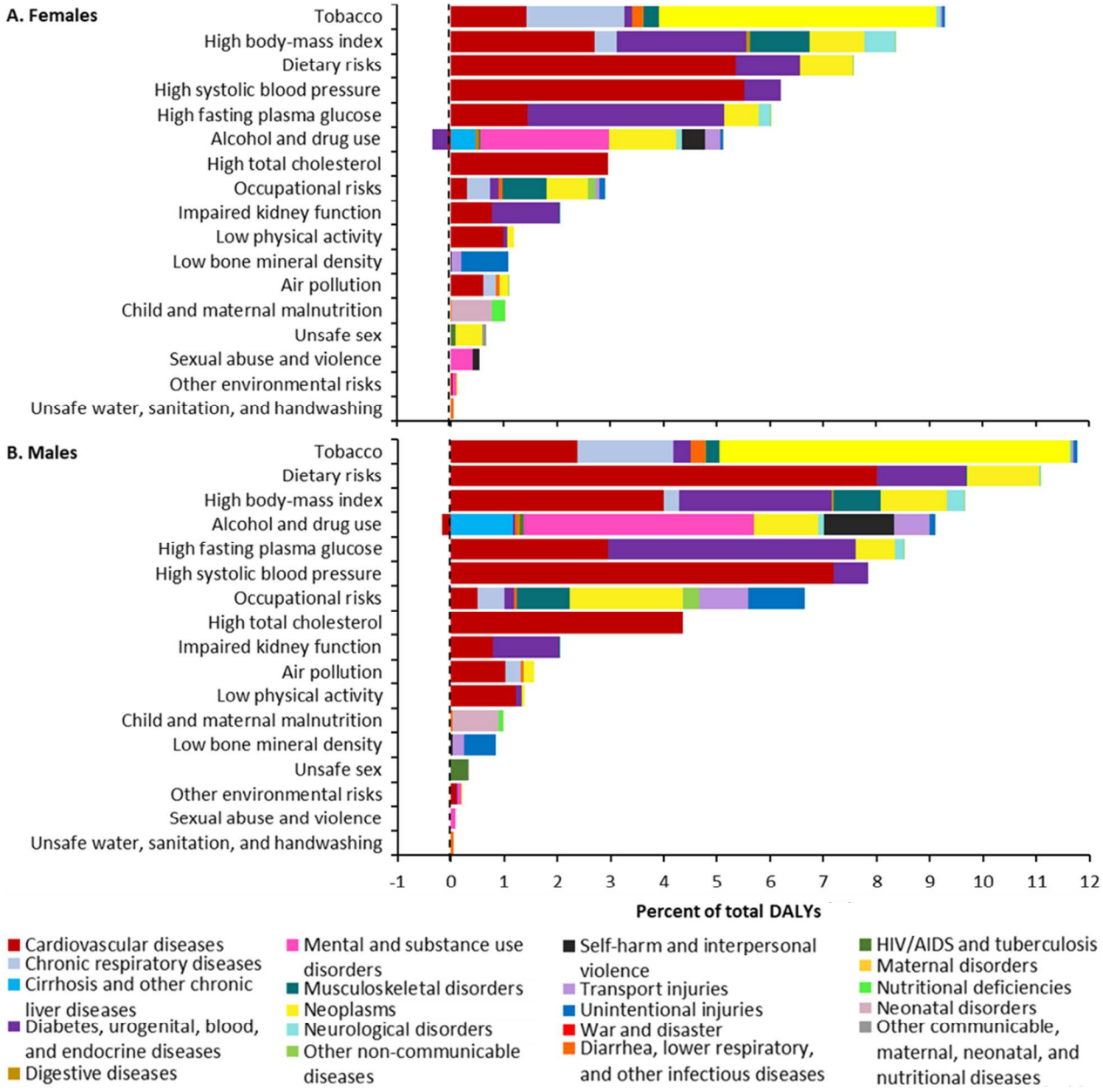
		Operation Enduring Freedom – Coalition Deaths by Year
Report	28	Canada UNGASS Country Progress Report 2012 Social Determinants of Health and Well-being Among Young People: Health Behaviour in School-aged Children (HBSC) Study: International Report from the 2001–2, 2005–6, 2009–10 Survey Canadian Neonatal Network Annual Report 2005, 2009 Canada Evaluation of Progress in Drug Control 2005–2006 Canada Community Health Survey Findings – Adult Obesity in Canada: Measured Height and Weight 2004 Canada: Alcohol and Partner Physical Aggression in the 10 Provinces Violence Against Women: An International Perspective Canada – Trends in Breastfeeding Practices in Canada (2001 to 2009–2010) Canadian National Report on Immunization 2006 Canada – Homicide in Canada, 2001 to 2010 World Taxation and Price Guide 1994 OECD Regions at a Glance 2011 Canada – Family Violence in Canada: A Statistical Profile 2007
Scientific literature	403	A 2015 global update on folic acid-preventable spina bifida and anencephaly Income adequacy and education associated with the prevalence of obesity in rural Saskatchewan, Canada A preliminary investigation into diet adequacy in senior residents of Newfoundland and Labrador, Canada: a cross-sectional study Prevalence of Hearing Loss Among a Representative Sample of Canadian Children and Adolescents, 3 to 19 Years of Age
Surveys	117	Canada Tobacco Use Monitoring Survey 2012 Canada Health Measures Survey 2012–2013 Canada Community Health Survey – Mental Health 2012 Major Depressive Disorder and Bipolar Disorder Tabulations Canada Childhood National Immunization Coverage Survey 2011 Canada Alcohol and Drug Use Monitoring Survey 2011 Canada Progress in International Reading Literacy Study 2010–2011 Canada Program for International Student Assessment 2015
Vital registrations	45	Canada Vital Registration – Deaths 1990 to 2012

		Canada Vital Registration Late Fetal Death Data 1997 to 2011 Canada CANSIM Database – Live Births, by Weeks of Gestation and Sex, Canada, Provinces and Territories, Annual Canada Vital Registration Birth Data 1990
TOTAL	868	

Supplementary Table 2. Included risk factors (levels 0-2, GBD Canada 1900–c2016)

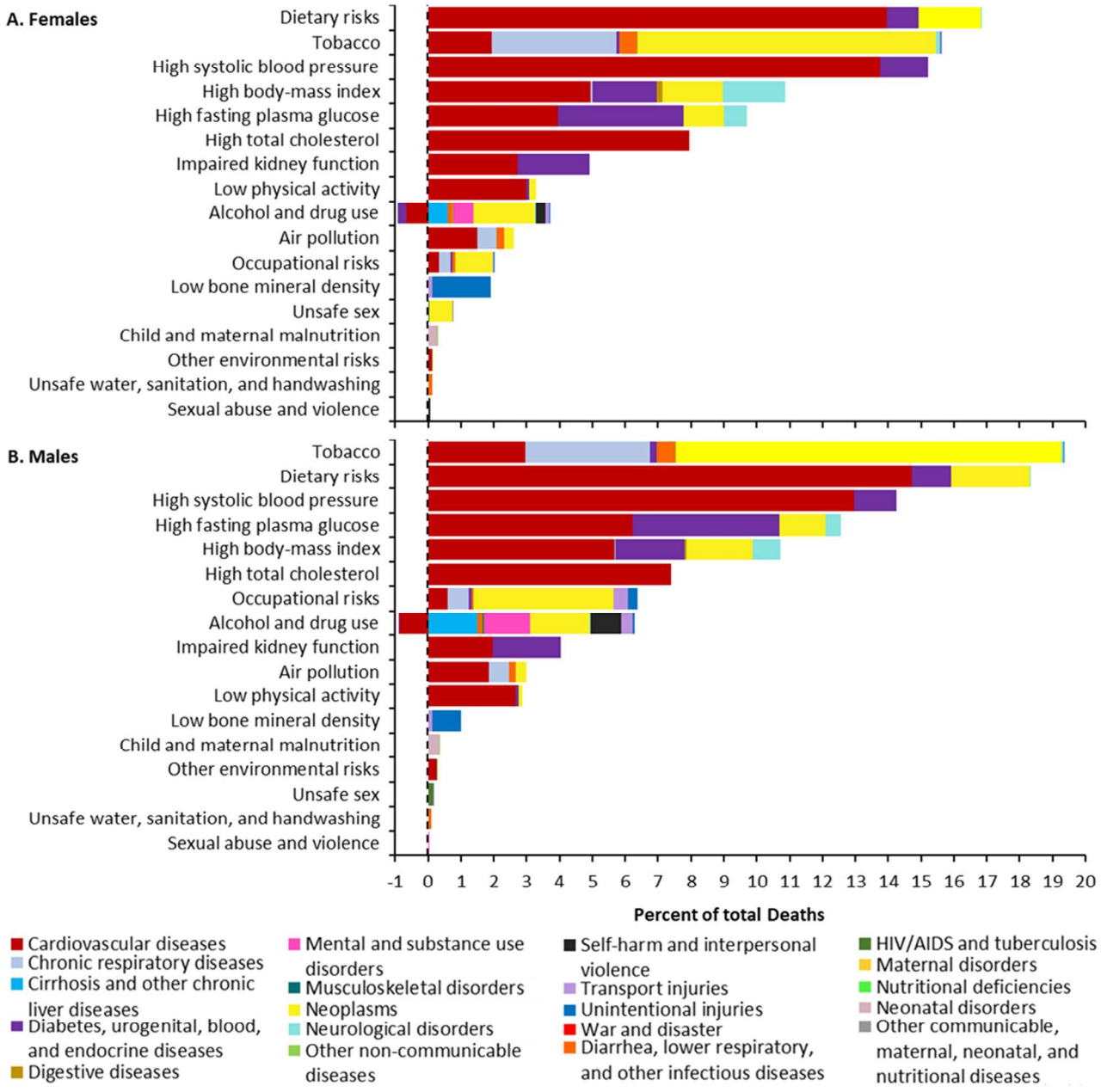
Level 0	**Level 1**	**Level 2**
All risk factors	Behavioural risks	Alcohol and drug use
		Dietary risks
		Low physical activity
		Malnutrition
		Sexual abuse and violence
		Tobacco
		Unsafe sex
	Environmental/occupational risks	Air pollution
		Occupational risks
		Other environmental risks
		Unsafe water, sanitation, and handwashing
	Metabolic risks	High body-mass index (BMI)
		High fasting plasma glucose (FPG)
		High systolic blood pressure (SBP)
		High total cholesterol
		Impaired kidney function
		Low bone mineral density

Supplementary Figure 1. Burden of disease attributable to leading risk factors for Canadians in 2016, expressed as a percentage of total disability-adjusted life years (DALYs) for (A) females (B) males.



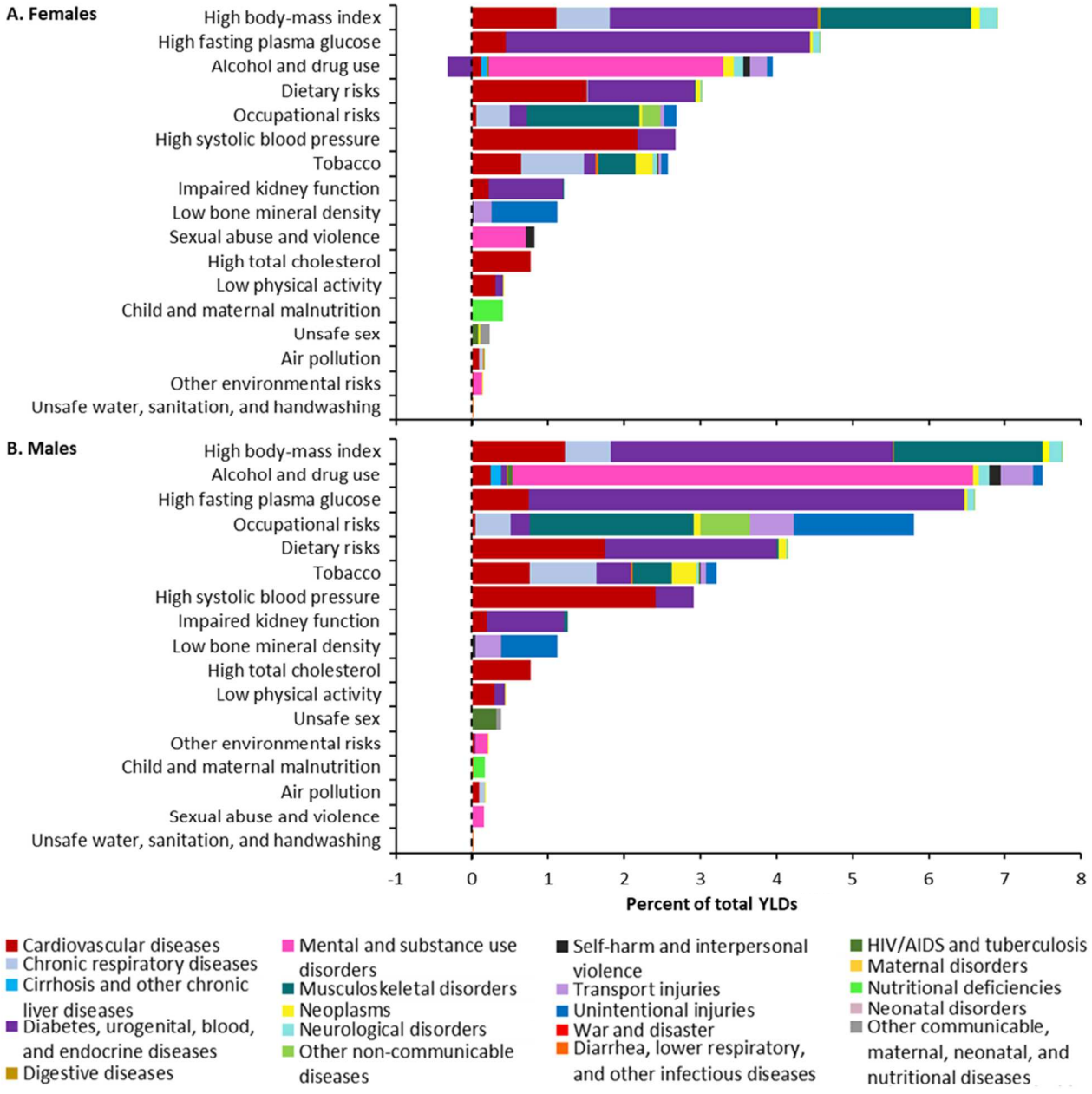
One DALY is equivalent to one year of healthy life (free of disease, injury, or disability) that has been lost**.** The negative percentage for alcohol is the protective effect of mild alcohol use on risk of cardiometabolic disease.

Supplementary Figure 2. The burden of disease attributable to leading risk factors for Canadians in 2016, expressed as a percentage of total deaths for (A) females (B) males



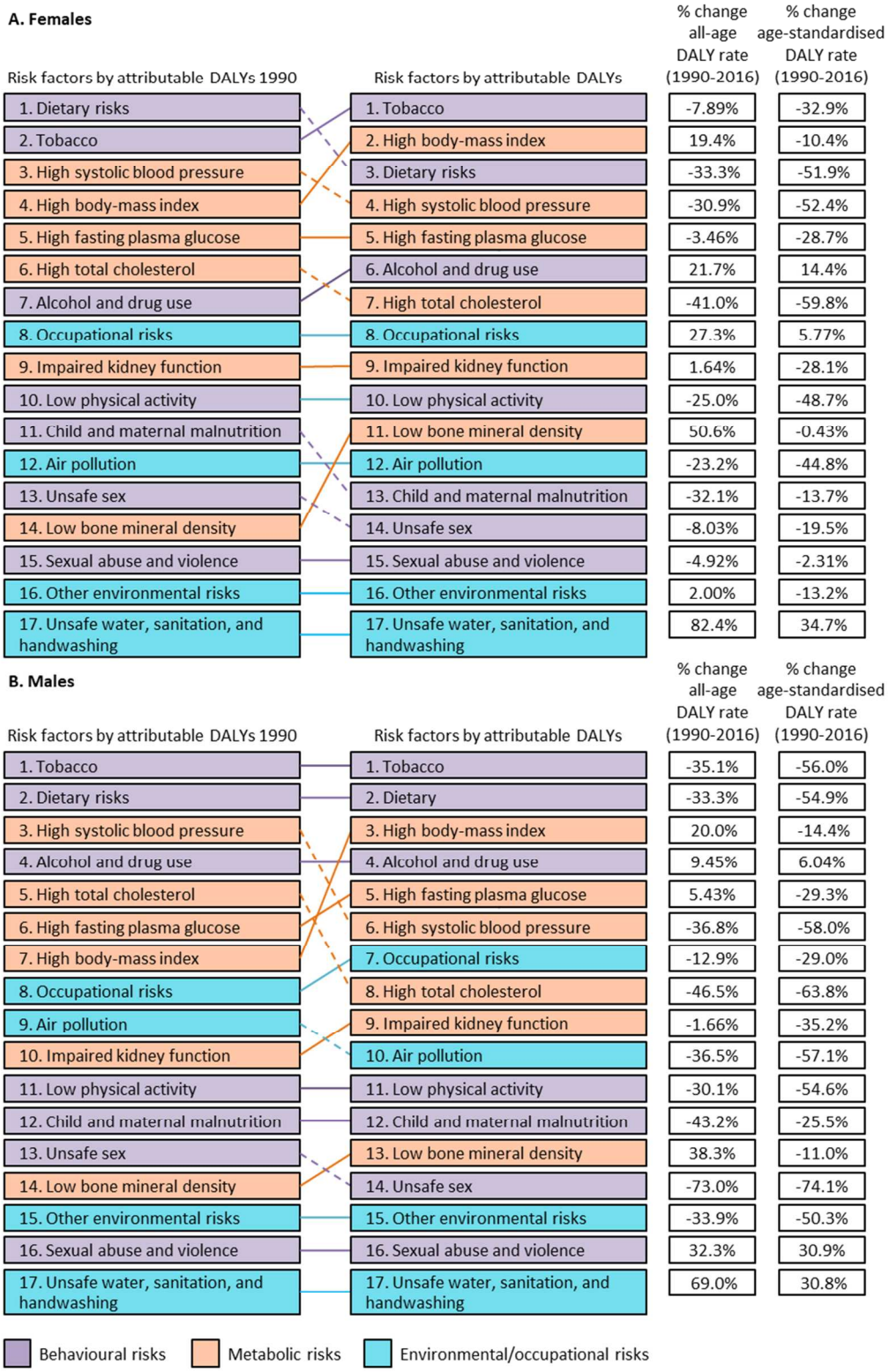
The negative percentage for alcohol is the protective effect of mild alcohol use on risk of cardiometabolic disease.

Supplementary Figure 3. The burden of disease attributable to leading risk factors for Canadians in 2016, expressed as a percentage of years lived with disability (YLDs) for (A) females (B) males

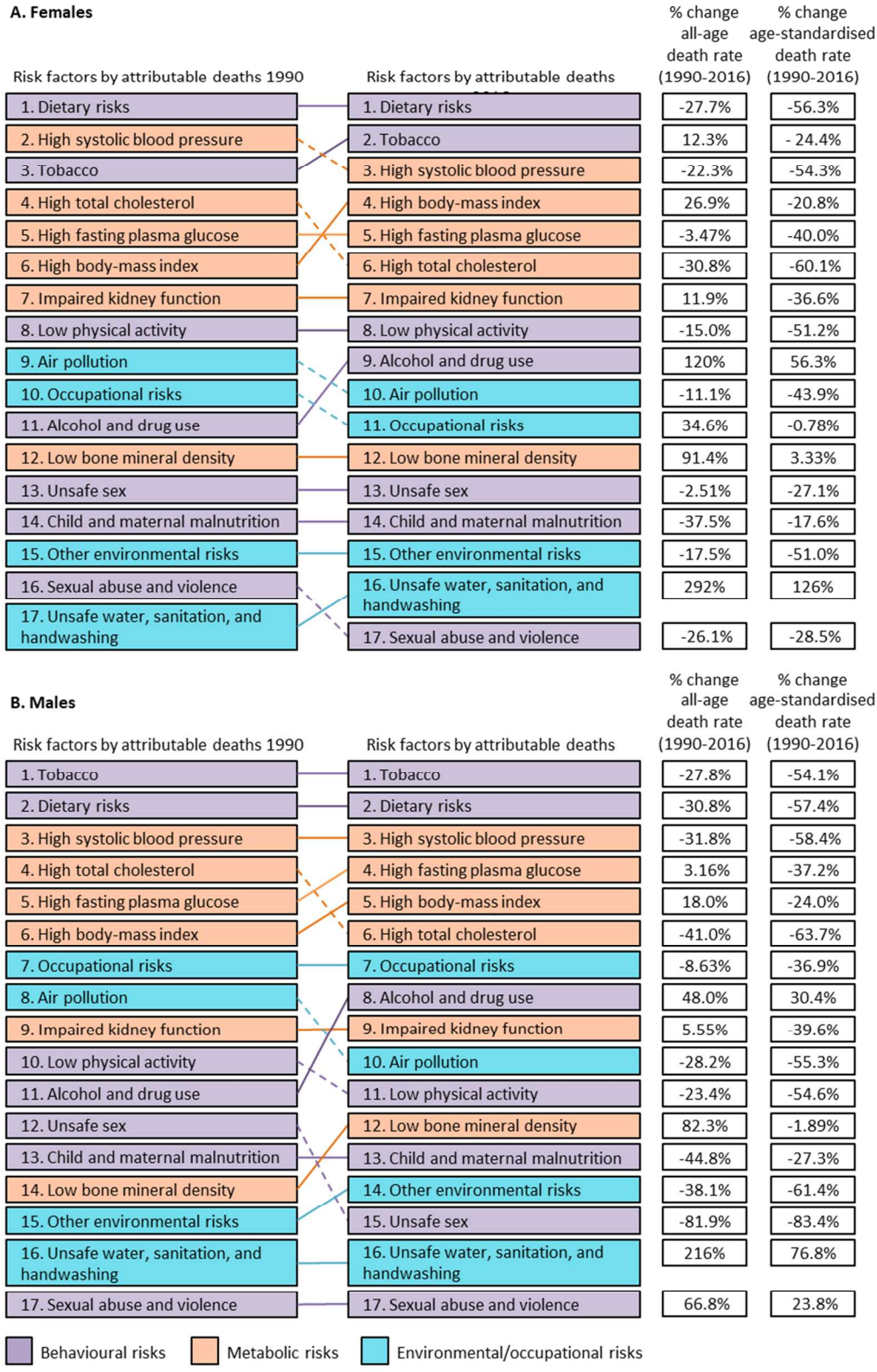


The negative percentage for alcohol is the protective effect of mild alcohol use on risk of cardiometabolic disease.

Supplementary Figure 4. Rank changes in disability-adjusted life years (DALYs) attributable to leading risk factors and percent change in all-age and age-standardized DALY rates in Canada between 1990 and 2016, for (A) women and (B) men

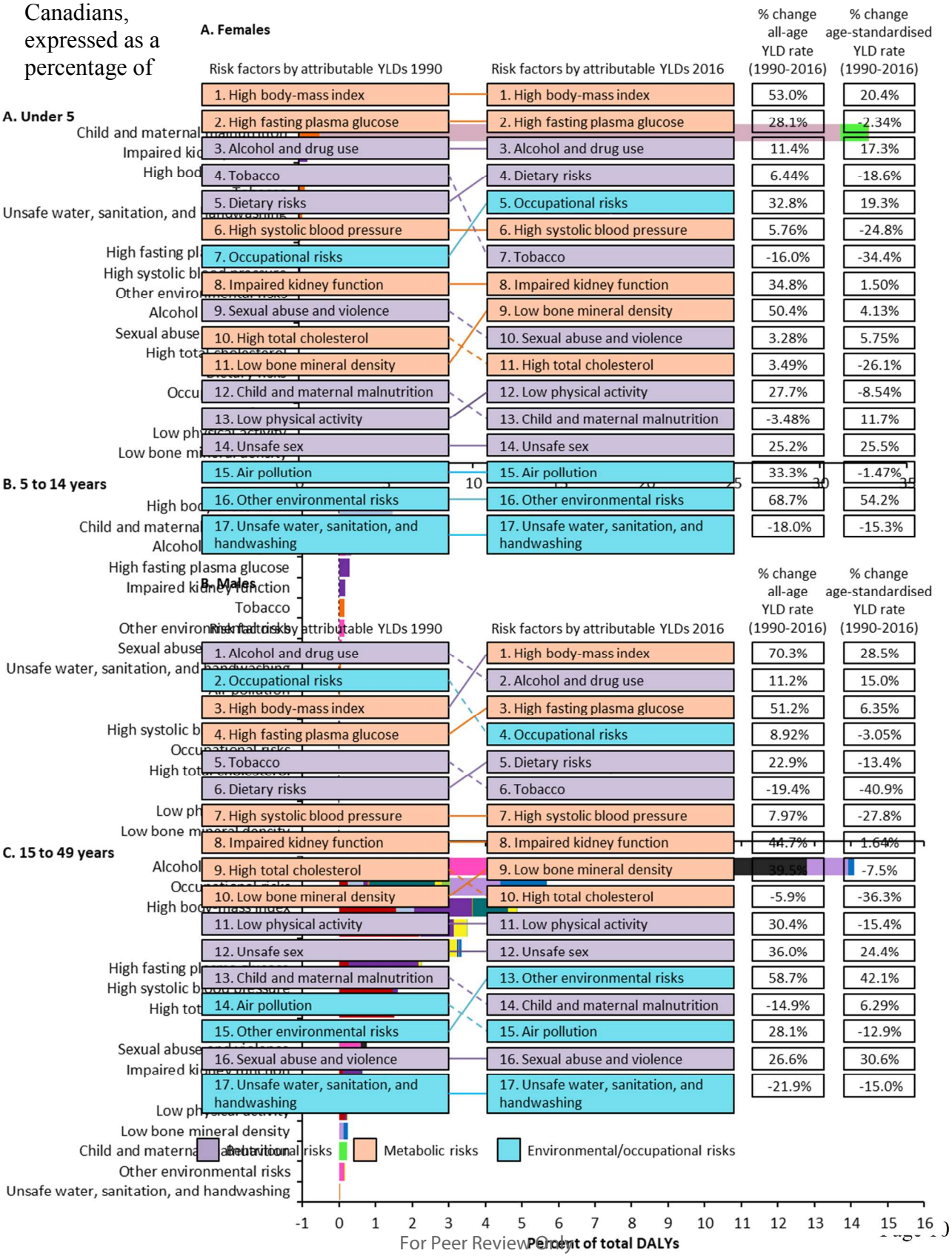


Supplementary Figure 5. Rank changes in total deaths attributable to leading risk factors and percent change in all-age and age-standardized death rates in Canada between 1990 and 2016, for (A) women and (B) men

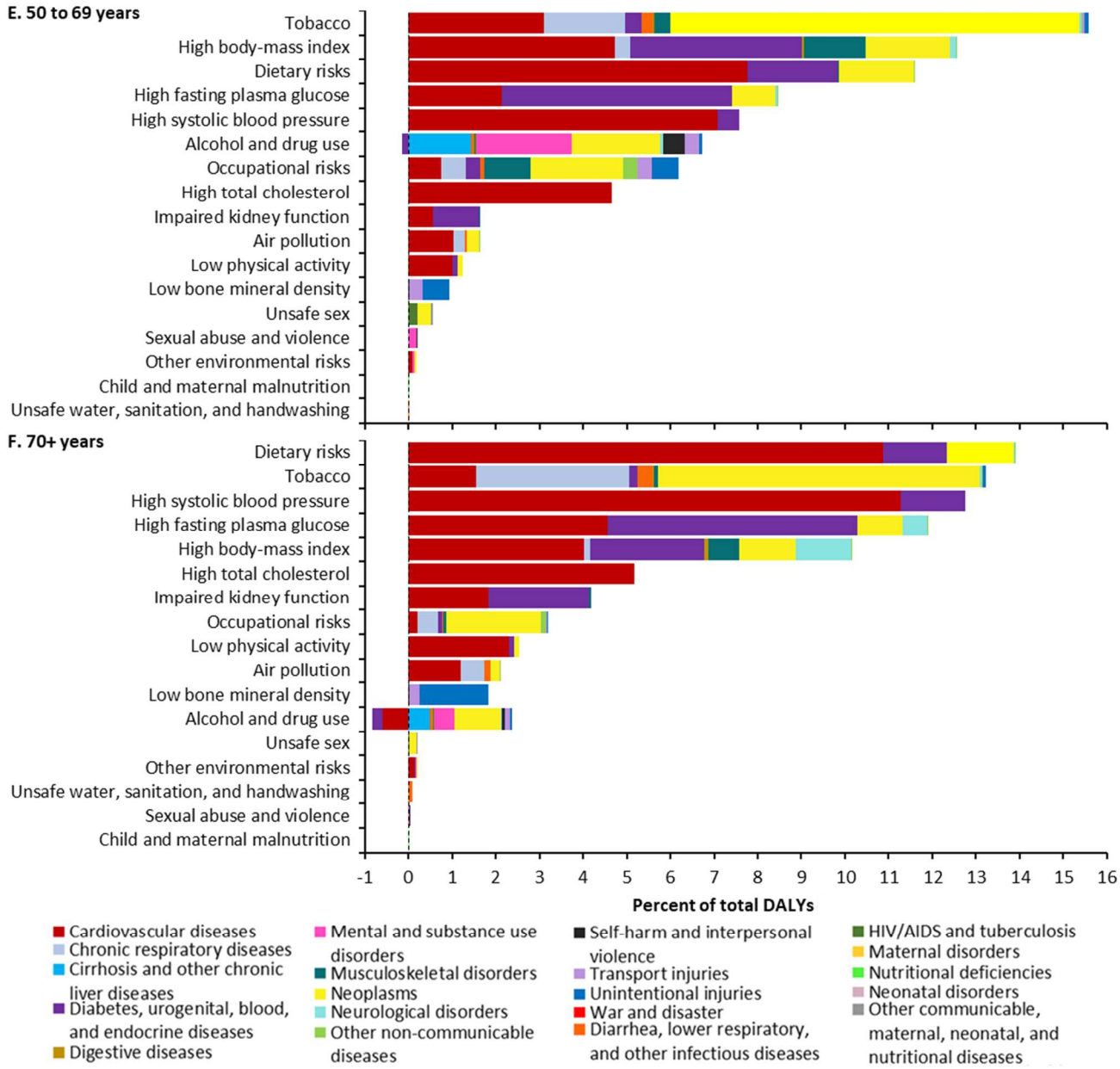


Supplementary Figure 6. Rank changes in years lived with disability (YLDs) attributable to leading risk factors and percent change in all-age and age-standardized YLD rates in Canada between 1990 and 2016 for (A) females (B) males

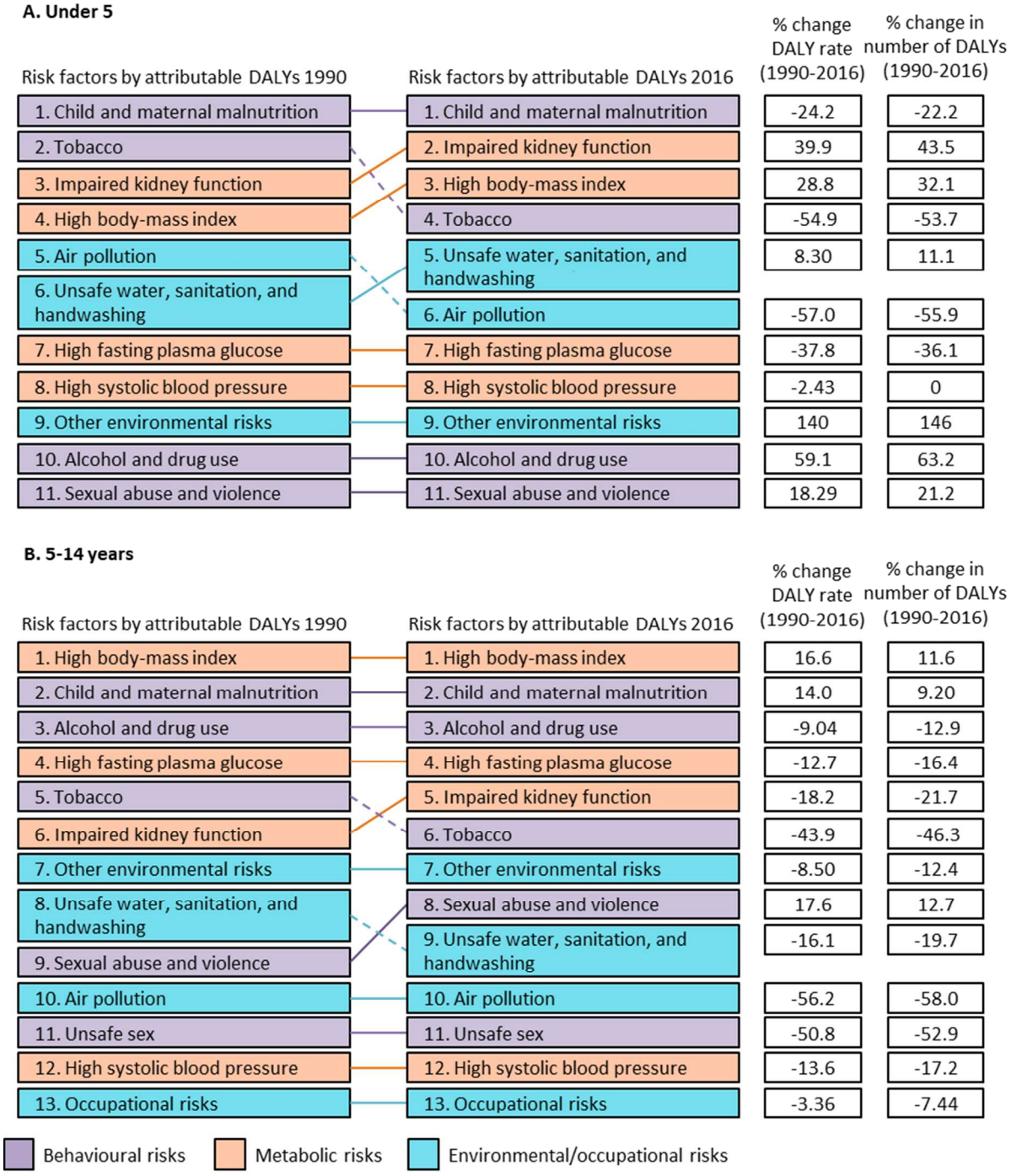
Supplementary Figure 7. The burden of disease attributable to leading risk factors in 2016 for Canadians, expressed as a percentage of



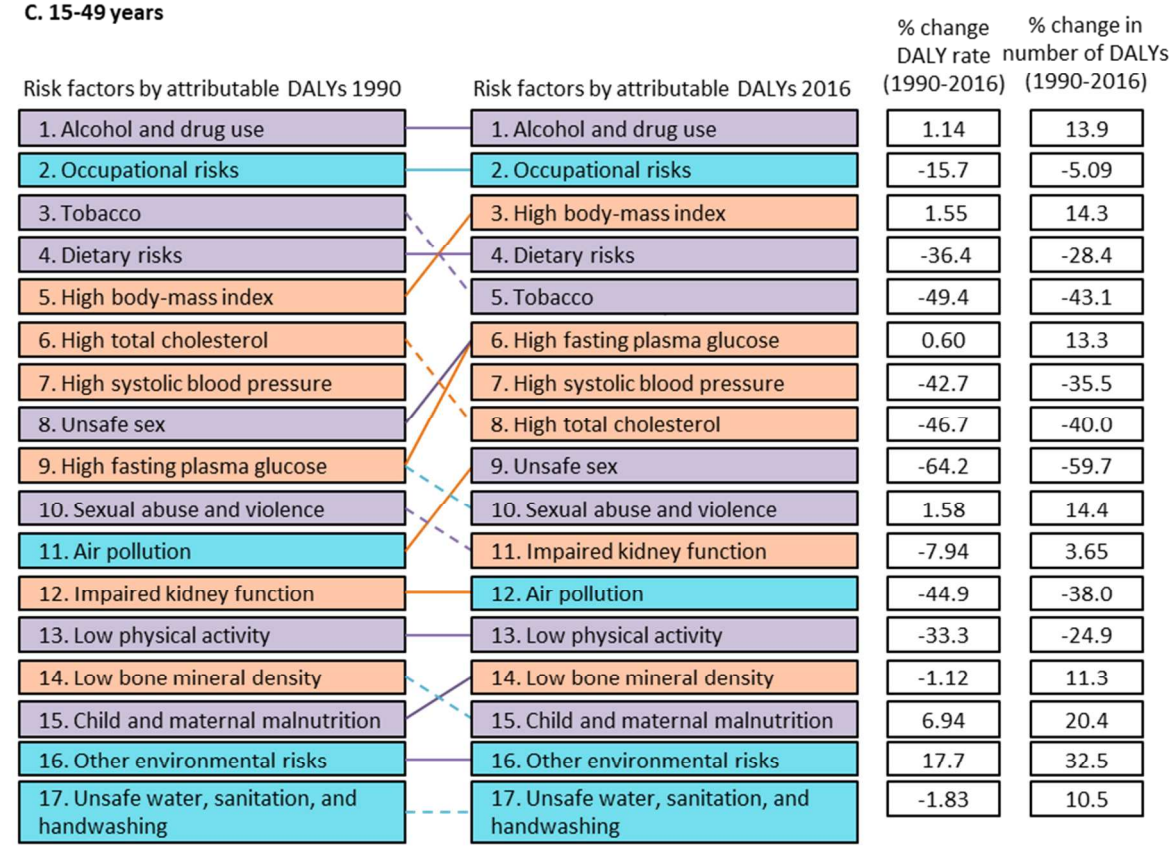
total disability-adjusted life years (DALYs) stratified by age group



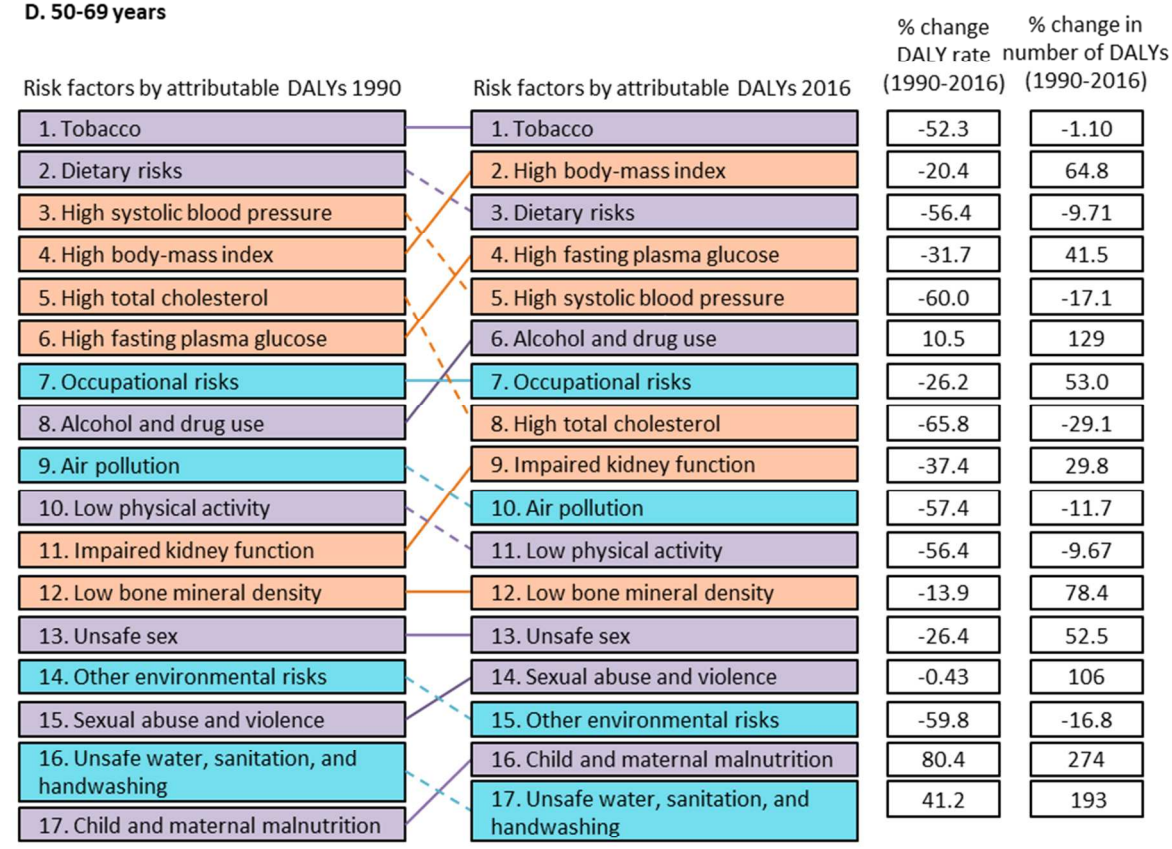
Supplementary Figure 8. Rank changes of disability-adjusted life years (DALYs) attributable to leading risk factors and percent change in DALY rates and number of DALYs in Canada between 1990 and 2016, in age categories



C. 15-49 years



D. 50-69 years



E. 70+ years