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The Profile and Epidemiology Report of Cardiovascular Disease (CVD) Burden in Canada – An Assessment of the Trend of CVD and its Correlation with Selected Risk Factors, between 2010-2011 and 2019-2020 Fiscal Years

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A DISSERTATION

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Declaration

This dissertation is the author's original work and has not been presented for a degree in any other university or award.

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Taiwo Oluwole Olubanwo **Date**

(UNISE2069IT)

We confirm that the candidate performs the work reported in this thesis under our supervision.

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Dedication

This dissertation is dedicated to Almighty God and my lovely family for their immense support thus far. To my caring parents, Pa. James O. Olubanwo and the Mrs. Felicia A. Olubanwo (late), my lovely and supportive wife, Mrs. Oluwakemi A. Olubanwo, and my dear children, Eunice, Emmanuel and Edward, for their unwavering support. This work is equally dedicated to all the academic scholars and those who care about adding value to humanity.

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Table of Contents

List of Tables

List of Figures

List of Pictures

Abbreviations and Acronyms:

AMI – Acute Myocardial Infarction
ASMR - Age-standardized Mortality Rate
ASPR - Age-standardized Prevalence Rate
ASR – Age-standardized rate
CCDSS - Chronic Disease Surveillance System
CCHS - Canadian Community Health Survey
CHD – Coronary Heart Disease
CHF – Congestive Heart Failure
CHMS - Canadian Health Measures Survey
CI – Confidence Interval
CV – Cardiovascular
CVA – Cerebrovascular Accident
CVD - cardiovascular disease
DALYs - Disability-Adjusted Life Years
DVT - Deep vein thrombosis
HBP - High Blood Pressure
HIDT - Health Inequalities Data Tool
HDL – High-Density Lipoprotein
HF - Heart Failure
IHD – ischemic heart disease
LDL – Low-density lipoprotein
NWT – Northwest Territories
PAD - Peripheral arterial disease
PHAC - Public Health Agency of Canada
RHD - Rheumatic heart disease
T1DM – Type 1 Diabetes Mellitus
T2DM – Type 2 Diabetes Mellitus
YLDs - Year Lost due to premature Deaths
YLLs - Years of Life Lost

Abstract

Background: For decades, cardiovascular disease (CVD) remains a public health threat as it contributes mainly to the rate of mortality, morbidity and disability globally. Although CVD remains the leading cause of death globally, a shift in the epidemiologic outlook of CVD burden is evident in Canada in recent times. Notwithstanding the identified shift, limited empirical evidence exists on the current status, and correlation between CVD burden and its risk factors across Canada.

Objectives: To assess the current status of CVD burden, and the correlation between the trajectory of CVD, mortality rate, and selected CVD-risk factors across Canadian provinces and territories over the past decade (2010-2020) using the principles of descriptive epidemiology.

Method: A selected community health survey data and health surveillance tool were explored to assess the burden of CVD for persons aged 20 and older in Canada between 2010 and 2020. The data on the age-standardized prevalence rate (ASPR) of a selected CVD condition, CVD risk factors and age-standardized mortality rate (ASMR) of CVD-attributable deaths were collected from the Canadian Chronic Disease Surveillance System (CCDSS) and Health Inequality Data Tools (HIDT) database between 2010-2011 and 2019-2020 fiscal years. The disease burden and correlation between the trend of CVD, its risk factors and mortality rate based on the population characteristics were assessed, synthesized and articulated using descriptive epidemiology by person, place and time with a simplified visual display that shows the trend.

Results: As of 2020, an improvement in the ASPR of two (2) CVD risk factors, namely tobacco smoking, 17.5% (-17.8% change) and physical activities, 56.7% (+9.0% change) at 95% CI, between 2010-2014 and 2015-2019 fiscal years is noticeable. Unlike the improved rate of tobacco smoking and physical activities, an upward trajectory in three (3) risk factors - alcohol 20.2% (+6.3% change), diabetes 7.7% (+10.0% change), and diet (fruit/vegetables), 30.8% (-24.7% change) at 95% CI between 2010-2014 and 2015-2019 is noticeable in this study. As of 2020, hypertension/high blood pressure (HBP) has the highest prevalence at 23.09% followed by ischemic heart disease (IHD) at 7.34%, heart failure (HF) at 3.36%, stroke/cerebrovascular accident (CVA) with 2.57% and acute myocardial infarction (AMI) with ASPR of 1.98% respectively. Between the 2010-2011 and 2019-2020 fiscal years, evidence of improvement in the ASPR prevalence of IHD (-10.12% change), followed by heart failure (-6.05% change) and hypertension (-5.02% change) at 95% CI were noticeable respectively. Unlike the promising IHD, HF, and HBP epidemiologic outlook, the ASPR prevalence rate of acute myocardial infarction increased with a +3.13% change, followed by stroke with a +0.78% change. In Canada, CVD-attributable deaths declined from 28.07% (2 in 7) in 2010 to 23.66% (1 in 4) of all deaths in 2020.

Conclusion: This study affirms a correlation between the trajectory of CVD burden and selected risk factors over the past decade. A promising epidemiology outlook is evident in the prevalence of ischemic heart disease, heart failure and hypertension, and the rate of CVD-attributable deaths, unlike the dissatisfactory trend in the rate of acute myocardial infarction and stroke. An improvement was noticeable in the trend of tobacco smoking and physical activity while inadequate fruit/vegetable intake, diabetes and alcohol consumption continued to rise in Canada between 2010 and 2020. A noticeable divergence in the trend of CVD burden across Canada has a public health implication that suggests disproportionate social determinants of health and health inequality despite Canada being among the high-income countries. While this study provides insight and a baseline for further studies, the analyzed data may differ from previous or subsequent reports due to the dynamics of the CCDSS surveillance system which allows for ongoing data updates. Early detection of CVD with an improved management model on the rate of alcohol consumption, dietary intake, diabetic education and robust social determinants of health across Canada promotes an improved CVD epidemiology outlook.

Keywords: Cardiovascular disease, cerebrovascular accident, ischemic heart disease, acute myocardial infarction, hypertension, congestive heart failure, diabetes, Health Inequalities Data Tool (HIDT), Chronic Disease Surveillance System (CCDSS), age-standardized prevalence rate, age-standardized mortality rate

CHAPTER ONE

1.0 Introduction

Health indicators, morbidity and mortality rates are critical in measuring the burden of disease or public health issues in a defined population. While disease burden has a direct correlation with the community health gradients, one of the fundamentals of ensuring a healthy community is the effective management of the existential and emerging population health issues. Public health practitioners rely on clinical parameters with composite healthcare management requisites in addressing emerging and contemporary public health issues, including communicable and non-communicable diseases (Teutsch & Fielding, 2013). The prevalence of cardiovascular disease takes the lead among the characterized non-communicable diseases globally (Menon et al., 2022).

For decades, cardiovascular disease (CVD) has remained the leading cause of death globally as it contributes mainly to the rate of morbidity and disability (Schwalm et al., 2019; WHO, 2021; Roth et al., 2020). CVD risk factors, inequality and disproportionate social determinants of health are the predisposing factors to developing CVD (WHO, 2021). Despite the efforts made by the Government of Canada over the past six (6) decades, CVD continues to pose a public health threat as it aligns with the global trend (Institute for Health Metrics and Evaluation, IHME, 2023). Although evidence of improvement is noticeable in the epidemiologic outlook of CVD in Canada, there is limited empirical evidence on the quantification, correlation of indicators and current status of CVD burden across Canadian provinces and territories in recent times (PHAC, 2021). A comprehensive data-driven and deliberate effort in managing the CVD burden is expedient – these efforts should align with the 2030 countdown enhanced Sustainable Development Goal (Bennett et al., 2018).

Exploring the trend of CVD, its burden, risk factors, effects and management modality is critical across all health system levels. The comprehensive data-driven analysis assesses the CVD burden and current status using descriptive epidemiology. The epidemiology report provides an insightful profile that serves as a baseline for future investigation and for developing a population-based management approach in addressing the public health threats attributable to the CVD burden in Canada.

1.1 Problem Statement

Non-communicable diseases (NCDs) account for an estimated 41 million (71%) deaths annually. CVD-attributable mortality accounts for nearly a third (32%) of the total reported deaths globally with about 85% attributable to heart attack and stroke (WHO, 2021). CVD (17.9 million deaths) take the lead of all the NCDs-attributable deaths, "followed by cancers (9.0 million), respiratory diseases (3.9 million), and diabetes (1.6 million") worldwide (PAHO, 2023; Singh & Kumar, 2019). Between 1999 and 2019, the prevalence of CVD has reportedly doubled globally (Roth et al. 2020). In 1990, the prevalence of CVD was 271 million – this record rose to 523 million in 2019 based on the population-level data sources (Roth et al., 2020). The global trend of disability-adjusted life years (DALYs) and mortality attributable to CVD has nearly doubled from 17.7 million to 34.4 million as of 2019 globally (Roth et al., 2020).

Unlike Canada and a selected high-income country, the leading cause of death continues to be attributable to CVD globally. In 2010, the total number of deaths was 240,075, at which time significant CVD-related deaths were 67,383 in Canada. In 2020, the total number of deaths rose to 307,205, out of which 72,677 deaths were attributable to CVD. Nearly a decade ago heart disease has consistently been the second leading cause of death next to cancer (malignant neoplasm: 71,882 in 2010 and 80,973 in 2020) in Canada (Statistics Canada, 2023). Although recent findings suggest an improvement in the CVD burden in Canada, over the past decade, CVD accounts for nearly a third of all causes of death in Canada. While some empirical evidence suggests an improvement in the prevalence of CVD in Canada others have a contrasting opinion. The generalization of the CVD profile with limited information on the selected CVD conditions that was researched is noticeable with scanty empirical evidence on the trajectory of CVD and its risk factors over a period of time. Notwithstanding the perceived promising CVD burden, it is unclear where in Canada an improvement in CVD burden is identified and where more work is expedient across the nation.

To validate the differing evidence, quantifying the current status of CVD across Canada is imperative. A comprehensive assessment and quantification of the trend of age-standardized prevalence and age-standardized mortality rate of CVDs in correlation with the trend of selected CVD-risk factors is expedient to show the epidemiologic outlook of CVD burden across Canada. The trajectory of CVD

and its risk factors over a specific period predicts future epidemiology outlook, thus providing insight into developing a proactive measure in addressing current gaps and future challenges.

1.2 Purpose of the Study

Objectives: To assess the current status of CVD burden. To investigate the correlation between the trajectory of age-standardized CVD prevalence, mortality rate, and selected risk factors in Canada between 2010 and 2020 using the principles of descriptive epidemiology. To explore if there is an improvement in the CVD burden across Canadian provinces and Territories with empirical facts.

Aims: The study aims to investigate and report on the change(s) in the trajectory of selected cardiovascular disease risk factors and whether it reflects on the trend of cardiovascular disease over the past decade. To develop evidence-based insight for a proactive conceptualized measure for effective management of future public health crises attributable to CVD.

1.2.1 Central research questions

1. Is the trend of CVD risk factors reflected in the trajectory of selected CVD conditions across Canada between 2010 and 2020?
2. Is there an improvement in the trajectory of the age-standardized prevalence rate of CVD for persons aged 20 and older in Canada between 2010 and 2020?
3. Is there an improvement in the trajectory of the age-standardized mortality rate of CVD for persons aged 20 and older in Canada between 2010 and 2020?
4. Is there an improvement in a selected CVD-risk factor for persons aged 12 and older across Canada between 2010 and 2020?

1.2.2 Hypothesis

1. There is a correlation between the trend of a selected CVD condition and its risk factors.
   Null hypothesis: There is no correlation between the trend of CVDs and selected Rusk factors.
2. There is an improvement in the age-standardized prevalence of CVDs between 2010 and 2020.

3. ***Null hypothesis***: There is no evidence of improvement in the age-standardized prevalence of CVDs in Canada between 2010 and 2020
4. There is an improvement in the age-standardized prevalence of CVD risk factors between 2010 and 2020.

   Null hypothesis: There is no evidence of improvement in the age-standardized prevalence of CVDs in Canada between 2010 and 2020.
5. There is an improvement in the age-standardized mortality rate attributable to CVD across Canada between 2010 and 2020.

   Null hypothesis: There is no evidence of improvement in the age-standardized mortality of CVD-related deaths in Canada between 2010 and 2020.

1.3 The significance of the study

A longstanding body of literature suggests an increasing trajectory of cardiovascular disease globally. A perceived trend of cardiovascular disease is in the public domain. The population-based epidemiologic outlook of cardiovascular disease burden needs better research. While the aforementioned population-based outcome refers to characteristics such as the person, time and place, assessing where gains and unfavourable CVD epidemiology outlooks using descriptive epidemiology is imperative. The empirical evidence of this study is invaluable as it influences the future direction and population-based epidemiology outlook of CVD across Canadian provinces and Territories. The outcome of this study shapes the population-based conceptualized approach to effective management of CVD in tandem with the population characteristics.

1.4 Theoretical framework of the study

A descriptive epidemiology model was used to observe the distribution of cardiovascular disease by person, time and place across Canada between 2010 and 2020. The pattern and distribution of the diseases are captured, while the limited focus is on influencing hypotheses other than the selected modifiable and non-modifiable risk factors. The assessed data is collected from a carefully devised public health surveillance system that reflects the core principle of a veritable surveillance system, including "detection, registration, confirmation (both epidemiologic and laboratory), reporting, analyses, and feedback" (Roger et al., 2023; Meier et al.,2017).

1.5 Scope and Limitation of the Study

- The public health threat of cardiovascular disease is well-researched globally. The need to improve the management of the public health threat attributable to cardiovascular disease continues to be prioritized over the past few decades by the public health experts and administrators. The available studies on the efficacy and gains from CVD interventions in Canada are incomparable with the perspective on CVD burden and threat in the global public health domain. The studies on CVD burden are often generalized nationally, with limited studies on the disease trend per Canadian province and territory. More focus is often placed on heart diseases such as heart failure, hypertension, and ischemic heart disease, with limited work on other indicators.
- While heart diseases remained the leading cause of death globally, there is a shift in the leading cause of death in selected high-income countries such as Canada. Although surveillance system captures health indicators and trends, studies on the correlation between cardiovascular disease and its risk factors are not readily accessible. The quantification of either an improvement or decline in the epidemiology outlook of CVD in Canada must be well-researched comparatively.
- In this study, the profile of cardiovascular disease burden is assessed with predetermined variables. The pattern of CVD has been investigated across Canadian provinces and territories over a decade using a descriptive epidemiology model. Selected cardiovascular diseases assessed include acute myocardial infarction, ischemic heart disease, heart failure, hypertension and cerebrovascular accident grouped as health conditions. The risk factors assessed include physical inactivity, alcohol consumption, elevated blood sugar/diabetes, hypertension and tobacco smoking. The trend of age-standardized morbidity attributable to CVD is investigated.
- Data are collected from the Canadian Chronic Disease Surveillance System (CCDSS), “a collaborative network of provincial and territorial chronic disease surveillance systems, led by the Public Health Agency of Canada (PHAC)” and Health Inequality Data Tools (HIDT) database (PHAC, 2017, np).

- The data collection and analysis reflect a population-based and age-standardized prevalence and mortality. As such, the extracted data only represent a snapshot at the time of extraction from the CCDSS system.
- Per the CCDSS surveillance tool, data were unavailable for some parameters assessed in Northwest Territories; for Nunavut, data were unavailable for 2019-2020. In Quebec, data cells with counts smaller than five (5) were suppressed by Quebec and substituted with random numbers; as such, this may impact the estimated age-specific incidence and mortality rate in this region (PHAC, 2023). According to the Public Health Agency of Canada (2023), "the modernization of the billing system for fee-for-service medical services by the Régie de l'assurance maladie du Québec (RAMQ) in 2016 has resulted in a decrease in the entry of diagnostic codes in the fee-for-service medical services file (Gallagher, 2022, np). Therefore, data for 2016–2017 and subsequent years should be interpreted with caution, as a slight underestimation is suspected" (PHAC, 2023).
- The dynamics of the surveillance reporting system allow for ongoing updates to existing data collected at the time of this study. The extracted and assessed data may differ from previous or subsequent reports.

1.6 Definition of Terms

Acute Myocardial Infarction (AMI): A medical emergency - a heart attack that occurs when the heart muscle begins to die due to insufficient blood flow (Innovative Oral Surgery & Dental Implants, 2022).

Age-standardization: The statistical method used to compare the assessed age of the population related to the health indicators and disease using raw counts and five-year age groups to adjust differences in population.

Age-specific estimate/rate: The "incidence, prevalence and all-cause mortality estimates or rates calculated for a five-year age group (i.e., 1-19, 20-34, 35-49, 50-64, 65-79, 80+)". Five-year age groups report CCDSS Data.

Age-standardized estimate/rate: The "incidence, prevalence and all-cause mortality estimates/rates age-standardized to the 2011 Canadian population to adjust for differences in population age structure, calculated using non-rounded counts and five-year age groups" (PHAC, 2023, np).

Age-standardized mortality rate: A weighted average of the age-specific mortality rate attributable to CVD per 100,000 persons.

Age-standardized prevalence rate: The disease (CVD) rate that would occur if the population of interest (Canadian) had the same age distribution as a given standard population.

Case definition: CCDSS disease/condition-specific case definitions are applied to identify individuals with the disease/condition (cases) – in this case, CVD.

Cerebrovascular Disease (CVA) or Stroke: A condition that occurs when there is a blockage of blood supply to the brain blood vessel or when the blood vessel in the brain bursts Irma (2019).

Confidence interval (CI): "A statistical measurement of the reliability of an estimate/rate. The size of the CI relates to the precision of the estimate/rate, with narrow CIs indicating greater precision than those that are wide. The 95% CI shows an estimated range of values likely to include the true value 19 times out of 20" (PHAC, 2023).

Crude estimate/rate: The Incidence, prevalence and all-cause-mortality estimates/rates are calculated using counts randomly rounded up or down to a multiple of 5.

CVD- attributable mortality: The number of deaths from CVD occurring in a given period.

Descriptive epidemiology: An observation of the distribution of disease by person, place and time.

Diabetes: A chronic metabolic disease characterized by inadequate control of blood glucose or elevated blood glucose. Untreated elevated blood sugar can lead to other chronic diseases, chiefly cardiovascular disease, kidney disease, nerves and eye disease.

Electrocardiogram (ECG): A painless test that records the heart's electrical activity.

Epidemiology outlook: A disease pattern and distribution over a period of time.

Fiscal year: April 1 to March 31 is considered fiscal year in the CCDSS data.

Incidence rate: The number of new cases of a disease/condition occurring in a given period in a population at risk, expressed as a rate.

Life-course age groups: The sequence of age categories individuals pass through as they age from childhood to older adulthood. The categories used for CCDSS reporting are 1-19, 20-34, 35-49, 50-64, 65-79, 80+.

Heart Failure (HF) or Congestive Heart Failure (CHF): When the heart cannot pump enough blood needed for the human body's functionality. CHF does not mean that the heart has stopped functioning.

Hypertension or High Blood Pressure (HBP): A measure of the force of blood against your artery wall. An elevated blood vessel pressure leads to severe other complications if unattended or treated.

Ischemic Heart Disease (IHD) or Coronary Heart Disease: One of the primary cardiovascular disease conditions where a plaque builds up along the inner walls of the coronary artery of the heart, which eventually obstructs the blood flow, thus causing a heart attack (Muleya et al., 2020).

Prevalence estimate: "The number of cases of a disease/condition present in a given period in a population, expressed as a proportion" (PHAC, 2023, np).

Risk factors: A variable or sets of conditions associated with the risk of developing a disease. Excessive alcohol consumption, unhealthy diet, tobacco smoking, physical inactivity and diabetes are the major CVD-risk factors assessed in this study. Other CVD-risk factors are unhealthy weight, cholesterol and other non-modifiable risk factors like genetics, to mention a few.

1.7 Cardiovascular Disease

According to the World Health Organization (WHO, 2021), "cardiovascular disease (CVD) is a group of disorders of the heart and blood vessels". The CVDs are coronary heart disease, cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis, and pulmonary embolism (Han-Wei et al., 2020). Some of the CVD presentations, including but not limited to heart attacks and strokes, are acute events often caused by the blockage caused by a build-up of fatty deposits on the inner walls that prevent blood flow to the brain or the heart (Migale, 2022).

"***Coronary heart disease, CHD –*** a disease of the blood vessels supplying the heart muscle;

Cerebrovascular disease (CVA) – a disease of the blood vessels supplying the brain;

Peripheral arterial disease (PAD) – a disease of blood vessels supplying the arms and legs;

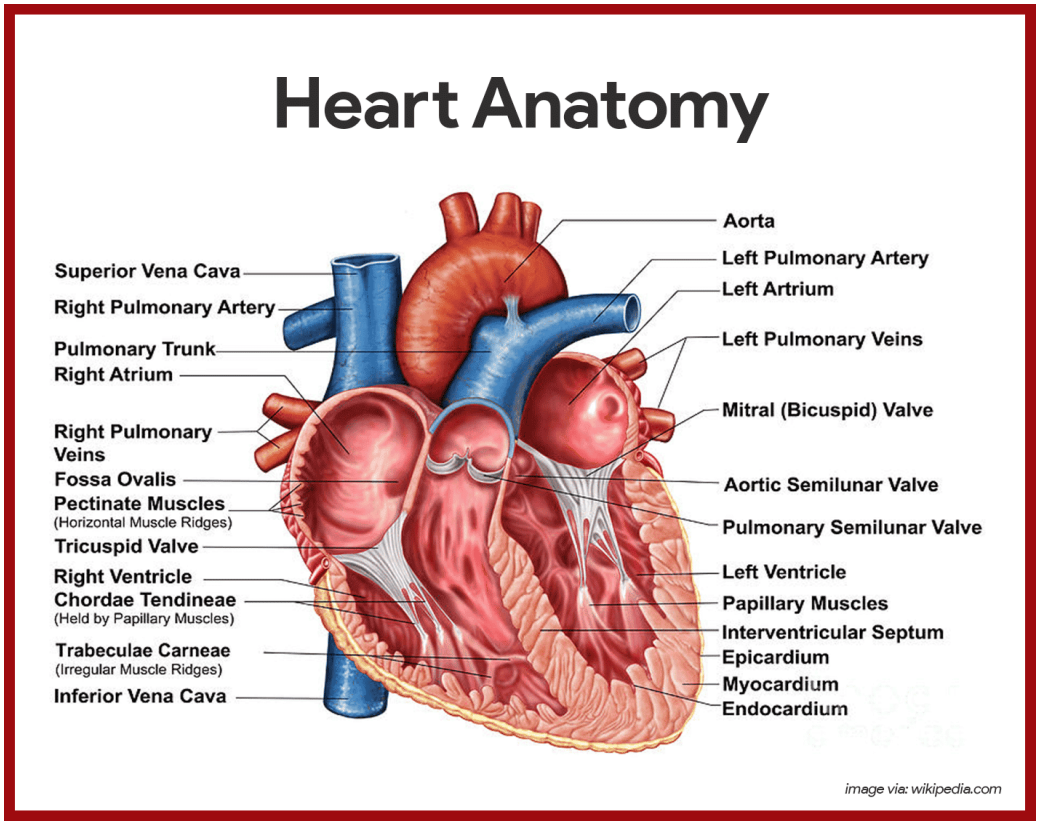
Rheumatic heart disease (RHD) – damage to the heart muscle and heart valves from rheumatic fever caused by streptococcal bacteria;

Congenital heart disease (CHD) – a congenital disability that affects the normal development and functioning of the heart caused by malformations of the heart structure from birth;

Deep vein thrombosis and pulmonary embolism (CVT) – blood clots in the leg veins, which can dislodge and move to the heart and lungs" (WHO, 2021).

Figure 1.0

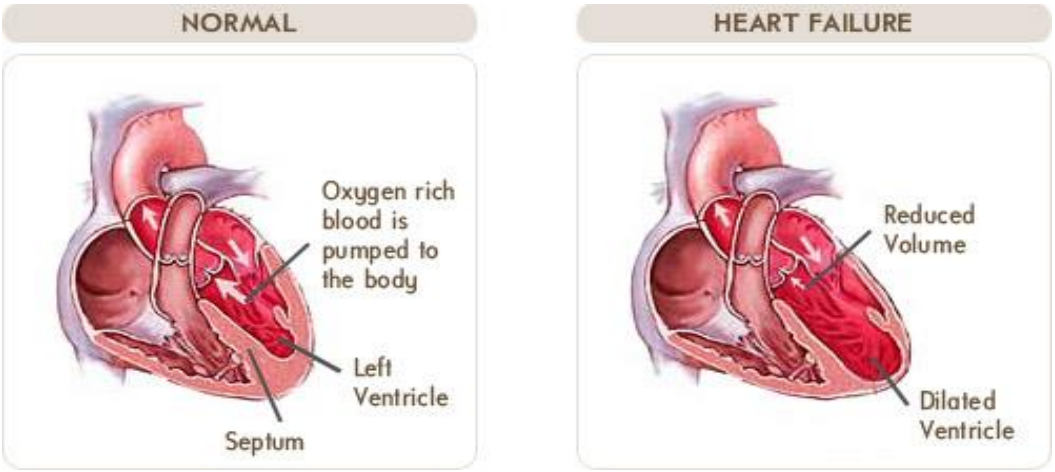
Heart Anatomy



Source: Nurselabs

Figure 1.1

Healthy heart and heart showing heart disease



Source: Terumoheart; Heart Foundation (2014)

1.8 Symptoms, Causes and Treatment of Heart Diseases – Heart Attacks and Strokes

Heart disease is characterized by both functional and structural abnormalities:

Symptoms: The common heart disease symptoms are chest pain, shortness of breath, nausea, sweating, palpitation and dizziness. The heart attack symptoms may include discomfort or pain in the centre of the chest and arms, left shoulder, jaw, elbows or back, while stroke symptoms may include "sudden weakness of the face, arm, or leg, most often on one side of the body." Other symptoms include but are not limited to confusion, speaking and speech understanding difficulties, vision problems, dizziness, loss of coordination or balance, difficulty walking, severe headache, unconsciousness or fainting (WHO, 2021).

Causes: Heart disease or condition could result from biological, hereditary or behavioural factors. The most common causes of heart disease are atherosclerosis, congenital heart defects, reduced blood flow, high blood sugar or heart blood pressure, and infection.

Risk factors: The leading behavioural risk factors of heart disease and stroke are tobacco smoking, unhealthy diet, physical inactivity and harmful use of alcohol (Johansson et al., 2021). Other risk factors are overweight or obesity, high systolic blood pressure, high low-density lipoprotein levels, and high fasting plasma glucose. Non-modifiable risk factors include age, gender, heredity, and ethnicity. Individuals whose family member(s) have a history of diabetes, high blood pressure, and high cholesterol are at increased risk of developing CDVs. These factors are hereditary and are classified under genetic risk factors. Although behavioural risk factors are easily modifiable, the modification of genetic risk factors may pose some challenges. Of note is the poor air quality noted to be one of the contributory factors to CVD deaths in developing countries (Jagannathan et al., 2019).

Diagnosis: CVDs are diagnosed using an array of laboratory tests, imaging, and patient and family history. Electrocardiogram (EKG/ECG), Stress Testing, Echocardiogram, Coronary Angiography and Cardiac Catheterization, chest X-ray, Electron-Beam Computed Tomography (EBCT), and Cardiac Magnetic Resonance Imaging (Cardiac MRI) are some of the primary diagnostic tools used to diagnosed CVD condition (Mandal, 2023).

Treatment: While medication management and surgery may offer solutions to some CVDs, eating a healthy diet, exercise and overall lifestyle medication hold the key to many heart problems. Some

treatment regimens may include aspirin, statins, beta-blockers and angiotensin-converting enzyme inhibitors. Other CVD cases may require surgical procedures including but not limited to coronary artery bypass, valve repair and replacement, artificial transplantation, stenting or ablation, balloon angioplasty or artificial heart operations (WHO, 2021).

1.9 Canada's Population and Demography

Defined population demography is critical in disease burden analysis. Canada is one of the North American countries sharing a border with the north of the United States of America. Canada became a 'self-governing dominion' in 1987 (CIA, no date; Statistics Canada, 2023).

1.9.1 Geography - Area, climate and natural resources

Canada has a total of 9,984,670 sq km, with 8.9% of the area covered with water and 91.15 covered with land (9,093,507 sq km of land and 891,163 sq km of water). Canada's climate "varies from temperate in the south to subarctic and arctic in the north." Canada has the following natural resources -bauxite, copper, lead, gold, iron ore, zinc, nickel, uranium, rare earth elements, potash, molybdenum, diamonds, timber, silver, fish, wildlife, petroleum, hydropower, natural gas, coal. Canada is among the countries with the largest deposit of uranium globally (CIA, 2023).

1.9.2 Population

Population trend: Records show an increasing Canadian population. In 2011, the Canadian population was estimated at 34,330,000, whilst in 2021 (a decade later), the population rose to about 38,250,000 (+10.25%) (Statista, 2022). A year later (April 1, 2022), the Canadian population rose to about 38,654,738 (Statistics Canada, 2022). As of March 9, 2023, the population of Canada is **39,483,209**. The province of Ontario has the largest population of 15,347,542, followed by Quebec with 8,767,694 and British Columbia with 5,387,694 populations, respectively, while the least populated territory is Nunavut, estimated at 40,626 (Statistics Canada, 2022). Of note, a record high (+0.3 percent increase in population) was recorded between January 1 and April 1, 2022, with an increase of 127,978 people within the first quarter of 2022. This increase is the highest population growth record since the early 1990s (Statistics Canada, 2022). As of 2023, the Canadian population growth is 0.73% per (CIA, 2023).

Upward trend in population: In retrospect, records show a noticeable upward trend in the Ontario population which currently seats 15,007,816 - surpassing the usual 15,000,000 people threshold. The appreciable growth seems noticeable across Canada in recent times (Statistics Canada, 2022). In the first quarter of 2022, Canada welcomed 113,699 people – the highest since 1994. International migration remains the most contributory factor to Canada's continued upward trend of population growth. While Ontario continues to be the most populated province, followed by British Colombia and Alberta, respectively, the least populated part of the country is Nunavut, with a population estimated at approximately 40,000 people (Statista, 2022; Statistics Canada, 2022).

Population dynamics and migration effects: The Canadian population dynamics continue to change with the influx of migrants across the provinces and territories. As earlier stated, international migration and natural increase through births, excluding deaths, are the two factors that drive a defined population. According to the 2021 Census, the percentage of immigrants was 23%, with the total number of immigrants recorded as 8,361,505 – representing more than 20% of the Canadian population (Statistics Canada, 2023). Between 2016 and 2021, the total number of immigrants was 1,328,240, while the percentage of the second-generation population was 17.6% (Statistics Canada, 2022). While the population increases with immigrants, more Canadians continue to age. On July 1, 2022, records show that nearly 20% (1 in 5 Canadians) were at least 65 years old, while persons in age groups 0 to 14 were 15.6% (Statistics Canada, 2022). Given that ageing is one of the risk factors for CVDs, the increasing CVD prevalence may be connected with the aging population in part

Statistics Canada (2021) states that "between July 1, 2020, and July 1, 2021, 74.9% of Canada's growth came from international migration, representing a net increase of 156,503 persons". By 2031, it is projected that migration will most likely account for more than 80 percent of the population growth, thus overtaking the increase due to natural causes in Canada. In perspective, the social norms, culture, tradition, heritage, health literacy, values and migrants' perceptions toward health challenges need to be reviewed annually to revamp the health interventions for managing emerging and contemporary health issues. The multicultural approach in health management profiles and models will allow for the existential integration of migrants.

***Gender distribution*:** The record shows a steady upward trend in the Canadian population for both males and females. In 2010, the male population was 16,847,823 – this number rose to 18,885,776 in 2020 (19,357,704 in 2022), while the Canadian female population rose from 17,157,066 in 2010 to 19,121,390 in 2020 (19,572,198 in 2022). The male population accounts for 49.7% of Canadians, while the female accounts for 50.1% of Canadians as of 2022 (Statistics Canada, 2023).

Age distribution: In 2022**,** the population of Canadians in the 18 to 24 years age group estimated as about 3.4 million or 8.73% Canadians (male 1.76 and female 1.64 million) was the lowest, followed by the 0 to 17 age group estimated as 7.32 million or 18.85% Canadians (male 3.54 and female: 3.74 million) closely followed by the older adult, 65 years and older estimated 7.33 million or 18.83% Canadians (male 3.38 and female 3.95 million). Canadians in the 45-to-64-year age group were estimated at 10.1 million or 25.94% Canadians (male 5.1 and female 5 million), while persons aged 25 to 44 years were estimated at 10.78 million or 27.69% (male 5.47 and female 5.31 million) takes the lead as the most populated age group in Canada with the median age estimated as 41.7 years (Statista, 2023; Statistics Canada, 2023).

Ethnic groups: Canada is a multicultural country inhabited by the Indigenous or Aboriginal people (a collective name for the First Nations, Metis, and Inuit people) and immigrants. The population of the ethnic groups in percentages are – "Canadian 32.3%, English 18.3%, Scottish 13.9%, French 13.6%, Irish 13.4%, German 9.6%, Chinese 5.1%, Italian 4.6%, North American Indian 4.4%, East Indian 4%, Ukrainian 3.9%, other 47.7% (2016 est.)" (CIA, 2023, np). Of note is the disproportionate social determinant of health in the Aboriginal communities compared with other Canadians' thus the increased prevalence of CVD and other communicable diseases in their communities (CCHS, 2005; CFHI, 2014).

Language: English is the most spoken language in Canada as one of the official languages, accounting for 58.7% of the total spoken language, followed by the second official language, French at 22%. Other languages in Canada are "Punjabi 1.4%, Italian 1.3%, Spanish 1.3%, German 1.3%, Cantonese 1.2%, Tagalog 1.2%, Arabic 1.1%, other 10.5% (2011 est.)" (CIA, 2023, np).

Religions: Religion plays a critical role in the population's health outcome and healthcare utilization rate. Religion arguably has an impact on the cardiovascular care of the Canadian population. Health users tend to comply with the treatment regimen if their regional perspective is unbiased (Dinham, 2018). According to the 2011 estimated records, Canada population based on the religion was – "Catholic 39% (includes Roman Catholic 38.8%, other Catholic .2%), Protestant 20.3% (includes United Church 6.1%, Anglican 5%, Baptist 1.9%, Lutheran 1.5%, Pentecostal 1.5%, Presbyterian 1.4%, another Protestant 2.9%), Orthodox 1.6%, other Christian 6.3%, Muslim 3.2%, Hindu 1.5%, Sikh 1.4%, Buddhist 1.1%, Jewish 1%, other 0.6%, none 23.9%" (CIA, 2023, np).

Life Expectancy: Despite a slight change in population growth and change in population dynamics, the life expectable is mostly stable over the past decade. Between 2009 and 2011, the Canadian's life expectancy was 81.40, with a minimal increase of 0.57 between 2018 and 2020, when the life expectancy was estimated at 81.87 years (Statistics Canada, 2023). In 2016, Canada's life expectancy at birth was 81.9 years (79.2 for males and 84.6 for females), the total fertility rate was 1.6 children born per woman; total births per 1000 population was 10.3 with a population growth of 0.74 percentile, the mortality rate was 7.4 deaths per 1 000 population (CIA, 2017).

1.9.3 Government

Canada's government types include "Federal parliamentary democracy (Parliament of Canada) under a constitutional monarchy; a Commonwealth realm; federal and state authorities and responsibilities regulated in the constitution," with her capital located in Ottawa in the province of Ontario (CIA, 2023, np). Since September 8, 2022, the chief of state has been King Charles III, represented by Governor General Mary Simon, since July 6, 2021 (CIA, 2023). The head of government is Prime Minister Justin Trudeau since November 4, 2015. Canada has ten provinces and three territories.

1.9.4 Economy

Canada is a notable global financial. Canada is the largest United States trading partner. Canada's GDP (purchasing power parity) was $1.832 trillion as of 2021, with real GDP per capita estimated at $47,900 as of 2021 (CIA, 2023).

1.9.5 Social Determinants and Health Inequalities

Health status differs across the society. The difference in the health status among the groups in a given society of different communities is termed health inequality (Government of Canada, 2022). The said differences could be predisposed by either biological factors, environmental factors (which is beyond the control of individuals), behavioural factors (chance of choices made which is modifiable) or socioeconomic factors such as education, income, available social support, employment, and access to quality health services. The biological and behavioural factors are largely caused by uneven distribution and disproportionate socioeconomic factors. The effect of health inequality and the disproportionate social determinants across Canada are assessed in this study as the social determinants and health inequality contribute largely to an array of CVD risk factors apart from the modifiable, non-modifiable and biological factors.

1.9.5 Effect of demographic and epidemiological transition age, gender and ethnicity

According to Defo (2014), pre-transition, transitory disequilibrium, and post-transition reflect demographic changes based on the shift in mortality and fertility rate. While Canada's population continues to grow, Canada is in the post-transition regime of demographic transition (with a low mortality rate, fluctuating fertility and declining population growth rate). A remarkable increase in the ageing population is noticeable, unlike the 1960s record (Defo, 2014; Statistic Canada, 2016). Since age is one of the CVD's uncontrollable risk factors, the increased trajectory of CVDs among older adults is justifiable. The trajectory of CVD being the leading cause of death is in part in connection with the observable epidemiological shift from communicable/infectious to non-communicable/chronic diseases as the leading cause of death (Lozano et al., 2012).

According to the Institute of Health Metrics and Evaluation, IHME (2016) report, life expectancy for males was 79.4 and 83.4 years for females in Canada as of 2013. This life expectancy contrasts with 1941 recorded as 63.0 and 66.3 for males and females, thus corroborating the aging report (Statistics Canada, 2016). According to the CCDSS (2023), the record shows that more males and elderly report and or were diagnosed with heart disease in Canada. Another socioeconomic group presenting with a higher prevalence of CVDs is Aboriginal people. According to Earle (2013), Aboriginal people experience disproportionate healthcare, environmental, political, and socioeconomic factors

compared to other Canadians. Corroboratively, Aboriginal people are at least ten times at risk of dying from CVD comparatively. In perspective, improving the Aboriginal health determinants, such as but not limited to increasing health facilities, education, income, and affordable food supply, will result in positive health outcomes (Reading, 2015).

CHAPTER TWO

2.0 Bibliography

In 2019, records show an estimated 17.9 million (about 231 per 100,000) people died from CVDs (WHO, 2021). About 9.6 million deaths among men were attributable to CVDs, while 8.9 million were reported among women (Kauffman, 2020). Haiti has the highest age-standardized CVD mortality rate at 428.7 deaths per 100,000, while Peru has the least age-standardized CVD mortality rate at 73.5 deaths per 100,000 population, respectively (PASO, 2023). The record shows that out of 17 million deemed premature deaths (death of persons under the age of 70) due to non-communicable diseases, about 38% were attributable to CVDs in 2019. CVDs remain a major public health threat as they largely contribute to the global disease burden, disability and mortality rate (WHO, 2021).

2.1 Global CVD Trajectory and Public Health Threats

While CVD remains the leading cause of death globally, the increasing trajectory of CVD-attributable mortality is more evident in low, middle-income and high-income countries. Haiti, Guyana, Suriname, Dominican Republic, Honduras, Grenada and the Bahamas had the highest prevalence of age-standardized CVD-attributable deaths, respectively. Of all the predisposing factors, ischemic heart disease, estimated at 73.6 deaths per 100,000 population, was the leading cause of CVDs-attributable mortality, followed by stroke (32.3), other circulatory diseases (14.8), hypertensive heart disease (10.6), cardiomyopathy, myocarditis, endocarditis (5.1) and rheumatic heart disease (0.7) in 2019 respectively (Pan American Health Organization, PAHO, 2023). Unlike in high-income countries, the CVD mortality rate continues to rise in most low- and middle-income countries for decades. It is projected to continue to increase due to the aging population and population growth (PAHO, 2023).

Of note is the prevalence of CVDs in socially disadvantaged and underserved population regions. While the rate of CVD death decreases in high-income countries, the record continues to rise in both low and middle-income countries comparatively (Jagannathan et al., 2019). According to the WHO (2021), findings show that about 75% of CVD-attributable deaths are from low and middle-income countries. The population in these areas has limited access to primary health care for early diagnosis, which is arguable to have been the contributory factor to the significant CVDs-attributable mortality rate. Late detection of CVDs limits the treatment efficacy, hence the increased mortality. Access to

primary health care for CVD management offers promising trajectory CVD outcomes. Notwithstanding access to the primary care center, Kaminsky et al. (2022) emphasize the importance of a CVD prevention program focusing on a healthy lifestyle and cardiac rehabilitation programme. In retrospect, a certain healthy lifestyle comes at a cost that continues to limit the efficacy of CVD prevention programs in socially disadvantaged areas.

2.2 CVD Burden

Economic: The continued increase in the prevalence of CVDs comes at a significant cost. Findings show that about 70% of all deaths are attributable to non-communicable disease, 60% of disability-adjusted life (DALYs), and at least 80% of years lived with disability (YLD) (Gheorghe et al., 2018). In the United States, the cost of CVD care and its risk factors rose from $212 billion in 1996 to $320 billion in 2016 (Birger et al., 2021). Evidence shows that CVD costs are between 7.6% and 21.0% of national health expenditures globally (Santos et al., 2020).

No doubt, the increased rate of CVD risk factors has economic implications. About 9% were diagnosed with diabetes alone, with a projected cost of US$612 billion globally over a decade ago (Abdullah et al., 2015). Although there are limited studies to substantiate the financial implication of CVD in Canada, the disease with the highest expenditure is CVD, which accounted for about CAD$22 billion in direct and indirect costs over a decade ago (Tarride et al., 2009). In perspective, the prevalence of diabetes rose by 70% between 1999 and 2009, with an estimated cost of CAD 2.5 billion. This cost is projected to increase by CAD$8 billion by 2016 (Abdulah et al., 2015).

Every year, heart and stroke disease cost the Canadian economy more than CAD$20 billion in direct and indirect costs (Heart and Stroke Foundation, 2012). An additional cost is expected to add up when other CVD risk factors are added as no less than 10% of all Canadians who visit the primary care physician is related to CVD while 17% (205 for men, 14% for women) of all hospitalization is associated with CVD in 2006 where 34.6 million was reported as the total visits in 2007 (Government of Canada 2020). The CVD-health expenditure, attributable deaths, and disability reduce direct and indirect productivity in Canada.

Clinical implication and CVD-attributable disability: CVD accounts for 40.8 million disability-adjusted life years (DALYs) annually and "36.4 million years of life lost (YLLs) due to premature deaths (89% of total CVD DALYs. 4.5 million years lived with disability (YLDs)" (PAHO, 2023).

Socioeconomic effect: Increasing evidence suggests the effect of demographic shift, particularly on the aging population. Findings show an increased prevalence of CVD among older adults (65+) as they present more to the hospital for CVD care – hence an increased utilization of healthcare resources by these age groups (Canadian Foundation for Health Improvement, CFHI 2023). The socioeconomic status of the population has a direct impact on the public health outcome. The limited access to healthcare services, low education level, low economic status, disproportionate environmental factors, and limited access to affordable healthy food in the rural and particularly the aboriginal communities directly correlate with an increased prevalence of CVDs in the said communities (CFHI, 2023). In Canada, CVD-attributable disability has both social and economic impact. Job loss, unemployment, decreased productivity, and increasing cost of social assistance will limit the economic buoyance of the country at par (Government of Canada, 2016). With more Aboriginal people presenting with more CVD risk factors than non-Aboriginal people, the Aboriginal population has a disproportionate cardiovascular disease burden in their regions (Tobe et al., 2015).

2.3 Cardiovascular Disease in Canada

In Canada, cardiovascular diseases (CVDs) account for nearly 30 percent of all reported deaths annually – the leading cause of death (PHAC, 2015; IHME, 2023). Of all CVDs, ischemic heart disease tops the chart of all the leading causes of death and has remained stable for the past decade (IHME, 2023). Between 2009 and 2019, ischemic heart disease (16.9% change), lung cancer (12.1% change), and stroke (20.6% change),), remain the three leading causes of death respectively in Canada (IHME, 2023). Chronic obstructive pulmonary disease (COPD) (30.8% change), which was the fourth leading cause of death in 2009, is now the fifth leading cause of death with a 30% change – with one rank down overtaken by Alzheimer's disease (45.6% change) in 2019 (Institute for Health Metrics and Evaluation, IHME, 2023).

In epidemiology, the distribution of population health indicators and health determinants are closely monitored using selected standardized approaches in assessing the health status of a defined population (CDC, 2012). The profile of mortality and morbidity - incidence (new cases) and prevalence (both new and pre-existing cases in a specified period) enhances risk group identification and the development of an evidence-based modality in addressing both the risk factors and the health issues (Noordzij et al., 2010; CDC, 2012).

According to the CCDSS data, about 8.3% (1 in 12 or 2.6 million) adults (age 20 and over) were reported to be diagnosed with ischemic heart disease (IHD)whilst 14 of these population died of heart disease hourly between 2017 and 2018 (Government of Canada, 2022). The reported death rate is 2.9 times higher for those diagnosed with heart disease and 4.6 times higher among those with a history of heart attack of age 20 and over. The rate of death is nearly doubled to 6.3 times among persons aged 40 and over with diagnosed heart failure compared with those without (Government of Canada, 2022). Canadian men are two times more likely to be diagnosed with a heart attack than women, with evidence showing that men newly diagnosed with a heart attack were ten years younger than women in 2012 (Government of Canada, 2022). 9.8% of Canadian men and 7.15% of Canadian women aged 20 and over were diagnosed with heart disease in 2018, while more than 255 of Canadians aged 65 and over were diagnosed with IHD (PHAC, 2021).

2.4 CVD Risk Factors

Studies show that an array of factors causes nine CVDs. The causes may include genetic or biological factors (mostly uncontrollable), environmental or ecological factors, and human factors, both controllable and preventable.

Modifiable or controllable risk factors: These are preventable factors, and they include tobacco smoking (7.2 million deaths annually), unhealthy diet, excess salt intake (4.1 million deaths annually), harmful alcohol intake (3.3 million deaths annually), and physical inactivity (1.6 million deaths annually). (World Heart Federation, 2016; Xiao Jun & Balluz, 2011; CFHI, 2014).

***Metabolic risk factors*:** Four fundamental metabolic changes are caused by metabolic risk factors, including raised blood pressure (19% of all global deaths annually), followed by overweight/obesity, hyperglycemia (high level of glucose in the bloodstream) and hyperlipidemia (high level of fat in the

bloodstream) respectively (PAHO, 2023). The recent data as of 2022 shows a marked increase in deaths attributable to metabolic risk factors. According to the World Heart Federation, in 2016, raised blood pressure accounted for 13 percent of all CVD-related deaths, followed by smoking (9 percent), raised blood glucose (6 percent), physical inactivity (6 percent), and overweight, and obesity (5 percent) respectively (World Heart Federation, 2016). This implies that a healthy lifestyle will have a remarkable impact on the heart of the population, hence why the Heart and Stoke Foundation (2016) continues to collaborate with schools, communities, policymakers, and other stakeholders to promote a healthy lifestyle.

Uncontrollable risk factors: such as gender (women have low CVD risk until menopause), family history (genetic/hereditary), age (elderly are at high risk), indigenous heritage, and South Asia and African heritage (high risk of developing high blood pressure, diabetes at a younger age), easy accessibility and affordability of cardiovascular care have been found effective for managing the CVD (Heart and Stroke Foundation, 2016).

Ecological factor: From the ecological perspective, individuals' choice of unhealthy lifestyles like smoking and unhealthy eating habits may be classified under the micro level, while the influence of the family on their children's choice of food could be classified under the meso-level system. For example, a family with unhealthy eating habits will predispose the underage population in the family to eat unhealthy food, hence increasing the risk for unhealthy weight, which is one of the CVD risks factors (Sallis et al., 2012). Likewise, an environment with limited social amenities and health facilities could discourage people from healthy choices, hence a macro-level system (Sallis et al., 2012). The best approach towards preventing CVD remains to stay active, eat a healthy diet, maintain a healthy weight, reduce stress, and avoid smoking, to mention a few (Heart and Stroke Foundation, 2016).

Recent findings on the trajectory of CVD risk factors: While unhealthy diets, physical inactivity, and harmful use of alcohol and tobacco use are the leading behaviour risk factors of CVDs, Santos et al. (2020), 10-year study findings show an increase in the prevalence of diabetes from 10.0% to 19.35, dyslipidemia from 37.3% to 52.8%, and hypertension from 44.9% to 57% among the asymptomatic individuals. In Canada, about 90 percent of Canadians have at least one CVD risk factor, while one in three Canadians have about three (3) or more risk factors – such as but not limited to raised blood

pressure, smoking, physical inactivity, obesity and raised blood glucose (CHHS-AP, 2009). Although many CVD cases are unreported, evidence shows that at least one in every 20 Canadians is currently diagnosed with CVD (CHHS-AP, 2009; IHME, 2023). Aboriginal people have twice the risk of developing CVD due to their disproportionate health determinants compared to non-Aboriginal people (CHHS-AP, 2009). With the increasing trajectory of the risk factors, a review of the prevention programs aimed at developing a veracious intervention is imperative.

Selected comorbidity: While the pathophysiological characteristics of CVDs are similar irrespective of the scientific population and comorbidity, studies show diabetes is associated with an increased risk of developing CVDs based on the outcome of the cohort studies by Nanditha et al. (2021). An early diagnosis and effective management of diabetes are deemed not to be a predicting factor of CVDs (Nanditha et al., 2019). Nanditha et al. (2021) stress that people living with HIV have an increased risk of developing CVDs than non-HIV individuals. Of note is the increased rate of sudden cardiac arrest in people aged 2 to 45, which is connected to the said individual's history of cardiovascular diseases, medication and underlying psychiatry history (Allan et al. (2019). Increasing empirical evidence shows the association between obesity and CVDs. It is believed that the etiology and the change in body composition, which interferes with the hemodynamics that alters heart structure, directly correlates with the development of CVDs, including coronary heart disease, stroke and heart failure (Carbone et al., 2019).

Etiology and natural history of cardiovascular disease: "Atherosclerosis is the process of formation of plaque composed of cholesterol, calcium, fat, and other substances in the wall of large and medium-sized arteries causing diminished blood flow to an area of the body" (Adhikary et al., 2022, np). The atherosclerotic vascular disease is classified into cerebrospinal disease, which causes ischemic stroke in the brain, and the CVD affecting the heart and peripheral blood vessels. The increased plaque formation, which accumulates cholesterol particles, reduces the blood flow, consequently decreasing the oxygen to the heart, hence the heart attack (Adhikary et al., 2022). The etiology of CVD is multifactorial and progresses gradually depending on other risk factors (Dreisbach, 2015; Shafi et al., 2019). According to Scott (2004), the major cause of CVD is atherosclerosis with hypertension, tobacco smoking, and hypercholesterolemia. Scott (2004:np.) coined, 'these risk factors unite behind a convergence of mechanism, involving oxidation and inflammation in the artery wall that, with time,

gives rise to characteristic fatty, fibrous lesions. With this, physical trauma and arterial wall inflammation produce lesions and ruptures, leading to heart attack and stroke.

As earlier mentioned, an increased blood pressure could be an asymptomatic-latent period, hence why some affected persons may not be aware of this medical condition (Gulat et al., 2017; Fuchs et al., 2020). An uncontrolled elevated blood pressure impairs the organs' functionality, thus leading to complicated hypertension (Dreisbach, 2015). Since hypertension develops gradually in stages, starting in persons aged 10-30 years, prehypertension occurrence causes increased cardiac output. Following this, peripheral resistance is prominent in people aged 20 to 40 years. This later advance to established hypertension between ages 30 and 50 and then progresses to complicated hypertension at ages 40 and 60 years (Dreisbach, 2015). Conversely, findings show that blood pressure lowering or optimum blood pressure is an essential primary and secondary prevention of CVDs (Rahimi et al., 2021). Health education on CVD prevention is imperative to enhance the knowledge base of the individuals on the subject.

***The host, environment, risk factors and ecological system of CVDs*:** While CVDs affect humans, any environment with a sedentary life and increased cost of healthy food predisposes an increasing prevalence of CVDs. Elevated blood pressure, tobacco use (15 % of adult Canadians), physical inactivity, obesity (40 % of Canadians), diabetes (6 % of Canadians), increased sodium intake, and alcohol are modifiable risk factors. Findings suggest a connection between the high cost of nutrition and low-income earners' intention to lower their risks of developing CVDs (Hassen et al., 2022). Findings show that the risk of CVD increases as we age; women's risk for CVD is low until menopause, while Aboriginal people, Africans and Asians are more at risk of developing CVD (Heart and Stroke Foundation, 2016).

Individuals with low income, low economic status and low purchasing power cannot afford healthy food that could prevent the risk for CVDs. To mitigate the socioeconomic factor, there is a need for a consistent review of healthy food affordability through government subsidies to encourage an individual with limited funds to afford the same. Unlike the non-Aboriginal people in Canada, the Aboriginal people have a greater risk of developing CVD in Canada due to their disproportionate social determinants of health (Tobe et al., 2015). The CVD crisis in the Aboriginal communities

prompted a call for action to optimize CVD health in Canada, focusing on closing the CVD health gaps between the Aboriginal and non-Aboriginal communities (Aziz et al., 2022). A reconciliation effort is proposed to increase the collaboration with the Aboriginal people with a culturally sensitive approach to CVD management. Increased engagement, access to healthcare, increased health research in the Aboriginal communities and increased health literacy across the board are proposed.

2.5 Hypertension

Hypertension (elevated blood pressure) is one of the leading risk factors for CVDs and the leading cause of hospitalization in Canada (CDC, 2016). When the blood pressure is measured, and the systolic is 140 mmHg or higher while the diastolic is 90 mmHg or higher, this measurement is said to be elevated or high blood pressure, indicating hypertension. While a specific cause of hypertension is unknown, studies have shown that hypertension is caused by multifaceted factors throughout the lifespan, which include increased sodium and potassium intakes, smoking, alcohol use, physical activity, lead, psychosocial stress, and the use of blood pressure-lowering drugs (PAHO, 2023). The clinical and economic implication of hypertension makes this health indicator attract both global and national initiates towards combatting the same.

Global findings on hypertension: A 2019 finding shows "the regional age-standardized prevalence of hypertension in adults aged 30–79 was 35.4% (95% uncertainty interval [UI] 33.3–37.6) in the total population. Higher in men 37.6% (95% UI: 34.4–40.9) than in women 33.3% (95% UI: 30.4–36.3)" (PAHO, 2023). According to the WHO, only 69.8% (75.3% women; 64.8% men) of persons living with hypertension were aware globally in 2019. In perspective, nearly 1 in 3 persons living with hypertension is unaware of the condition worldwide as of 2019. Arguably, a nation's economic status and health determinates correlate with the rate of disease conation awareness as countries like Costa Rica, Canada, and the United States top the chart for counties with the highest prevalence of awareness at about 77% awareness rate (PAHO, 2023). While the top 20% of countries with the "highest prevalence of hypertension in 2019 (≥45%) were Paraguay, Dominican Republic, Dominica, Argentina, Grenada, Jamaica, Saint Kitts and Nevis, and Brazil", Paraguay (56.4%) has the highest rate of hypertension with Peru (20.7%) have the least (PAHO, 2020).

Hypertension trend in Canada: As noticeable worldwide, hypertension contributes largely to disability-adjusted life years in Canada. Although the current trend of hypertension is investigated and reported in chapter four of this dissertation, within the past decade, an estimated 1 in 4 Canadian adults is diagnosed with hypertension based on the Canadian Health Measures Survey (CHMS) record (Statistics Canada, 2019). Hypertension is the leading predisposing CVD risk factor that continues to cause a record high death in Canada. In 2010, an estimated $13.9 billion was expended on hypertension care in Canada, this cost rose to $20.5 billion in 2020 thus largely contributing to the CVD-attributable economic burden (Statistics Canada, 2019).

Notwithstanding the prevalence of hypertension and its economic burden, Canada has one of the highest awareness rates of hypertension, with only about 1 in 3 unaware of the rates of hypertension in Canadians (Statistics Canada, 2019). The high awareness rates are attributable to improved knowledge translation efforts and health literacy in Canada thus making Canada one of the three countries with the highest hypertension awareness rate at about 70% (Maurer & Ramos, 2015; Statistics Canada, 2019). Effective management of the CVD predisposing factors limits the rise of CVDs (CDC, 2016). The prevention of hypertension could be classified as primary, secondary, and tertiary.

2.5.1 Prevention of Hypertension

Primary prevention **primarily targets** an unaffected population. Health promotion and education targeting preventative measures to prevent risk factors are articulated (Naidoo & Wills, 2016). Prevention of hypertension, unhealthy weight and increasing physical activities are considered forms of primary prevention of CVD (ODPHP, 2016).

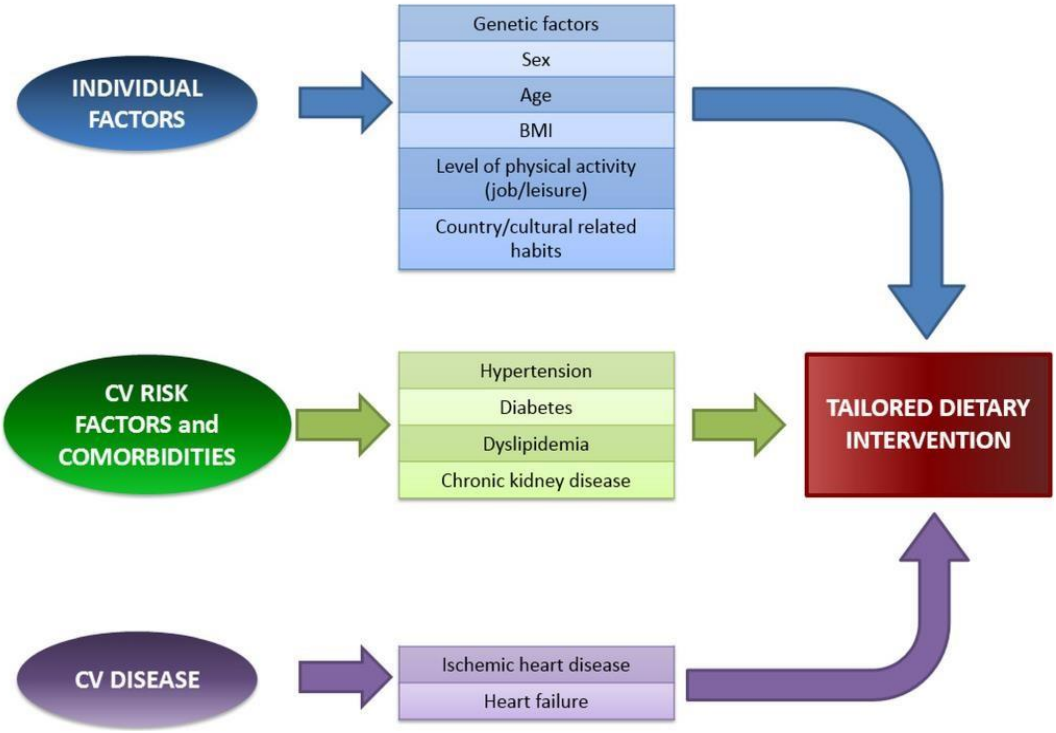
Secondary prevention**:** Once diagnosed with CVD, the aim is to prevent the progression of the disease, thus limiting complications. Prompt treatment of comorbidities (diabetes and obesity), limiting alcohol and tobacco use, constant blood pressure, cholesterol, and lipid monitoring, and adhering to treatment plans are recommended.

Tertiary Prevention: The goal here is to increase the functionality of the affected individual by increasing health literacy on the disease condition and managing the same to prevent complications

and crises. Continue medical follow-up, maintain a healthy weight and seek prompt medical attention when necessary (Bozkurt et al., 2016). See figure 2.1.

Figure 2.1

Cascade of Cardiovascular Disease and Risk Factors



Source: Ravera et al., 2016

2.6 Comparing current and previous epidemiologic outlook of CVD burden

At least 1 in 12 persons aged 20 and older are living with diagnosed heart disease (Government of Canada, 2022). CVD-related death is about three times higher among persons aged 20 and older with diagnosed heart disease compared with others who are not, 4.6 times higher among those with a history of heart attack and 5.3 times among persons aged 40 and older with a diagnosed heart failure. Men are two times more likely to present with heart attacks compared with women. Men (55-64 years) newly diagnosed with heart disease are ten years younger than women (65-74 years). An estimated 14 people aged 20 and older with diagnosed heart disease die hourly in Canada (Government of Canada, 2022). In Canada, CVD-related death rate has declined by over 20% within the past decade (Government of Canada, 2022).

In 2012, the estimated number of CVD cases was 1,300,000, with 66,598 CVD-related deaths at the time the Canadian population was 34,750,545 (CDC, 2017). While the CVD prevalence rate was 37.4 cases per 1,000 population, the CVD-attributable mortality rate was 191.6 per 100,000 in Canada, while the CVD-attributable mortality was 192.7 per 100,000 population in the United States (CDC, 2017).

2.6.1 Epidemiology report of CVD about a decade ago

Epidemiology, the cornerstone of public health, is the study and analysis of disease patterns, disease conditions and their causes, health determinants, population responses, and the management of the same in a defined population (Bhopal, 2016). Epidemiologists integrate descriptive and analytic epidemiological approaches to investigate disease patterns, causes, and trends of health-related events.

2.6.1.1 Descriptive epidemiology of CVD in Canada – previous findings

In descriptive epidemiology, the distribution of CVD is described utilizing a person's (age, gender, and ethnicity), place and time as follows:

By person: Although CVD affects all age groups and ethnic groups in Canada, CVD prevalence is higher among men, the elderly and Aboriginal people. Studies show that Aboriginal people are 1.5 to 2 times more likely to develop CVD than non-Aboriginal due to the disproportionate health determinants and increased risk factors in their community, as illustrated in Figure 1 (HRI, 2017;

CCHS, 2005; CFHI, 2014). In 2014, studies showed that 7% of men and 5 % of women were reported living with CVD (Government of Canada, 2016). Between 2007 and 2010, nearly 1 in 3 Aboriginal persons (30%: First Nations – 11%; Metis – 10%; Inuit – 9%) were diagnosed with CVD, while only about 1 in 7 non-Aboriginal Canadians were living with CVD. Exploring the current trend and identifying possible shifts in the ethnic characteristics, ethnicity, age, gender and location as they impact the CVD profile in recent times is imperative – this is assessed in this study as described in Chapters four and five of this dissertation.

By place: In Canada, reports show that Newfoundland and Labrador are ranked highest (202.3 deaths per 100,000) for mortality related to CVD closely followed by the North West Territory (199.9) and Prince Edward Island (172.3), while Nunavut (97.2 deaths per 100,000) has the lowest mortality rate followed by Quebec (124.6) and British Colombia (131.6) annually between 2009 and 2011respectively (TCBC, 2017). Although Nunavut reported the lowest number of CVD-related deaths between 2009 and 2011, it is puzzling to see the prevalence of some CVD risk factors such as high blood pressure and smoking higher in Nunavut compared to other regions in Canada at the time.

By time: CVD is a chronic disease that develops over a period of time. The time of diagnosis depends on the lifestyle, social determinants and risk factors. Although there has been a decline in CVD-related deaths over the past few decades, in recent times, the decline in CVD-attributed mortality is staggering. Between 2007 and 2014, the proportion of Canadians living with heart disease was stable at 5 percent, while up to 6 percent of Canadians aged 20 and over were reported to be living with heart disease in 2014 (HRI, 2017; Government of Canada, 2016). In 2009, the number of CVD-attributable deaths was 68,703 when the total deaths were 238,418, and the number declined to 67,701 in 2010 at the time the total reported deaths was 240,075 respectively (Statistics Canada, 2017). Although there is an increased change in the death rate in Table 5 above, the number of CVD-related deaths has limited changes. This is why CVD prevalence could be well understood when assessed based on the socio-demographic characteristics of a defined population.

2.6.1.2 Limitations in previous Epidemiology Outlooks

Although the study noted in 2.6.1 by the author of this study provides some insight into the CVD burden in Canada, identified limitations include the generalization of CVD profile without information on selected CVD conditions. The relationship in trend between CVD and its risk factors were not assessed. The study did not include the trend of selected CVD conditions, risk factors, and mortality rate. These identified limitations were investigated to report the current status of CVD burden in Canada in this dissertation.

2.7 Cardiovascular Diseases Interventions

The Public Health Agency of Canada collaborates with many private, government and non-governmental organizations, universities, and health professionals to develop cardiovascular health intervention initiatives to manage cardiovascular disease prevalence (PHAC, 2015). Organizations such as but not limited to the Heart and Stoke Foundation of Canada, Canadian Cardiovascular Society, Hypertension Canada, Canadian India Network Society, and the Institute of Clinical Evaluation Sciences were consulted to develop programs and health interventions chiefly focusing on preventative measures and treatment strategies in view of curbing the prevalence of CVD in Canada (PHAC, 2015; IHME 2016; Heart and Stroke Foundation, 2016).

Canadian Heart Health Strategy and Action Plan (CHHS-AP) was developed to manage the burden of CVD with effective outcomes (Smith, 2009; Arthur et al., 2010). This resonates with the remarkable decline of CVD-related deaths, showing a 75 percent decline rate since a few decades back (Smith, 2009; Heart and Stroke Foundation, 2016). Community empowerment through education on preventing the risk factors was chiefly considered the most effective way to curb the disease. For example, increasing physical activities is recommended in all schools given that 9.3 percent of children and youth (aged 5-17) practice at least 60 minutes of moderate to vigorous exercise per day, with 51.8 percent of the same population spending at least 2 hours watching television or using a computer daily in 2013. Increasing sedentary life is common among young people, as only 22.2 percent of adults met the physical activity guidelines. Smoke cessation and healthy eating habits are promoted (Government of Canada, 2016). This is important as close to 1 in 4 Canadians currently smoke while only 39.7 percent of Canadians consume fruit and vegetables daily.

Arguably, eating well requires having money. In a situation where 9.7 percent of Canadians live under the poverty line, it is not strange to see this vulnerable population present with chronic disease – a phenomenon more apparent in the Aboriginal communities (Government of Canada, 2016). On this note, adequate distribution of wealth and social amenities, as proposed in the action plan, is fundamental. Also, there is no evidence to suggest a single approach to treating CVD – the treatment includes the combination of medication, surgery and or a behavioural approach to avoidance of risk factors (Heart and Stroke Foundation, 2016).

2.7.1 Canadian Heart Health Strategy and Action Plan (CHHS-AP)

Developing a sustainable and equity-focused public health program is fundamental to ascertaining a healthy community as it will combat health inequality (Dunn et al., 2013). For example, an action plan was developed to combat CVD in Canada - the Canadian Heart Health Strategy and Action Plan (CHHS- AP, 2009) primarily focuses on sustainable prevention strategies for cardiovascular diseases. The planning principles and approach of CHHS-AP are centred on educating and empowering the citizens on CVD risk factors and prevention (CHHS-AP, 2009; Heart and Stroke Foundation, 2012).

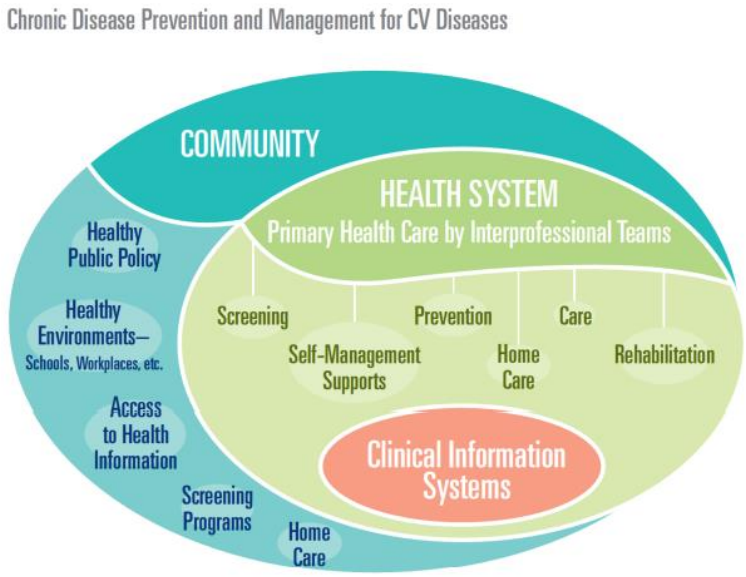
A multi-sectoral approach is considered with the coalition of the health stakeholders, community and government and private organizations. The multi-sectoral approach creates an enabling environment that promotes the efficacy of the prevention strategies (WHO, 2008; CHHS-AP, 2009). Also, the community members and people living with CVD actively participated in the prevention planning. This is important as it promotes patient-centred care (Haber, 2011; Raphael, 2000). Collaboration with the community is also essential as it helps the health promoter to be conversant with the community situation in view of developing a community-based and sustainable health intervention (Walley & Wright, 2010; Muntaner et al., 2012). Notably, questions related to health promotion's needs, processes, outcomes, and impact are key while evaluating the intervention (CDC, 2011; University of Wisconsin-Extension, 2003).

Apart from the preventative approach employed in the action plan, prompt emergency services, specialized care, rehabilitation services, home and community care and end-of-life planning and care are embedded in the action plans (CHHS-AP, 2009). In part, the Wagner model with emphasis on

chronic disease prevention and management for CVD is adopted to showcase the action plan with the objectives mentioned above as in Figure 2.2:

Figure 2.2

Chronic Disease Prevention and Management for CV Disease



CHHS-AP, 2009

2.7.2 Program Process

According to the program representative, in 2006, the Honorable Minister Tony Clement announced the funding for the development of CHHS-AP. A multidisciplinary group comprising 29 members was formed to oversee the program, with 100 professionals involved in the program's development based on the cardiovascular disease burden (Smith, 2009).

2.7.3 Program Aims and Objectives

- To create healthy hearts and healthy environments.
- To help Canadians live healthy lives.
- To deal with the urgent crisis existing in the Aboriginal and Indigenous populations.
- To continue the reform of health services.
- To build the knowledge infrastructure.

- To develop the right service providers

2.7.4 CHHS-AP Program Evaluation

Has the Agency Collected Credible evidence of need? The data were collected from the Public Health Agency of Canada and healthcare stakeholders nationwide and processed by more than 1,500 professionals, making the statistics credible (Smith, 2009). Also, given that studies have shown that up to 80 percent of cardiovascular diseases (CVD) are preventable, the Canadian Heart Health Strategy and Action Plan (CHHS-AP) primarily focuses on sustainable prevention strategies (CHHS-AP, 2009).

Was the Agency's Health Promotion Activities Effective? The strategies identified by the committees aimed at decreasing annual heart attack and stroke deaths by 25 percent by 2020 were partly met. Twenty percent more Canadians now eat healthy diets, and there are fewer Canadians with obesity compared to 2006 data (Smith, 2009). The communities are now more involved through empowerment and improved health literacy in preventing CVD. Canadians now receive excellent cardiac care due to integrative health services (Smith, 2009). A number of jurisdictions are now using the CHHS-AP platform to provide more integrated services, hence mitigating health inequity in the underserved population (CHHS-AP, 2009).

Have the Values and Principles of Health Promotion been met? Citizens were empowered with the knowledge, resources and support needed to manage CVD risk factors (CHHS-AP, 2009; Heart and Stroke Foundation, 2012). Reflecting on the CDC (2011) guidelines, the CHHS-AP (2009) is evaluated based on the rate of accessibility of cardiac care and health literacy (Haque & Dimitropoulos, 2011). The aspect of the program that is considered in judging the program's performance is the decrease in the mortality rate related to cardiovascular diseases. Initial findings before intervention will form the cardinal point in developing health promotion. The intervention outcome will determine if there is a need for improvement.

2.8 Canadian Heart Health in Future

Considering the current level of performance, by 2030, the hospitalization rate due to heart attack and stroke will be reduced by 25 percent, there will be a 32 percent decrease in the Canadians with

high blood pressure, the smoking rate will be reduced by 25 percent, and the rate of CVD among mainstream Canadian will equal Aboriginals (health equity) (Smith, 2009). Evidence showing that the program has performed will reflect health equity. All affected persons nationwide will receive similar treatment regardless of socioeconomic status or geographical location. Of note is the benefit of the blood pression station in selected public places in Canada.

Picture 2.1

Wellness Station in Superstore

Picture by: *Taiwo Olubanwo (2023)*
Location: *Real Canadian Superstore, Moose Jaw, Sk., Canada*

Picture 2.2

Blood Pressure Check Station in Walmart

Picture by: *Taiwo Olubanwo (2023)*
Location: *Walmart Supercentre, Moose Jaw, Sk., Canada*

CHAPTER THREE

3.0 Materials and Methods

A selected population-based community health survey data and health surveillance tool were explored to assess the profile of CVD burden for persons aged 20 and older in Canada between 2010 and 2020 using descriptive epidemiology. The trend, disease burden, and risk factors of the CVD were assessed using data collected from the Canadian Chronic Disease Surveillance System (CCDSS) and Health Inequality Data Tools (HIDT) database between the 2010-2011 and 2019-2020 fiscal years. The age-standardized prevalence of CVD conditions, including - acute myocardial infarction, heart failure, hypertension (high blood pressure/HBP), ischemic heart disease (IHD), stroke (cerebrovascular accident/CVA) and age-standardized mortality rate of CVD. The trend of selected CVD-risk factors, including the age-standardized prevalence rate of alcohol consumption, elevated blood sugar (diabetes), dietary intake (fruit/vegetable), tobacco smoking, and physical activity for persons aged 12 and older, were assessed over ten years. The correlation between the trend of CVD and CVD-risk factors based on population and socio-demographic characteristics is articulated using descriptive epidemiology by person, place and time in Canada.

Objectives: To assess the trend and prevalence of CVDs across Canada. The principles of analytic epidemiology are implemented to assess the association of risk factors of cardiovascular disease (CVD) condition (CDC, 2012). To study the effect of CVD risk factors on the prevalence and incidence of CVD in a population, a 'cohort study, an observational study method is used within a specified period.

Study Design: Age-standardized and population-based data on health inequality, health determinants and CVDs were collected using the Community Health Survey and the clinical providers reported health information. With a secondary quantitative research method, selected population-based observational cohort studies were explored in articulating the effect of CVD risk factors on the prevalence and disease burden of CVD socio-demographic characteristics.

Study Method: An observational study with a quantitative desk-research methodology using the Canadian Chronic Disease Surveillance System (CCDSS) and Health Inequalities Data Tool (HIDT)

to collect data for assessing the effect and trend of selected health indicators on the prevalence of CVDs in Canada between 2009-2010 and 2019-2020. The CVD burden trend and its risk factors are assessed and reported using descriptive epidemiology by person, time and place across Canada. The trend is described and represented with the visual display.

Data sources and collection: The data for this report was successfully extracted from the Canadian Chronic Disease Surveillance System, CCDSS Database, Canada Health Inequality Data Tool and Canadian Community Health Survey as reported by the Public Health Agency of Canada. Although the selected health indicators were collected from partisans aged 12 and above, the CVD conditions were assessed on persons aged 20 and above. The data collection and analysis reflect a population-based and age-standardized perspective. Of note, data extracted from the surveillance system represent a snapshot at the time of extraction. The extracted data may differ from previous or subsequent reports as the data source is a dynamic disease reporting system, which allows ongoing updates to data from existing data at the time of this study.

Data Caveat: The data extracted from the surveillance system and community health survey only represent cases reported to public health units and recorded in the specified case and contact management system (CCM). The data counts and characteristics are subject to varying degrees of underreporting due to factors such as disease awareness and medical care-seeking behaviours secondary to clinical practice, the expertise of the practitioner, changes in laboratory testing, severity of illness, and reporting behaviours. The data caveat is arguably one of the limitations identified in this study.

Health condition of interest: The health condition of interest is cardiovascular disease – which includes acute myocardial infarction, heart failure, hypertension excluding gestational hypertension (high blood pressure), ischemic heart disease, and stroke (cerebrovascular accident).

Risk factors of interest: Diabetes (CCDSS database), unhealthy diet (Nutrition database)**,** harmful use of alcohol, tobacco use, and physical inactivity. Other risk factors include disproportionate social determinants of health and CVD Care access – see Chapters One and Two for some literatures about the selected risk factors.

3.1 CVD Data Collection

Given that CVD is a chronic disease, a passive surveillance approach, known as 'provider-initiated surveillance,' is used. CVD data are continuously collected nationwide through a health insurance database linked with a hospitalization database and physician billing (CDC, 2012; PHAC, 2021; Boston University School of Public Health, 2016). Although CCDSS started with the surveillance of diabetes, in 2009, CCDSS expanded its objectives by including CVD-related conditions such as hypertension. For example, if a person meets criteria such as having a record of 'two or more physician claims within two years, or one inpatient hospital hospitalization related to high blood pressure or hypertension, the person would be considered a case of hypertension diagnosis' (PHAC, 2021).

Table 3.1

CCDSS case definitions

Disease, condition and indicator	Age	Case definition summary	First reported year	Last reported year
Heart failure	40+	One or more hospital separation records, or two or more physician claims within one year	2000–2001	2019–2020
Hypertension, excluding gestational hypertension	20+	One or more hospital separation records, or two or more physician claims within two years	2000–2001	2019–2020
Ischemic heart disease	20+	One or more hospital separation records or procedure code, or two or more physician claims within one year	2000–2001	2019–2020
Stroke	20+	One or more hospital separation records, or two or more physician claims within one year	2003–2004	2019–2020
Hospitalized stroke (annual)	20+	One or more hospital separation records within one year	2000–2001	2019–2020

3.1.1 Canadian Chronic Disease Surveillance System (CCDSS)

Canadian Chronic Disease Surveillance System (CCDSS) is a collaborative network of provincial territorial surveillance systems supported by PHAC where linked administrative data sources are used to estimate the incidence and prevalence of chronic conditions, related risk factors, as well as the public use of health services and their health outcomes (PHAC, 2021). The use of linked administrative data in data collection across the nation fosters consistent and comparative information across jurisdictions.

Table 3.1

THE CANADIAN CHRONIC DISEASE SURVEILLANCE SYSTEM

AN OVERVIEW

The Canadian Chronic Disease Surveillance System (CCDSS) is a collaborative network of provincial and territorial surveillance systems, supported by the Public Health Agency of Canada (PHAC). The CCDSS enhances the scope of data on chronic diseases in Canada and supports the planning of health resources and the development of health policies and programs. It collects data on all residents who are eligible for provincial or territorial health insurance and can generate national estimates and trends over time for over 20 chronic diseases (see the textbox **"Chronic diseases included in the CCDSS"**).[i]

CHRONIC DISEASES INCLUDED IN THE CCDSS

Cardiovascular diseases
- heart failure
- hypertension
- ischemic heart disease, including acute myocardial infarction
- stroke

Chronic respiratory diseases
- asthma
- chronic obstructive pulmonary disease

Mental illnesses
- mental illness
- mood and anxiety disorders
- schizophrenia

Diabetes

Musculoskeletal disorders
- osteoarthritis
- gout and crystal arthropathies
- rheumatoid arthritis
- juvenile idiopathic arthritis
- osteoporosis
- osteoporosis related fractures

Neurological conditions
- dementia, including Alzheimer's disease
- epilepsy
- multiple sclerosis
- parkinsonism, including Parkinson's disease

More information on these diseases is available at: www.canada.ca/en/public-health/services/chronic-diseases.html.

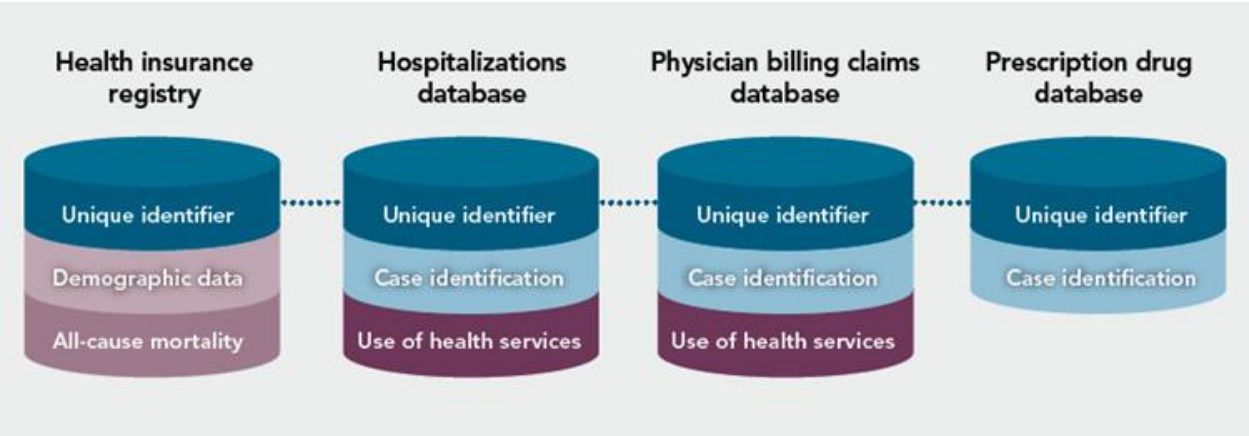
i In this document, the term 'chronic diseases' is also used to refer to chronic conditions, disorders, or health related consequences or events.

Public Health Agency of Canada | Agence de la santé publique du Canada

Canada

Figure 3.1

CCDSS data sources for case identification



Sources: Government of Canada – Public Health Agency of Canada (2021)

3.1.1.1 Strengths of CCDSS

- CCDSS initiatives make it possible for CVD information to be available to the public, through a number of government-instituted platforms (Government of Canada, 2015).
- The PHAC website and its social media platforms, amongst others, provide access to some relevant information on the prevalence and incidence rate of a number of CVD indicators, such as hypertension, coupled with current government action plans on the same (PHAC, 2021).
- Collecting chronic disease-related information through administrative data collection with CCDSS on a day-to-day basis promotes the possibility of analyzing the relationship among chronic diseases (PHAC, 2021).
- CCDSS database validates the co-existence between hypertension and diabetes along with other ‘cardiovascular risk factors such as obesity and elevated lipids or fats in the blood’ (PHAC, 2021).

3.1.1.2 Weakness of CCDSS

- CCDSS's scope is broad; hence, it may need more room for detailed analysis of CVD data.
- Given that some CVD indicators, such as hypertension, may be asymptomatic, there is no specific plan for reporting the unreported data related to asymptomatic cases.

- Although CCDSS has a link to every province and territory, there needs to be more CVD-related information reported from Nunevaut, Quebec City.

3.1.2 Health Inequalities Data Tool

In 2010, the PHN proposed a set of health inequalities indicators. "The Health Inequalities Data Tool contains data on indicators of health status and health determinants, stratified by a range of social and economic characteristics (i.e. social stratifiers) meaningful to health equity. Indicators are grouped into twelve framework components". Public Health Agency of Canada, the Pan-Canadian Public Health Network (PHN), Statistics Canada, and the Canadian Institute for Health Information collaboratively endorsed the Rio Political Declaration on Social Determinants of Health in Canada and other WHO member states (Government of Canada, 2022).

3.2 Alternative Research Study and Methodology

Objective: To investigate the effect of selected risk factors on the potential development of CVD in persons aged 18 and older between 2 and 5 years of observation.

Research design, method and selection criteria: Participants include those with and without CVD risk factors. Both groups of participants would be assessed for two to five years (first 2, then 5 years) to determine who will develop CVD among the participants. During participant selection, participants with evidence of CVD would be reported but not considered in the cohort study. Participants with CVD may be used in a case-control study design following the 'cohort' study.

Participant Selections: Age-standardized 100,000 participants with evidence of selected CVD risk factors and those without the risk factors. The participants are selected from rural and urban cities in a predetermined proportionality, along with their lifestyle and socio-demographic characteristics.

Data Collection*:* A questionnaire is prepared to collect information related to the participant's bio-data, such as age and gender, and socioeconomic status, including education, income, and location (rural or urban). The questionnaire would also be used to collect self-reported CVD-related risk factors. Although self-reported data would be collected through questionnaires, hospital health records and CCDSS data would be collected.

Risk factors of interest: The effect of major CVD risk factors including blood pressure, cigarette smoking, Body Mass Index, and self-reported frequency of physical activity would be assessed. The questionnaire would also assess the participants with a diagnosed and self-reported history of hypertension, stroke, myocardial infarction, and congestive heart, diagnosis or history of diabetes or elevated blood sugar and elevated cholesterol level – which are CVD indicators to streamline the participant to only those with CVD risk factors and those without CVD risk factors (America Heart Association, 2017). In the cohort study, only participants with CVD risk factors and those without risk factors would be recorded and studied for a period (2 to 5 years) in order to identify who develops CVD and who does not.

3.3 Analysis of an exemplified Research study with the use of Observational (Cohort study)

Background: Given that diabetes is one of the risk factors for developing cardiovascular disease (CVD), a study was conducted to assess whether there is an association between hypoglycemia, the risks of CV events and all causes of mortality among insulin-treated people with type 1 and type 2 diabetes using a cohort study (an observational epidemiological study) (Khunti et al. 2015; Thorsted et al., 2015). The main independent variable is hypoglycemia and diabetes, while the outcome, a dependent variable, is CVD.

Objective: To assess the impact of past exposure – diabetes on the outcome (CVD) for persons aged 30 and older for six years

Research design and method: Data including insulin-treated diabetes patients (aged 30 or over) was collected from the clinical practice research datalink database using a retrospective cohort study to assess the impact of (past exposure – to diabetes) on the outcome (of CVD) between January 1, 2001, and December 31, 2007 (Khunti et al., 2015).

Participant Selection: Participants were selected and assigned to the control and study groups as follows – Participants (≥30 years of age) diagnosed with diabetes (being treated with insulin) were selected and assigned to the study group. In contrast, participants with diabetes and a history of CV and those without a history of CV were observed to see the impacts of hypoglycemic episodes on the development of CV. The participants with no hypoglycemic episode and a CV history were mainly the control group. The participants with diabetes who presented with hypoglycemic episodes were

studied and assessed for the possibility of their exposure (diabetes) as a contributory factor to hypoglycemic (study exposure) to developing the outcome (CVD) (Khunti et al., 2015).

3.3.1 Characteristics of the Study

Given that Khunti et al. (2015) study was based on an observational study design, an experimental approach needed to be more evident. Since a cohort study was used, the retrospective aspect of the study reflected the participants with previous exposure (hypoglycemia) while assessing their presentations as touching on the impact of the exposure on the participants' development of CVD. Whereas the diabetic participants with no history of CVD at the index date (January 1, 2001) were followed up to assess their exposure to hypoglycemia to develop the outcome (CV) in future (at the end of the study) (Khunti et al., 2015).

For the cross-sectional study, the exposure of participants to hypoglycemia and their outcome (whether they developed CV or not) were measured simultaneously (CDC, 2012). According to Khunti et al. (2015), the cross-sectional study approach could be considered at the end of the study or any given period as long as the exposure and the outcome (CV) have occurred or not. Since evidence shows that CVD occurred at the end of the study, the participants with CVD would be considered as the case patients. The case-patient (case) and another group of participants without CVD are also enrolled as the control group – then the impact of exposure such as hypoglycemia would be compared among the group (CDD, 2012; Khunti et al., 2015).

3.3.2 Measure of Association

The consideration of the measure of association between study groups with risk of disease due to exposure compared with those with limited or no risk of disease is essential to assess or quantify the relationship between the group with respect to their exposure and presentations (CDC, 2012). For example, in Khunti et al., (2015) study, where the impact of hypoglycemia on the development of CV is studied, the ratio of participants with the risk of CV to the group without risk factors was considered. For patients who experienced hypoglycemia within the study period, the hazard or risk ratio (HR) for developing CV was 1.51 with a 95% confidence interval and 1.61 for those with a CV history before the index date. For all causes of mortality, the HR in those with type 1 diabetes was 1.98, and for those with or without a history of CVD, the HR was 2.48.

3.3.3 Eliminating Biases and Control for Confounders

However, in an attempt to limit the impact of confounding bias and errors, variables such as 'age, sex, smoking status, geographical region, history of CV events before the index date, use of oral antidiabetic medications, Charlson comorbidity index, BMI, and HbA1c level on the index date' were captured in the course of the study apart from the hypoglycemia and diabetes. However, some of the variables, such as BMI, smoking status and HBA1C, were not captured in the database within six months following the index date (Khunti et al., 2015).

Since the variables mentioned above could limit the accuracy of the study outcome, it is essential to capture the said variables and all independent variables to mitigate any confounding bias. One of the ways to checkmate the impact of confounding variables in the study is the randomization of patients in the exposure group - in the study, this was not considered. The researchers need to plan for this element before conducting the study (Khunti et al., 2015).

While some independent variables were considered as possible confounding variables, there is no evidence to indicate the consideration of the family history of CV in patients who later develop CV irrespective of the impact of diabetes and hypoglycemia. Capturing a family history CV could also mitigate compounding bias (Hoseini et al., 2016).

Given that the social determinant of health plays a significant role in the health outcome of diabetes and CV patients, it is essential to capture at least the socioeconomic status, such as the income and education of the participant in the process of sampling and study as this could reflect other predisposing factors for the disease condition (Braveman & Gottlieb, 2014; EDIS, 2015). While Khunti et al. (2015) indicated that the number of participants is adequate, relaying the specific number of the participants and their locations, whether urban or rural, will provide insight into a clear picture of the cause-effect, which allows for the confidence interval justification.

3.4 Formulae used for calculating Prevalence, Incidence and Mortality Rates

Prevalence estimate

$$\textbf{Annual prevalence} = \frac{\text{Total number of individuals meeting annual case definition during the fiscal year}}{\text{Total number of individuals with valid health insurance during the fiscal year}} \times \text{100 or 100,000 for osteoporosis-related fractures and hospitalized stroke events}$$

$$\textbf{Cumulative prevalence} = \frac{\text{Total number of individuals who met the case definition during the capture period and who are alive during the fiscal year}}{\text{Total number of individuals with valid health insurance during the fiscal year}} \times 100$$

$$\textbf{Active prevalence} = \frac{\text{Total number of cumulative prevalence cases meeting active case definition}}{\text{Total number of individuals with valid health insurance during the fiscal year}} \times 100$$

Incidence rate

$$\textbf{Incidence rate} = \frac{\text{Total number of incident cases during the fiscal year}}{\text{Total number of individuals with valid health insurance during the fiscal year} - \text{prevalent cases} + \text{incident cases}} \times 100{,}000$$

Mortality (all-cause) rates and rate ratio

$$\textbf{Mortality (all-cause) rate } \underline{\textbf{with}} \textbf{ the disease/condition} = \frac{\text{Total number of deaths from all causes during the fiscal year among individuals } \textbf{with} \text{ the disease/condition}}{\text{Total number of individuals } \textbf{with} \text{ the disease/condition during the fiscal year}} \times \text{100,000 or 1,000 for hip fracture}$$

$$\textbf{Mortality (all-cause) rate } \underline{\textbf{without}} \textbf{ the disease/condition} = \frac{\text{Total number of deaths from all causes during the fiscal year among individuals } \textbf{without} \text{ the disease/condition}}{\text{Total number of individuals } \textbf{without} \text{ the disease/condition during the fiscal year}} \times \text{100,000 or 1,000 for hip fracture}$$

$$\textbf{Rate ratio of (age-standardized) mortality (all-cause) rates} = \frac{\text{All-cause mortality rate among individuals } \textbf{with} \text{ the disease/condition}}{\text{All-cause mortality rate among individuals } \textbf{without} \text{ the disease/condition}}$$

Source: PHAC, 2023

$$\textit{CVD gender-specific mortality rate} = \frac{\textit{Number of CVDs attributed to a specific gender death}}{\textit{Total number of male populations}}$$

$$\textit{CVD prevalence rate} = \frac{\textit{Number of existing CVD cases}}{\textit{The total number of the population}}$$

$$\textit{Cause-specific mortality rate (for CVD)} = \frac{\textit{Number of CVD-attributed deaths in a specific year.}}{\textit{Total number of Canadian populations in a specific year}}$$

Formula to calculate Percentage Change

$$\%\ \text{change} = 100 \times \frac{(\text{final} - \text{initial})}{|\text{initial}|}$$

Initial value	
Final value	
Change	%
Difference	

CHAPTER FOUR

4.0 Result and Analysis using Descriptive Epidemiology Model

The pattern of a selected cardiovascular disease conditions, risk factors and CVD-attributable mortality rate are explored, assessed, and analyzed by examining the disease characteristics by person (age, gender), place (geographical location) and time. Sequel to the CVD descriptive epidemiology, the analyzed results are interpreted based on the percentage change in the trend of the CVD burden across Canada between 2010-2011 and 2019-2020 fiscal years:

4.1 The trend and prevalence of selected risk factors for CVDs in Canada

From the Health Inequality Data Tool, the prevalence of selected health behaviours with specific health indicators is assessed using the conceptualized framework that reflects the health behaviours, health determinants and health indicators based on the outcome of the Canada Community Health Survey (CCHS) conducted across Canada between 2010 and 2019 as a note in 2017 (2010-2014) and 2022 (2015-2019) editions (Government of Canada, 2023; Public Health Agency of Canada, PHAC, 2023). The assessed indicators are some of the modifiable, metabolic and uncontrollable risks for CVD – this indicator doubles as the health determinants. Of note, the focus of the assessment is to analyze the trend and effects of tobacco smoking, High blood pressure, unhealthy diet, heavy alcohol use, physical inactivity, high blood pressure, overweight and obesity, elevated blood glucose/hyperglycaemic/diabetes, and high cholesterol (LDL, HDL) on the trajectory of CVDs for persons aged 12-year and above over the past decade.

4.1.1 Trend and Prevalence of Tobacco Smoking in Canada

Tobacco smoking is one of the modifiable risk factors for developing CVDs, as many studies have linked Tobacco smoking to a large number of chronic diseases and conditions, including but not limited to CVDs. In this study, evidence shows that tobacco smoking remains a public health threat. The trend and prevalence of this chosen health behaviour are imperative to explore if the same is in tandem with the trends and prevalence of CVDs using descriptive epidemiology reportage.

Trend: Since 2001, findings show a decrease in the age-standardized rate (ASR) and crude rate of daily or occasional smokers from 25.1 % to 17.8 % in 2014 among Canadians aged 12 and older.

In this study, findings show the crude prevalence of daily or occasional smokers among the Canadian population aged 12 to 17 as 5.7 % (male – 6.0 %; female 5.4 %: 95 % CI), while the ASR prevalence was 21.3 % (male - 24.2 %; 18.3 %: 95 % CI) among Canadians aged 18+. In the same period, 2010-14, the crude rate was 9.6 % (male - 10.3 %; female – 9.0 %: 95 % CI) among Canadians aged 65+, see Tables 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and Figure 4.1.

Table 4.1

Smoking, daily or occasionally, children (12-17 years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	5.7	5.2	6.2
Males	Total [Males]	6	5.3	6.6
Females	Total [Females]	5.4	4.7	6.1

Source: Health Inequalities Data Tool - Canadian Community Health Survey

Table 4.2

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Age-standardized rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	21.3	20.9	21.6
Males	Total [Males]	24.2	23.7	24.7
Females	Total [Females]	18.3	17.9	18.8

Table 4.3

Smoking, daily or occasionally, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	9.6	9.2	10
Males	Total [Males]	10.3	9.7	10.9

Females	Total [Females]	9	8.5	9.5

Evidence of downward trend is noticeable in 2022 as finding shows the prevalence of daily and occasional tobacco smoking as 3.5 % (male – 3.3; female – 3.6%: 95% CI) among the Canadian populations aged 12 to 17; 17.6 % (male – 20.3; female – 14.8 %: 95 % CI) of Canadian aged 18+; and 9.5 % (male - 10.7; 8.6 %: 95% CI) of Canadians aged 65 and older as noted in Table 4.4, 4.5 and 4.6 respectively.

Table 4.4

Smoking, daily or occasionally, youth (12-17 years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	3.5	3.1	3.9
Males	Total [Males]	3.3	2.8	3.9
Females	Total [Females]	3.6	3	4.2

Table 4.5

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	17.6	17.2	17.8
Males	Total [Males]	20.3	19.8	20.7
Females	Total [Females]	14.8	14.4	15.1

Table 4.6

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%), Canada between 2010-2014 and 2015-2019

Sex	Overall	Age-standardized rate (ASR)	
		2010-2014	2015-2019
Both sexes	Total	21.3	17.6

Males	Total [Males]	24.2	20.3
Females	Total [Females]	18.3	14.8

Figure 4.1

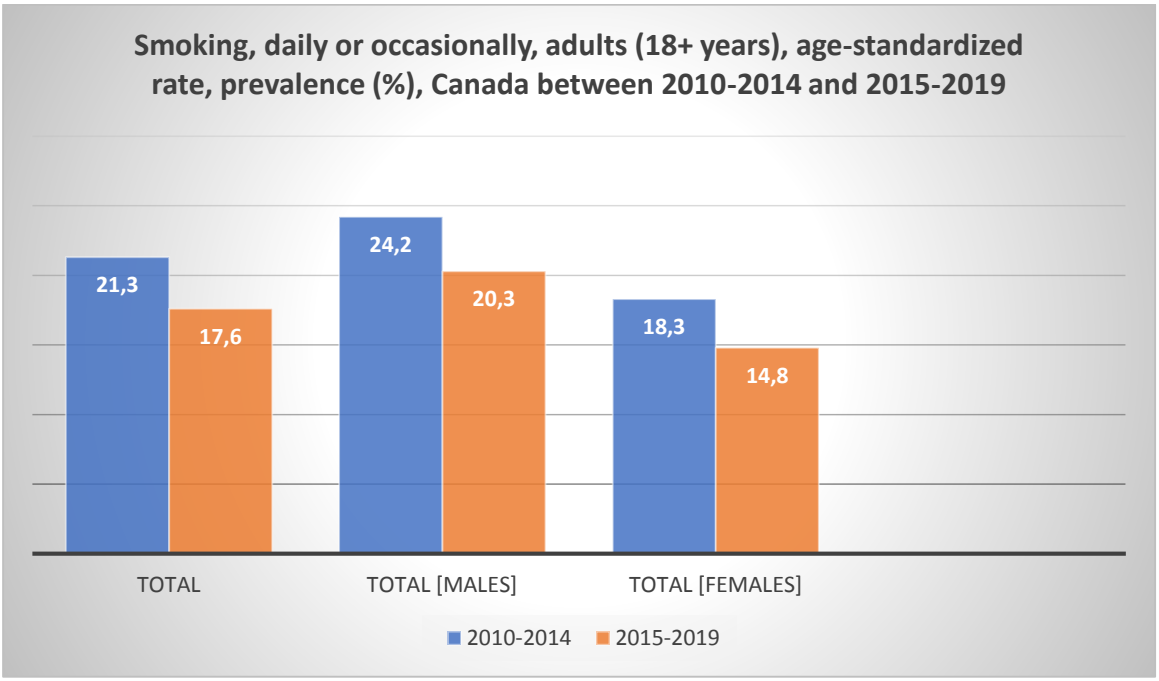


Table 4.7

Smoking, daily or occasionally, seniors (65+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit: 95% CI	Upper limit: 95% CI
Both sexes	Total	9.5	9.1	9.9
Males	Total [Males]	10.7	10	11.3
Females	Total [Females]	8.6	8.1	9.1

In perspective, the ASPR prevalence of tobacco smokers has steadily decreased over the past decade as findings show a decrease from 25.1 % in 2001, 21.3 % in 2010-2014 and 17.6 % in 2015-2019, respectively. The percentage change between 2017 and 2022 was -17.4 %, translating to -3.5 % annual changes. In comparison with the ASR tobacco smoking prevalence annual change of

-2.1 % between 2001 and 2014, as reported by the Public Health Agency of Canada, PHAC (2016), the most recent finding in the 2015-2019 period confirms a continued downward trajectory of - 3.5 % (95 % CI) annual change in the ASR prevalence of tobacco smoking among Canadian aged 18 and above with nearly same trajectory noticeable among Candia's aged 12 to 17 and those in the 65+ age-group see Table 4.7.

4.1.1.1 Prevalence of tobacco smoking by

Gender: Findings show that more Canadian males were tobacco smokers than females. In 2014, 21.1 % of males and 14.8 % of females Canadians aged 12+ were smokers; in 2017, the record was 24.2 % of males vs. 18.3 % of females, while the record shows 20.3 % vs. 14.8 % of females with 95 % CI, respectively. There was an estimated -3.9 % change for males and -3.5 % change for females aged 18+ between 2017 and 2022. Although more males would smoke tobacco in a ratio of 1 in 5 and females in a ratio of about 1 in 6, the recent tobacco cessation programs have had a similar effect across the genders over the past decade.

Age: While findings show 7.8% of youths aged 12-19 reported daily and occasional smoking in 2014, 24.3 % of young adults aged 20-34 were reported to account for the highest number of tobacco smokers, followed by those of age group 35-64 at 20 % respectively. The downward trajectory of tobacco smoking is equally evident across the age groups as it was learnt in this study that 5.7 % of people aged 12 to 17, 21.3 % of persons aged 18 and older and 9.6 % of persons aged 65 and older reported daily and occasional tobacco smoking in 2017. However, 3.5 %, 17.6 % and 9.5 % (95 % CI) of persons aged 12 to 17, 18 and older, and 65 and older reported daily tobacco and occasional tobacco smoking in 2022, respectively. With this evidence, young adults smoke tobacco than older adults, while the youth are the least tobacco smokers in Canada.

Geography/Place: In 2014, the Canada national prevalence of daily and occasional tobacco smokers was estimated at 20 %. While British Columbia has the lowest ASR of 14.4 % daily and occasional tobacco smokers, significantly below the national average, the prevalence was more than the national average in the rest of the Canadian provinces and Yukon. The Northwest Territories (NWT) rate was nearly double the national average, while Nunavut more than tripled the national average in 2014. In 2017, British Columbia continued to have the lowest ASR

prevalence of daily and occasional tobacco smokers at 17.2 % among persons aged 18 years and older, followed by Ontario (20.3 %) and Manitoba (20.9 %) at 95 % CI, respectively. While British Columbia's tobacco smokers rate continues to be the only province whose ASR tobacco smokers' prevalence is below the national average of 21.3 % (95 % CI), the ASR tobacco smokers' prevalence in NWT (38.0 %) nearly doubles the national value and more than doubled the national value in Nunavut (51.1 %). What is apparent is that the rate is decreasing in Nunavut, and NWT is also noticeable across Canada, as noted in Table 4.9 and Figures 4.2 and 4.3.

As noted in Table 4.9, Canada's national daily or occasional tobacco smokers ASR prevalence is 17.5 % (95 % CI) among persons aged 18 and older in 2022. British Columbia (14.1 %) has the lowest prevalence of tobacco smokers in Canada, followed by Prince Edward Island, PEI (17.1 %) and Alberta (17.7 %) respectively. The ASR of tobacco smokers is again more than triple the national average in Nunavut (59.4 %) as recorded in 2014, while the NWT (35.5) rate continues to improve in 2022. As of 2022, PEI (17.1) has joined British Columbia – both are now the only provinces with ASR tobacco prevalence rates below the Canadian national average of tobacco smokers. It would be interesting to know the contributing factors to what led to the remarkable ASR tobacco smokers' record noticeable in British Columbia and now PEI – See tables 4.8-4.11 and figures 4.2 and 4.3.

Table 4.8

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

Region	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Newfoundland and Labrador	24.4	22.7	26.2
Prince Edward Island	23.9	21.9	26
Nova Scotia	24.3	22.7	25.8
New Brunswick	24.3	23	25.6
Québec	23.8	23.1	24.5
Ontario	20.3	19.7	20.8
Manitoba	20.9	19.4	22.4
Saskatchewan	23.8	22.3	25.3
Alberta	22.1	21.1	23.1
British Columbia	17.2	16.3	18
Yukon	29.2	27.1	31.3
Northwest Territories	38	35.4	40.7
Nunavut	51.1	47.2	54.9
Canada	21.3	21	21.7

Table 4.9

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%) in Canada in 2015-2019

Region	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Canada	17.5	17.2	17.8
Newfoundland and Labrador	22.5	21	23.9
Prince Edward Island	17.1	15.6	18.6
Nova Scotia	19.4	18.2	20.7
New Brunswick	17.8	16.5	19.1
Québec	18.9	18.3	19.5
Ontario	16.9	16.4	17.5
Manitoba	18.6	17.3	19.9
Saskatchewan	21.3	19.9	22.6
Alberta	17.7	16.9	18.6
British Columbia	14.1	13.4	14.7
Yukon	22.2	19.6	24.8
Northwest Territories	35.5	31.5	39.4
Nunavut	59.4	55.8	63

Table 4.10

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014, 2015-2019

	Tobacco Smoking in 2010-2014	Tobacco Smoking in 2015-2019
Newfoundland and Labrador	24.4	22.5
Prince Edward Island	23.9	17.1
Nova Scotia	24.3	19.4
New Brunswick	24.3	17.8
Québec	23.8	18.9
Ontario	20.3	16.9
Manitoba	20.9	18.6
Saskatchewan	23.8	21.3
Alberta	22.1	17.7
British Columbia	17.2	14.1
Yukon	29.2	22.2
Northwest Territories	38	35.5
Nunavut	51.1	59.4
Canada	21.3	17.5

Figure 4.2

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%) in Canada in 2010-2014 and 2015-2019

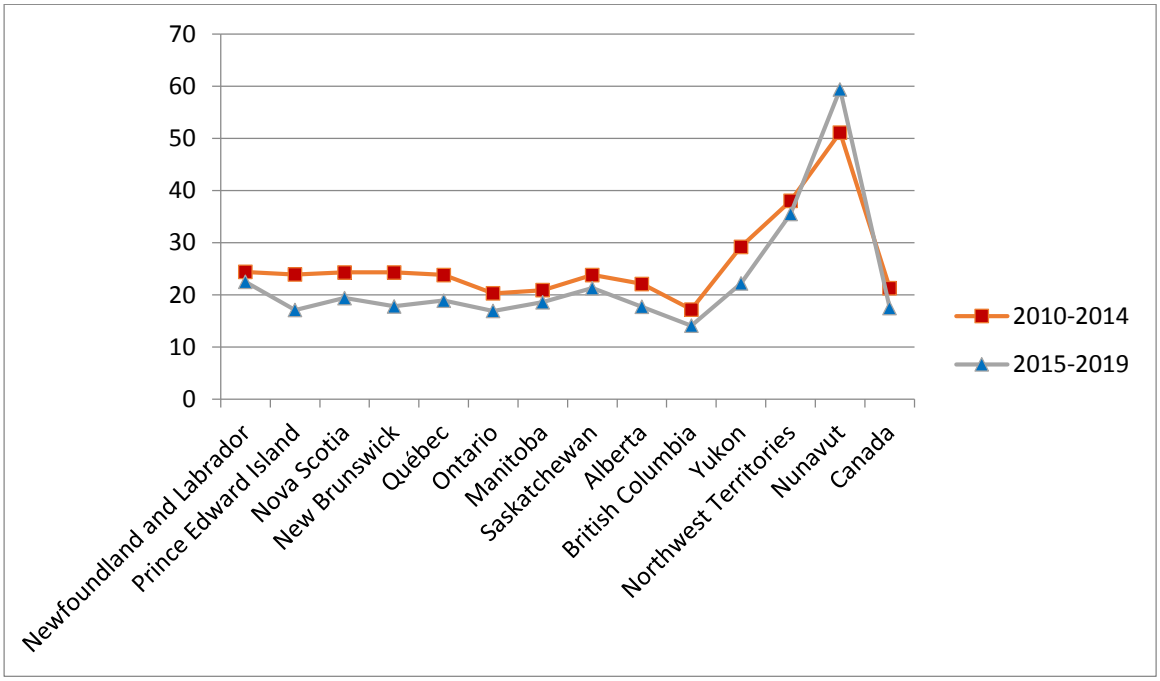


Figure 4.3

Smoking, daily or occasionally, adults (18+ years), age-standardized rate, prevalence (%) in Canada in 2010-2014 and 2015-2019

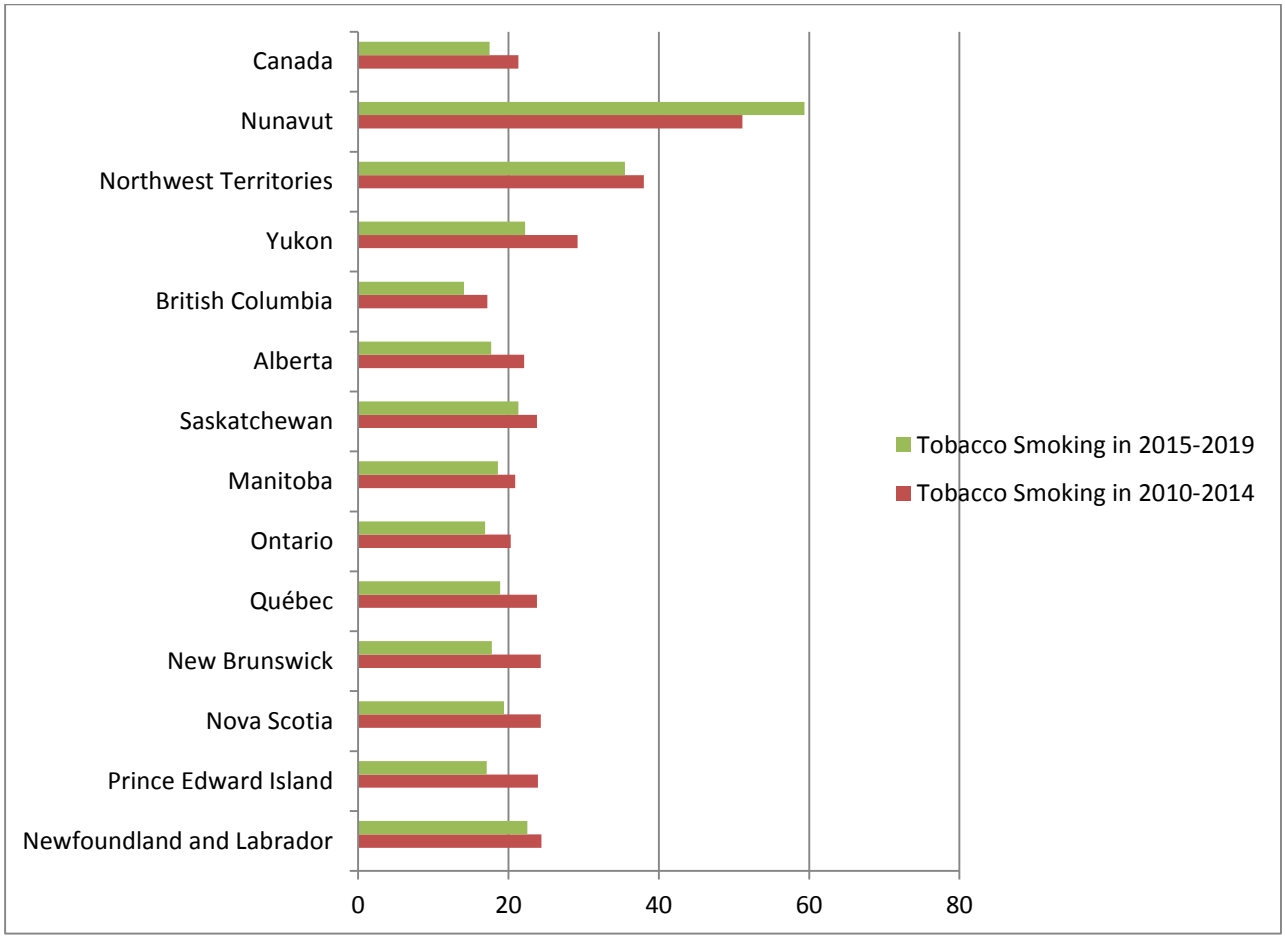


Table 4.11

The prevalence of smoking (daily and occasional) for age 12 and older numerator in Canada, 2010-2014 and 2015-2019

	2010-2014			2015-2019		
	M	F	Total	M	F	Total
12-17	74,950	63,370	138,320	38,336	39,776	78,112
18-64	3,225,600	2,483,030	5,708,630	2,907,199	2,148,793	5,055,992
65+	232,452	241,622	474,074	286,432	268,388	554,820

4.1.2 Trend and Prevalence of Heavy Alcohol Drinkers in Canada

Within the past decade, a shift in the prevalence of heavy alcohol drinkers has been recorded. In 2013, 18.9% of Canadians aged 12+ were heavy alcohol drinkers, with an average change of +/-1 annually up to 2019. A downward trajectory of heavy alcohol drinkers was reported in 2020 (16.6%) and 15.6% in 2021, respectively (Statista, 2022). However, for Canadians aged 18 and older, findings show a slight increase in the ASR prevalence of heavy alcohol drinkers from 19% to 20.2% based on the HIDL analytics. Based on the Pan-Canadian Health Inequalities Data Tool between 2015 and 2022, findings show that 59.4% of males and 40.6% of females aged 12-17 years old reported they consumed alcohol heavily out of the 149,720 respondents. Out of the 4,991,060-population aged 18 to 64 years old, 3,490,626 were male (69.9%), while 1,500,450 were female (30%) who reported heavy alcohol use in 2017. Out of the 268,181 aged 65 years and above noted heavy alcohol users, 197,358 were male (73.6%) and 70, 823 were female (26.4%).

In 2022, findings show that out of 86,626 Canadian populations aged 12-17 who responded to be heavy alcohol users, 48.9% were male, while 51.1% were female. While evidence shows a decline in the persons aged 12-17 years who consume heavy alcohol, the female population seems to have overtaken the heavy alcohol users in this age group. In 2022, out of an estimated 5,838,930 population aged 18 to 64 years old, 3,571,300 were male (61.2%), while 2,267,631 were female (38.8%) who reported heavy alcohol use in 2017. In 2022, out of 419,815 Canadians aged 65 years and above noted to be heavy alcohol users, 278,281 were male (66.3%), and 141,534 were female (33.7%) (Government of Canada, 2022).

4.1.2.1 Prevalence of heavy alcohol drinkers by person:

Gender: The crude and ASR for heavy alcohol use differs across the genders. While males have continued to lead as heavy alcohol drinkers, there is a rise in the prevalence of females aged 18+ who drink alcohol heavily, in contrast with a decline in the rate among males. In 2017, the crude rate prevalence of heavy alcohol users among Canadians aged 12 to 17 years declined from 6.2 to 3.9 % [Male: 7.1 % to 3.7% (-47.9% change); Female: 5.2% to 4.1% (-21.2% change)] with 95% CI. The inference is that the number of males aged 12 to 17 years who have quit drinking alcohol is considerably higher than their female counterparts between 2017 and 2022. The ASR prevalence

of heavy alcohol users among Canadians aged 18+ increased between 2017 (18.9%) and 2022 (20.2%). The increase in the prevalence is, however, noticeable among the females with evidence of upward trajectory (females: 11.4% to 15.7% with a -37.7% change at 95% CI), unlike the males with a record of downward trajectory (males: 26.5% to 24.9% with a 6% change at 95% CI).

While there is evidence of improvement in the ASR prevalence of alcohol users among the males with -6.7% change for persons aged 18 and older, a remarkable increase in the ASPR of alcohol is noticeable in the female population with a +15.7% between 2010 and 2019. Unlike Canadians aged 12 to 17 and 18 and older, findings show an increase (5.5% to 7.3%) in heavy alcohol users among older adults in both males (8.9% to 10.5%) and females (2.7% to 4.6%) between 2010 and 2019. Although there is a marked increase in the number of alcohol users among older adult Canadians, particularly females, it is imperative to note that more old adult female Canadians now consume alcohol than their male counterparts.

Age: While there is a remarkable decrease in the number of Canadians aged 12 to 17 who consume alcohol heavily, findings show an increasing trend in the older adults who consume alcohol in Canada. A slight increase is equally noticeable among Canadians aged 18 and older, with females taking the lead, while the rate decreases in males between 2017 and 2022. With increasing numbers of older adults consuming alcohol in recent times, the likelihood of increased CVD among older adults cannot be overemphasized down the road if no efficacious intervention is explored and implemented. See the prevalence of heavy alcohol drinkers by gender session for the correlation between age, gender and alcohol use above.

4.1.2.2 Prevalence of heavy alcohol drinkers by Place

Geography/Place: Since 2017, only British Columbia (17.3% ASR, 95% CI) has a heavy alcohol drinker prevalence below the Canada national value (19%) for persons aged 18 and older, followed by Alberta (19.7%), Saskatchewan (20.3% and Nunavut (20.5%) respectively. The place in Canada where the highest number of heavy alcohol users were recorded in 2017 was Newfoundland and Labrador. While the rate of alcohol users slightly increases among Canadians aged 18 and older from 19% in 2017 to 20.3% in 2022, Manitoba (18.2%) takes the lead among the provinces with the lowest heavy alcohol drinkers – which is a remarkable improvement with a 16.5% and

surpassing British Columbia (Increased from 17.3% in 2017 to 19.1% in 2022). Unlike in 2017, where only British Columbia's ASR rate of heavy alcohol users was below the Canada National average, four (4) provinces, namely Manitoba (18.2%), Ontario (18.9%), Alberta (19.2%) and PED (19.8%) have joined the provinces whose ASR heavy alcohol users are now below the Canada national value in 2022.

Although NWT (30.9%) has the highest ASR followed by Newfoundland and Labrador (28.8%) in 2017, there was a slight improvement in the ASR prevalence of heavy alcohol users in both NWT (29.8%) and Newfoundland and Labrador (28.6%) in 2022 – these two territory and province continue to have the highest ASR of heavy alcohol drinkers – see Table 4.12, 4.13, 4.14 and Figure 4.4, 4.5 4.6. The model alcohol management model explored by Manitoba and other provinces with an improved ASR heavy alcohol drinkers may hold the key to an overall improvement in alcohol management – See tables 4.12-4.23 and figures 4.4-4.11.

Table 4.12

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

Region	Both Sexes Age-standardized rate 95% CI	Males 95% CI	Females 95% CI
Newfoundland and Labrador	28.8	42.1	16.2
Prince Edward Island	21.1	30	13
Nova Scotia	23.2	30.8	16.3
New Brunswick	22.7	32.9	13
Québec	19.6	27.1	12.3
Ontario	17.6	25.7	9.8
Manitoba	21.8	30.5	13.3
Saskatchewan	20.3	27.2	13.3
Alberta	19.7	26.8	12.3

British Columbia	17.3	23.8	11
Yukon	25	32.5	17.3
Northwest Territories	30.9	39.3	21.8
Nunavut	20.5	24.1	16.2
Canada	19	26.7	11.4

Figure 4.4
Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

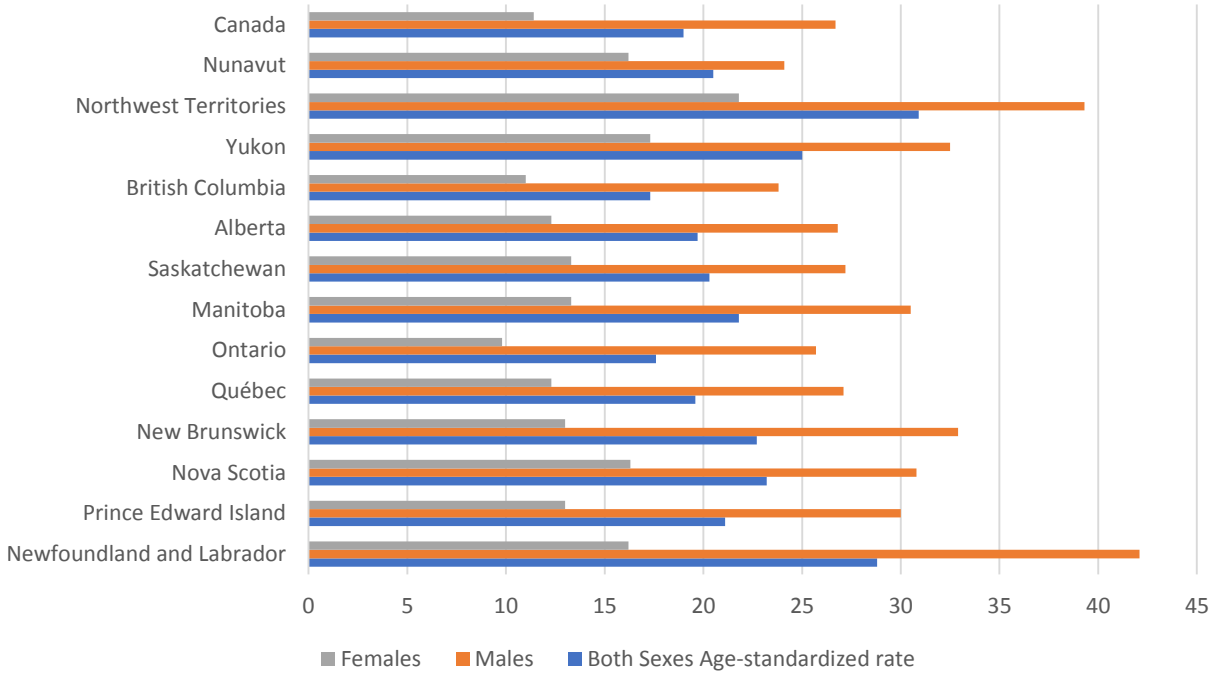


Table 4.13

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2015-2019

Region	Both Sexes Age-standardized rate - 95% CI	Males 95% CI	Females 95% CI
Canada	20.2	24.9	15.7
Newfoundland and Labrador	28.6	37.7	19.8
Prince Edward Island	19.8	25.5	14.4
Nova Scotia	22.5	28.4	17.1
New Brunswick	20.8	27.3	14.4
Québec	22.9	26.6	19.1
Ontario	18.9	23.5	14.5
Manitoba	18.2	22.7	13.9
Saskatchewan	21.4	27.5	15
Alberta	19.2	24	14.3
British Columbia	19.1	24.1	14.4
Yukon	25.9	31.4	20.2
Northwest Territories	29.8	31.8	28
Nunavut	22.1	25.1	18.8

Figure 4.5

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2015-2019

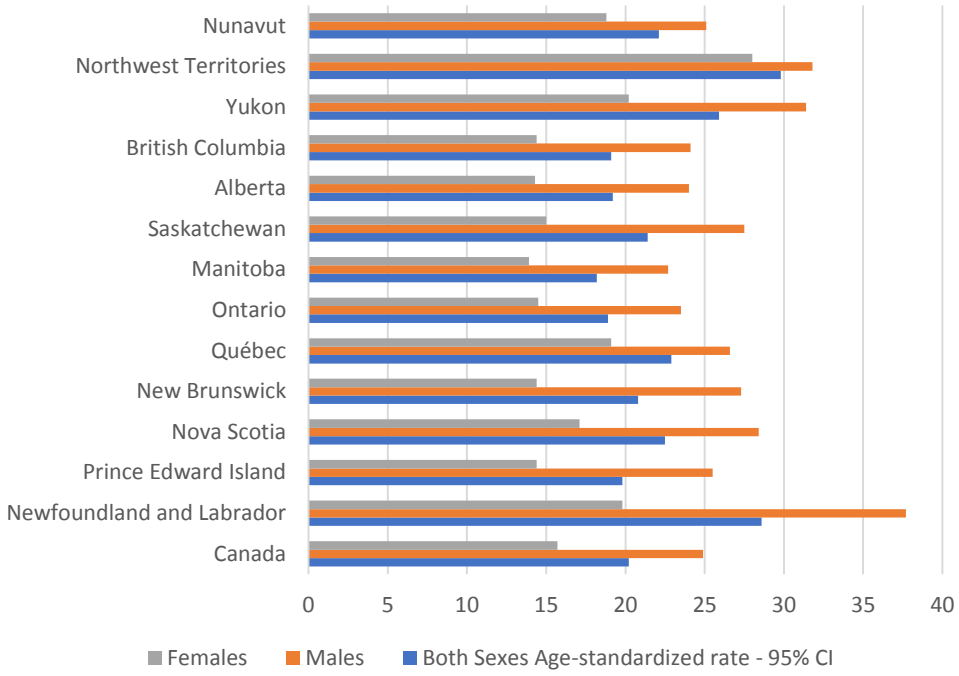


Table 4.14

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%) in Canada between 2010-2014 and 2015-2019

Region	2010-2014 Age-standardized Rate 95% CI	2015-2019 Age-standardized Rate 95% CI
Canada	19	20.2
Newfoundland and Labrador	28.8	28.6
Prince Edward Island	21.1	19.8
Nova Scotia	23.2	22.5
New Brunswick	22.7	20.8
Québec	19.6	22.9
Ontario	17.6	18.9

Manitoba	21.8	18.2
Saskatchewan	20.3	21.4
Alberta	19.7	19.2
British Columbia	17.3	19.1
Yukon	25	25.9
Northwest Territories	30.9	29.8
Nunavut	20.5	22.1

Figure 4.6

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada between 2017 and 2022

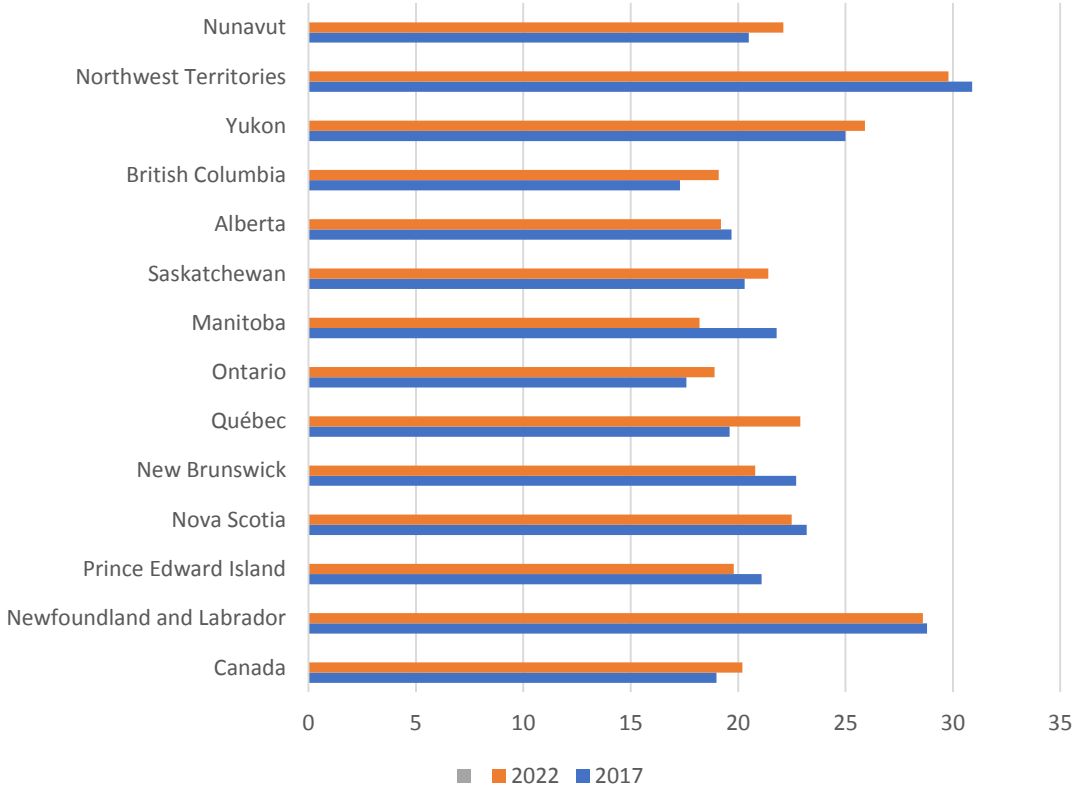


FIGURE 4.7
Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada between 2017 and 2022

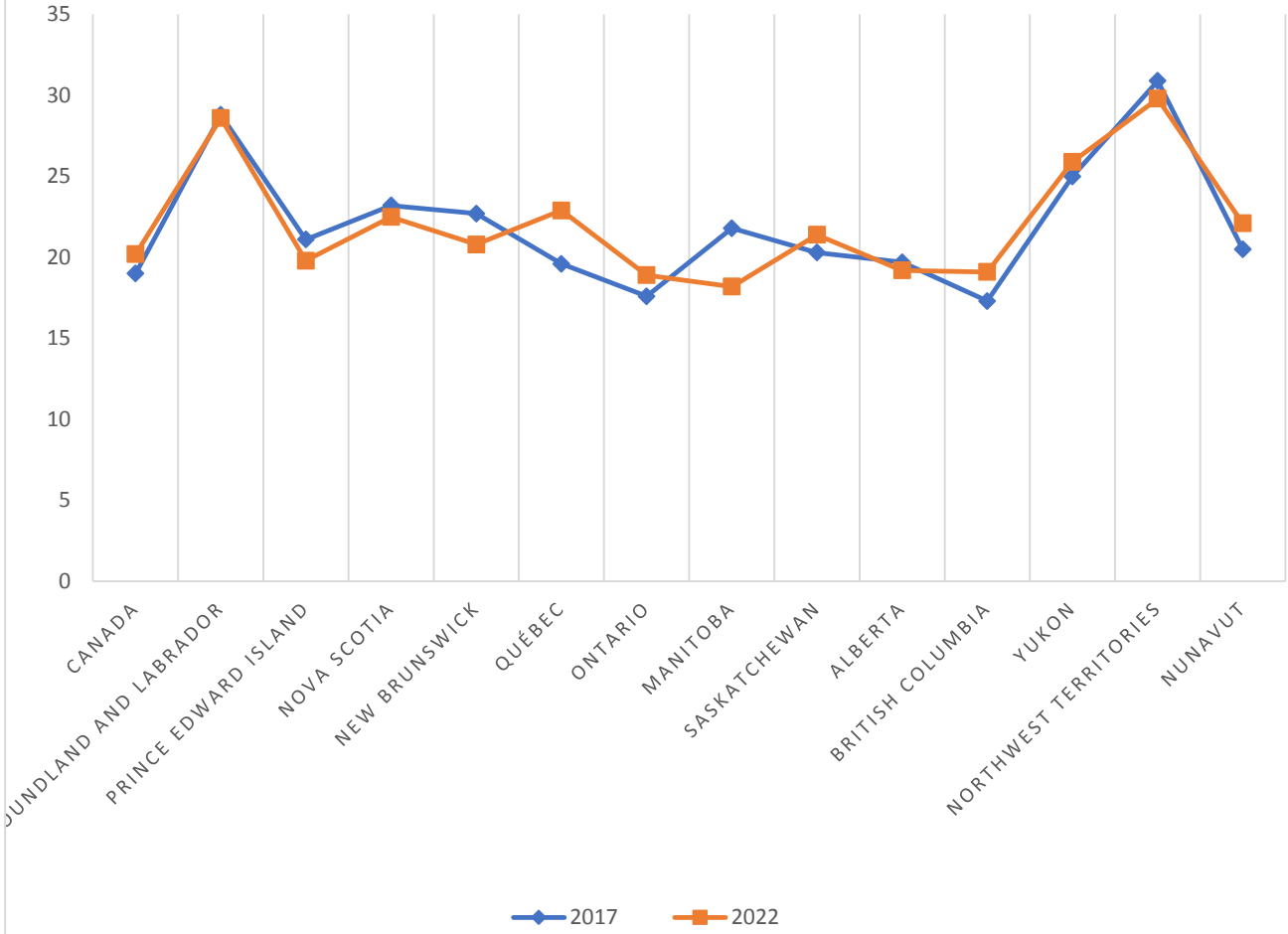
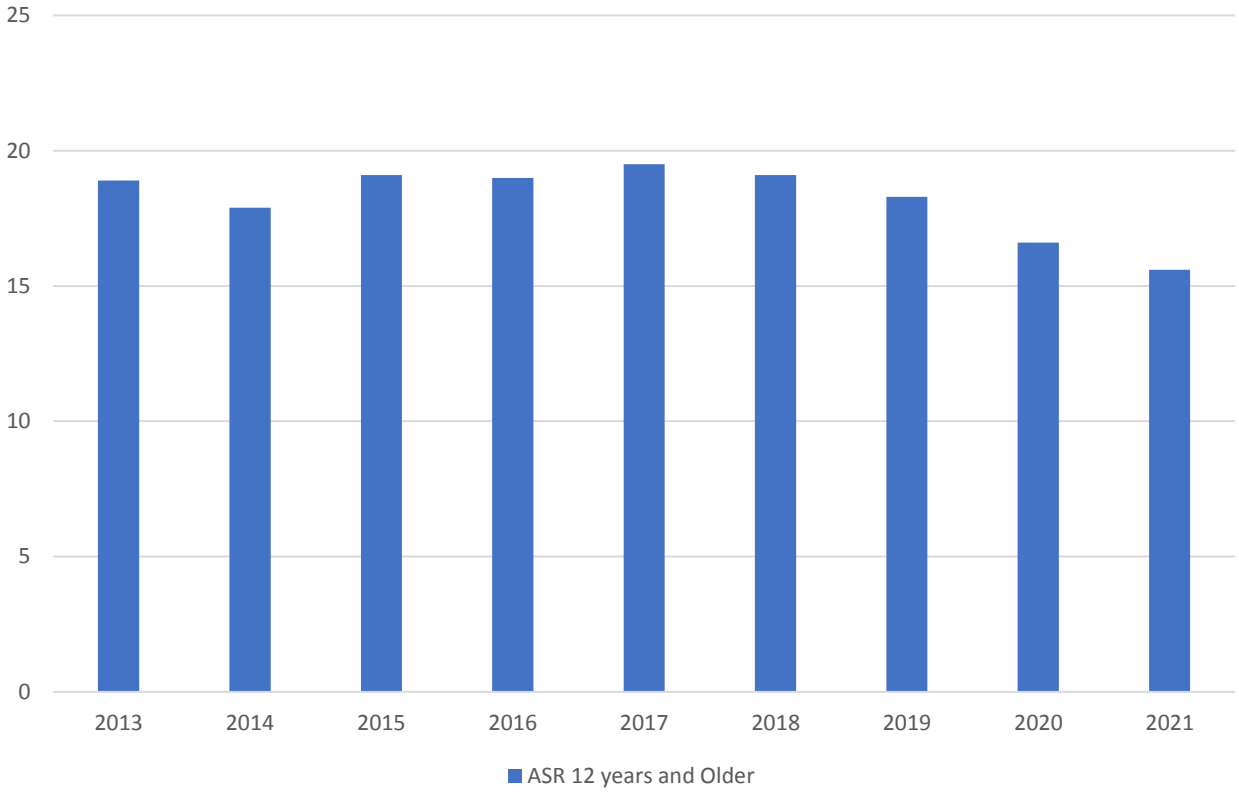


Figure 4.8

Percentage of Canadians aged 12 years and older considered heavy alcohol drinkers from 2013 to 2021



Source: Statista 2023

Table 4.15

Alcohol use, heavy drinking, children (12-17 years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	6.2	5.6	6.7
Males	Total [Males]	7.1	6.3	7.9
Females	Total [Females, reference]	5.2	4.4	5.9

Table 4.16

Alcohol use, heavy drinking, youth (12-17 years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	3.9	3.4	4.3
Males	Total [Males, reference]	3.7	3.1	4.2
Females	Total [Females]	4.1	3.4	4

Table 4.17

Alcohol use, heavy drinking, children (12-17 years), crude rate, prevalence (%), Canada between 2017 and 2022

Sex	Overall	2017 Crude rate	2022 Crude Rate
Both sexes	Total	6.2	3.4
Males	Total [Males]	7.1	3.7
Females	Total [Females, reference]	5.2	4.1

Table 4.18

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2017

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	18.9	18.6	19.2
Males	Total [Males]	26.5	26.0	27.1
Females	Total [Females, reference]	11.4	11.0	11.8

Table 4.19

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada in 2022

Sex	Overall	ASPR	Lower limit95% CI	Upper limit – 95% CI
Both sexes	Total	20.2	19.9	20.5
Males	Total [Males]	24.9	24.4	25.4
Females	Total [Females, reference]	15.7	15.3	16.0

Table 4.20

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada between 2010-2014 and 2015-2019

Overall	2010-2014, ASPR 95% CI	2015-2019, ASPR 95% CI
Total	18.9	20.2
Total [Males]	26.5	24.9
Total [Females]	11.4	15.7

Figure 4.9

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), Canada between 2017 and 2022

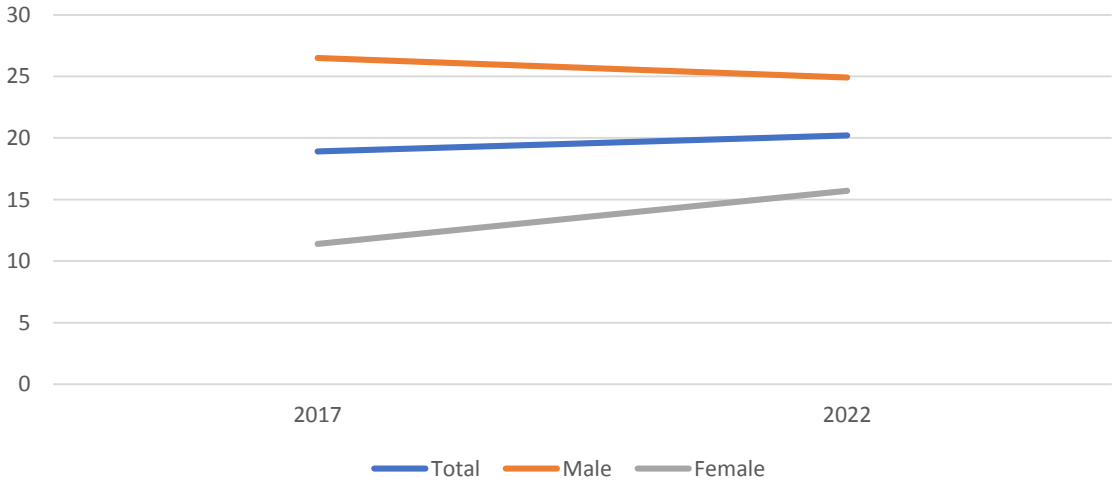


Figure 4.10

Alcohol use, heavy drinking, adults (18+ years), age-standardized rate, prevalence (%), in Canada between 2010-2014 and 2015-2019

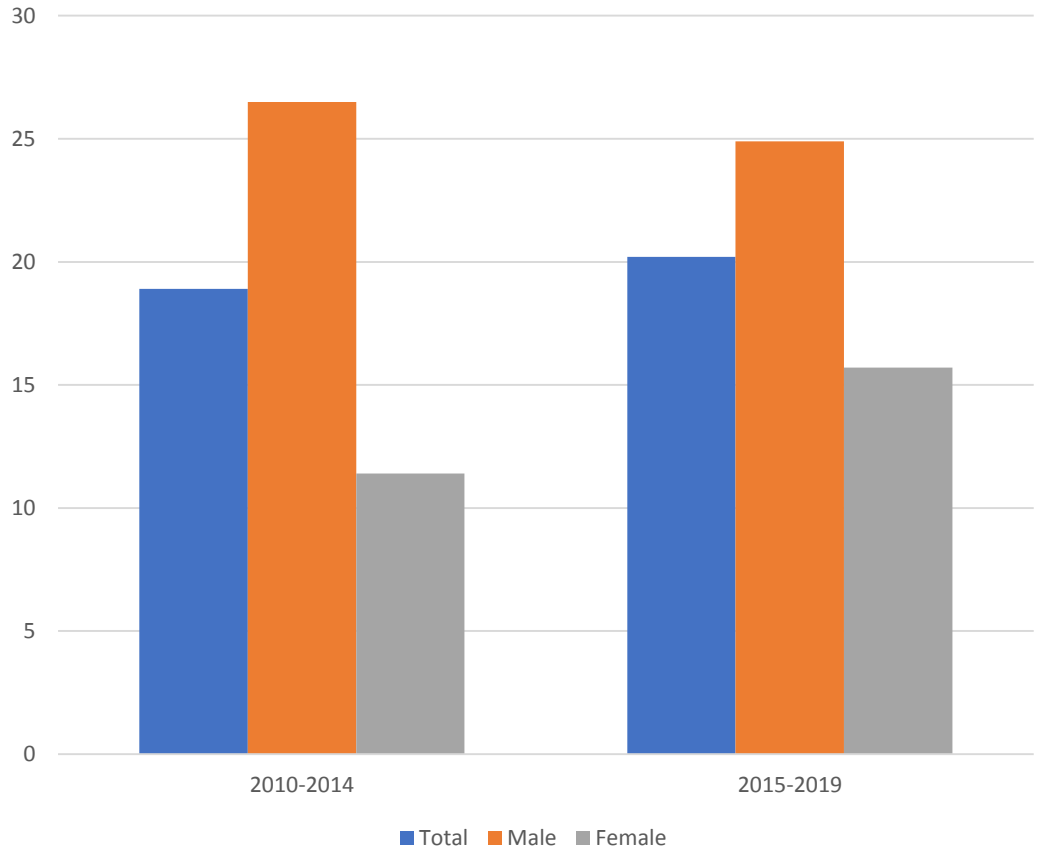


Table 4.21

Alcohol use, heavy drinking, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	5.5	5.3	5.8
Males	Total [Males]	8.9	8.4	9.4
Females	Total [Females,]	2.7	2.4	2.9

Table 4.22

Alcohol use, heavy drinking, seniors (65+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	7.3	7.0	7.6
Males	Total [Males]	10.5	9.9	11.0
Females	Total [Females]	4.6	4.2	4.9

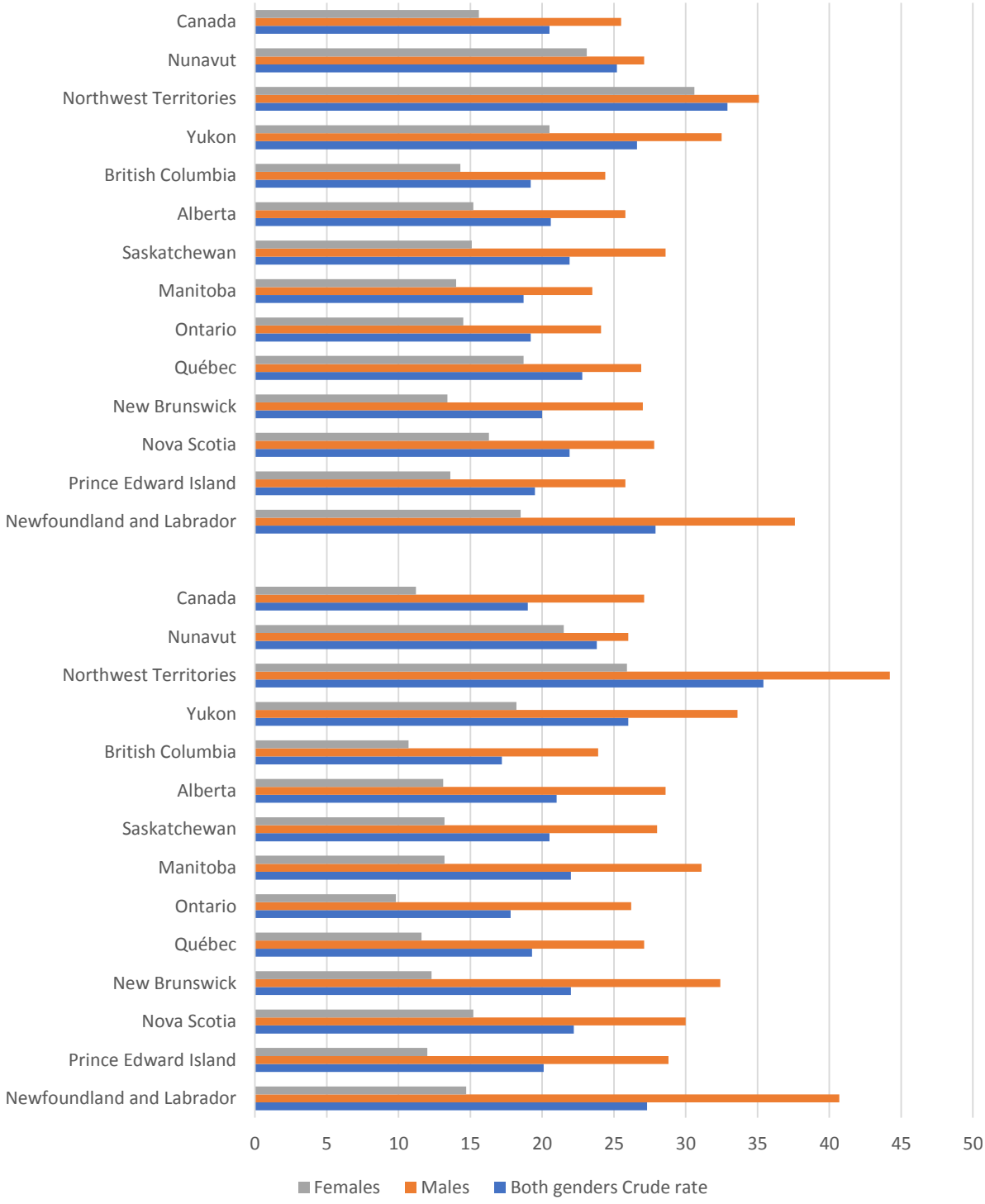
Table 4.23

Alcohol use, heavy drinking, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014 and 2015-2019

Sex	Overall	2010-2014 Crude rate -95% CI	2015-2019 Crude Rate – 95% CI
Both sexes	Total	5.5	7.3
Males	Total [Males]	8.9	10.5
Females	Total [Females,	2.7	4.6

Figure 4.11

Alcohol use, heavy drinking, adults (18+ years), crude rate, prevalence (%) in Canada per provinces and territories between 2010-2014 and 2015-2019



4.1.2.3 Prevalence of heavy alcohol drinkers by *Time:*

Although the record of heavy alcohol users in Canada, which shows a marked increase between 2017 and 2022, may be connected to the population growth in part, what seems apparent is the increase in the percentage of heavy alcohol users among the female population. Notwithstanding the Canadian population growth of less than 1% annually within the period, a +14.8% change in the heavy drinkers in Canada between 2017 and 2022 is remarkable. The rate of the female population who are heavy alcohol drinkers across the age groups has nearly doubled within the past decade.

Table 4.24

The prevalence of heavy alcohol drinkers for Canadians aged 12 and older

	2010-2014			2015-2019		
	M	F	Total	M	F	Total
12-17	88,900	60,820	149,720	42,363	44,264	86,626
18-64	3,490,620	1,500.450	4,991,060	3,571,300	2,267,631	5,838,930
65+	197,358	70,823	268,181	278,281	141,534	419,815

4.1.3 Trend and prevalence of Fruit/Vegetable consumption five or more times in Canada

Increasing evidence has shown that diet is a significant risk factor for CVDs. Although identifying the specific diet that predisposes CVDs may be complex, food high in saturated fat, low fibre, and high sodium, to mention a few, may potentially increase the risk for obesity, uncontrolled diabetes, high blood pressure and ultimately heart diseases (Wang et al., 2020; Kim & Giovannucci, 2021). Wang et al. (2020), in their studies, show the correlation between increased dietary sodium and risk of CVDs. In their studies, "the risk of cardiovascular disease increased up to 6% for every 1 g increase in dietary sodium intake" (Wang et al., 2020, np). It is therefore recommended that individuals should consume food low in sodium to limit the CVD risk. Consuming adequate fruits and vegetables is linked to an optimum health status with a low risk for CVDs. Individuals who consume less fruit and vegetables may be at risk for CVDs. In this section, the rate of fruit and vegetable consumption is assessed in Canada. Canadians who consume less than the prescribed amount of fruit and vegetables may be at risk for developing CVDs in part. The data collected from

the HIDL, according to the Canadian Community Health Survey, is analyzed and reported using a descriptive epidemiology methodology. As of 2017, the ASR prevalence of Canadians who consume fruit/vegetables five or more times

4.1.3.1 Trend and rate Fruit/Vegetable consumption five or more times by person

Gender: Across the age groups, more females consume fruit/vegetables for or more times daily than males. In 2017, 47.5% of Canadians aged 12-17, 47.8% of 18 years and older, and 48.6% older adults aged 65 and older consumed fruit/vegetable five or more times daily in Canada, while the males were 45.1%, 33.4%, and 34.8% respectively. The 2017 trend is equally noticeable in 2022 – see Tables 4.5 to 4.30 for a simplified insight. While it would be interesting to explore why more females consume fruit/vegetables, it is arguable to link the fact that females have more access to the kitchen and would potentially go to the store more than males and or perhaps females are likely to be more at home. In contrast, more males go to work hence females accessing the food more than the females. To corroborate the outcome in part, there is an insignificant difference between the males and females aged 12-17 years as they potentially stay more at home after school hours. By inference, staying home increases access to the kitchen and the store. In retrospect, increased fruit/vegetable consumption by females has a direct correlation with their outlook in the CVDs panel as more males present with CVDs comparatively.

Age: In 2017, 46.3% of Canadians aged 12 to 17 took the lead among those who consume fruit/vegetable five or more times daily, followed by the older adults aged 65 and older (42.4%) while Canadians aged 18+ (40.6%) who consume fruit/vegetable five or more times daily were the least. Findings, however, show a significant decline in the rate of fruit/vegetable consumption in Canada between 2017 and 2022, where there was a decline from 46.3% in 2017 to 30.1% of Canadians aged 12-17, 40.6% to 30.8% of Canadians aged 18 years and older and 42.4% to 30.6% with a 95% CI of older adult Canadians aged 65 years and older who consume fruit/vegetable, five or more times daily.

The percentage change in the fruit/vegetable consumption rate in Canada between 2017 and 2022 is noticeably more significant for persons aged 12 to 17, which is a 35% change, followed by older adults aged 65 and older (24.1% change) and Canadians aged 18 years and older at 24.1% change

respectively. By inference, the youth are more impacted despite their vulnerability. While the reasons for the downward trend of fruit/vegetable consumption rate are not explored in this study, it is arguable to link the increasing price of food across the board as one of the attributable reasons for the low consumption rate of healthy food.

4.1.3.2 Trend and rate Fruit/Vegetable consumption five or more times by Place and time

Findings show a decline in the prevalence and ASR at which Canadians across age groups consume fruit/vegetables five (5) or more daily from ASR 40.9% to 30.8% (24.7% change) between 2017 and 2022. The decline in rate is noticeable across the Canadian provinces and territories, but Nunavut's findings show an increase from 21.2% in 2017 to 23% in 2022. Quebec (47%) has the highest number of Canadians who consume fruit/vegetables five (5) or more times daily, followed by British Columbia (41.2%), Alberta (40.3%) and Yukon (40.3%) in 2010-2014, respectively. The territory of Nunavut has the lowest prevalence of Canadians who consume fruit/vegetable five (5) or more daily at 21.2% in 2010-2014 as well as in 2015-2019, where the record rose to 23%.

In 2015-2019, the province of Quebec (38.4%) continued to take the lead in Canada as the province with the highest number of individuals who consume fruit/vegetable five (5) or more times daily, followed by British Colombia (31.2%), and Alberta (29.7%) respectively. Unlike in 2010-2014, the province of British Colombia has joined Quebec, and both provinces are now the only provinces whose ASR fruit/vegetable consumption rate is more than the Canada national values in 2015-2019. See tables 4.23-4.31 and figures 4.12-4.15.

Table 4.25

Fruit/vegetable consumption, five or more times per day, children (12-17 years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	46.3	45.1	47.4
Males	Total [Males]	45.1	43.5	46.7
Females	Total [Females]	47.5	46	48.9

Table 4.26

Fruit/vegetable consumption, five or more times per day, children (12-17 years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	30.1	28.6	31.6
Males	Total [Males]	28.9	26.8	30.9
Females	Total [Females]	31.4	29.3	33.6

Table 4.27

Fruit/vegetable consumption, five or more times per day, adult (18+ years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	40.9	40.5	41.3
Males	Total [Males]	33.6	33.1	34.1
Females	Total [Females]	47.9	47.3	48.4

Table 4.28

Fruit/vegetable consumption, five or more times per day, adult (18+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	30.8	30.3	31.3
Males	Total [Males]	23.4	22.7	24
Females	Total [Females]	37.8	37.1	38.6

Table 4.29

Fruit/vegetable consumption, five or more times per day, older adult (65+ years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	42.4	41.7	43
Males	Total [Males,]	34.8	33.7	35.8
Females	Total [Females]	48.6	47.7	49.4

Table 4.30

Fruit/vegetable consumption, five or more times per day, older adult (65+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	30.6	29.6	31.6
Males	Total [Males]	23	21.7	24.2
Females	Total [Females]	37	35.7	38.3

Table 4.31

Fruit/vegetable consumption, five or more times per day, older adult (65+ years), crude rate, prevalence (%), Canada in 2010-2014 and 2015-2019

Region	2010-2014 Age-standardized rate 95% CI	2015-2019 Age-standardized rate 95% CI
Newfoundland and Labrador	26.4	20.5
Prince Edward Island	33.7	28.5
Nova Scotia	33.8	24.4
New Brunswick	35.1	27.1

Québec	47	38.4
Ontario	39.6	28
Manitoba	34.5	26.6
Saskatchewan	36.6	28.5
Alberta	40.3	29.7
British Columbia	41.2	31.2
Yukon	40.3	25.9
Northwest Territories	31.1	24.9
Nunavut	21.2	23
Canada	40.9	30.8

Figure 4.12
Fruit/vegetable consumption, 5 or more times per day, older adult (65+ years), crude rate, prevalence (%), Canada in 2017 (2010-2014) and 2022 (2015-2019)

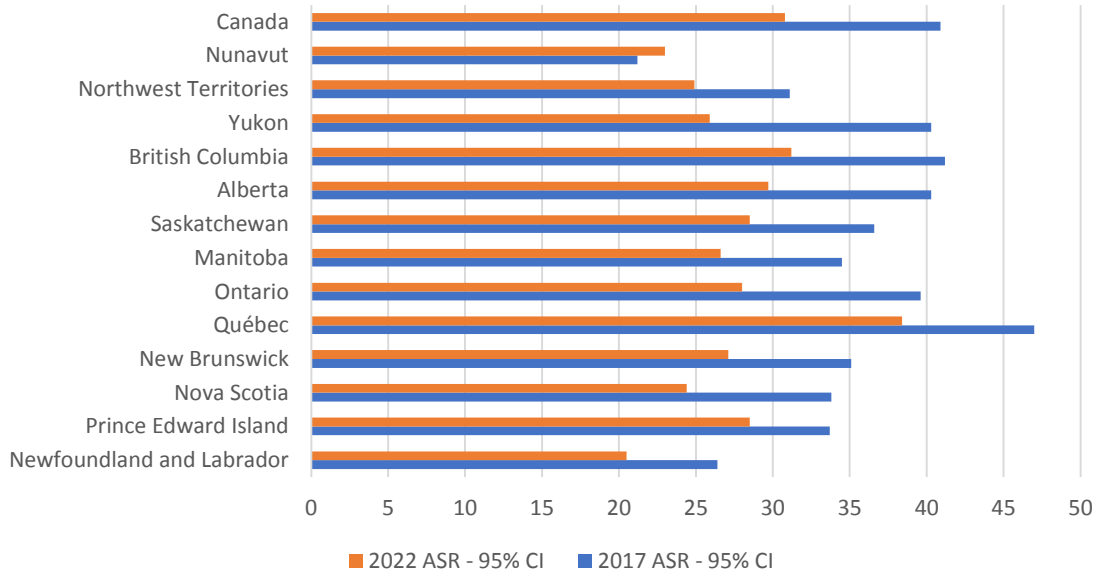


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Figure 4.13

Figure 4.14
Fruit/Vegetable consumption, 5 or more times per day for Canadian aged 18+ in 2010-2014

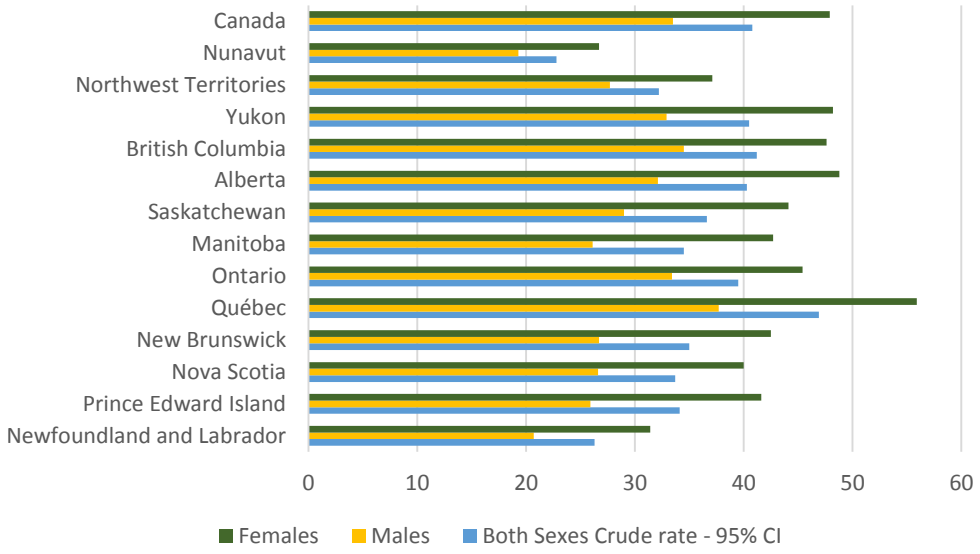
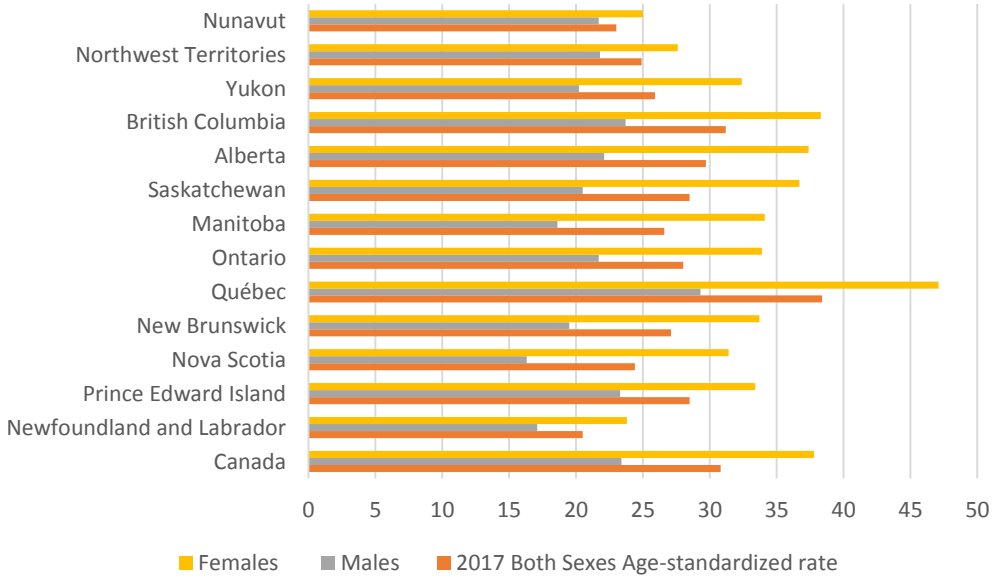


Figure 4.15
Fruit/vegetable consumption, 5 or more times per day, adults (18+ years), age-standardized rate, prevalence (%) Canada in 2015-2019



4.1.4 Trend and prevalence of active or moderate physical activity in Canada

Increasing evidence suggests the correlation between sedentary life and limited physical activities as the risk factors for developing CVDs (Prince et al., 2020). With the recent pandemic, COVID-19, the effect of its attributable limited social interaction, limited physical activity and increasing usage of cell phones on the CVD burden cannot be overlooked.

4.1.4.1 Prevalence of moderate or active physical activity in Canada by person

Gender: Findings in this study reveal that males engage in moderate or active physical activities more than females across all age groups. Between 2010 and 2014, 77.5% of male youths, 41% of male adults and 46% of male older adults were engaged in moderate or active physical activities. At that time, 68.2%, 49.8% and 42.6% of females engaged in physical activities within the same period, respectively. The same trend of physical activities, although at different rates, was recorded between 2015 and 2019, respectively.

Age: In this study, findings show from the CCHS 2010-2014 annual component noted in the HIDT 2017 edition that 73% (male - 77.5%; female - 68.2% at 95% CI) of Canadians aged 12-17 years moderately or actively engaged in physical activities as recommended. Unlike the 2010-2014 annual component, the finding shows a significant decline in the rate at which Canadians aged 12-17 years engage in physical activity in the 2015-2019 annual component of the CCHS, which shows 8.2 % (male 10.4; female – 5.8 at 95% CI). While it is unclear why the number plumaged, which seems evident is the 89.1% change in the crude rate of physical activity within the two periods. Between 2010 and 2014, the age-scandalized prevalence of the active or moderate for Canadians aged 18 years and over was 51.8% (males – 54%; females – 49.8% at 95% CI), while the rate increased to 56.7% (male – 49.3%; females – 50.4% at 95% CI) between 2015 and 2019.

The noticeable percentage change between the 2014 and 2019 records was --9.5 %, an improvement from the previous period within the past decade. For the older adults aged 65 and older, the prevalence of active or moderate crude rate was 46.8% (male – 52.1%; females – 42.6% at 95% CI) between 2010 and 2014. The crude rate - prevalence of active and moderate physical activity for Canadians aged 65 years and older decreased from 46.8% to 40.1% (male - 44.5%; females – 36.3% at 95% CI) between 2015 and 2019. The 14.3% change – indicative of a decline

in physical activities among older adults, has a potential correlation with the CVD profile. Although more Canadian youths aged 12–17 years engage in moderate or active physical activities compared with Canadians aged 18 and older followed by the older adults between 2010-2014 CCHS annual components, there was a significant drop in the physical activities for the youths, increased for the adults and moderate reduction for the older adults between 2015-2019 comparatively.

Geography/Place: While the CCHS data collected from the HIDT between 2010-2014 reveals that the ASPR of 52% of adult Canadians (18+) engages in moderate and active physical activities, the rate increased to 56.7% in the CCHS 2015-2019 annual component with evidence of 8.3% change; 95% CI. Four (4) provinces and one (1) territory have a rate above the national value, with the Territory of Yukon (61.8%) taking the lead, followed by the province of British Columbia (59.4%), Alberta (53.7 %) and Manitoba (52.8**%)** respectively.

Within the 2010 and 2014 annual components, the territory of Nunavut (37.9%) has the least ASR prevalence of Canadians who engage in moderate or active physical activity. Although all the Canadian territories and Provinces recorded improved physical activity, and unlike the 2010-2014 data, Yukon (67.3%) and British Columbia (65.4%) are the only territory and provinces whose ASR prevalence of moderate or active physical activities is above the national average. Nunavut (47.5%) continues to be the territory, with a few Canadians engaging in moderate or active physical activities. A further study may reveal the contributory factors for the gaps in physical activity data between two (2) territories, Yukon and Nunavut – where the former has the highest and the latter the lowest rate in spite of the fact that the two territories nearly shared similar health determinants with a selected indicator. See tables 4.33-4.40 and figures 4.16-4.17.

Table 4.33

Physical activity, active or moderately active, children (12-17 years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	73	72	73.9
Males	Total [Males, reference]	77.5	76.3	78.8
Females	Total [Females]	68.2	66.7	69.7

Table 4.34

Physical activity, active or moderately active, children (12-17 years), crude rate, prevalence (%), in Canada between 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	8.2	7.5	8.8
Males	Total [Males]	10.4	9.3	11.4
Females	Total [Females]	5.8	5	6.5

Table 4.35

Physically active (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	51.8	51.4	52.2
Males	Total [Males]	54	53.4	54.6
Females	Total [Females]	49.8	49.3	50.4

Table 4.36

Physically active (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	56.7	56.4	57.1
Males	Total [Males]	60.3	59.8	60.8
Females	Total [Females]	53.3	52.8	53.8

Table 4.37

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	46.8	46.2	47.5
Males	Total [Males]	52.1	51.1	53.1
Females	Total [Females]	42.6	41.7	43.4

Table 4.38

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	40.1	39.4	40.8
Males	Total [Males]	44.5	43.5	45.5
Females	Total [Females]	36.3	35.4	37.2

Table 4.39

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014, 2015-2019

Region	2010-2014 ASPR - 95% CI	2015-2019 ASPR - 95% CI
Canada	52	56.7
Newfoundland and Labrador	47	50.9
Prince Edward Island	48.3	52.6
Nova Scotia	53	56.3
New Brunswick	50.1	51
Québec	48.8	54.1
Ontario	51.1	56.1
Manitoba	52.8	53.7
Saskatchewan	50.7	55.4
Alberta	53.7	58
British Columbia	59.4	65.4
Yukon	61.8	67.3
Northwest Territories	48.6	56.4
Nunavut	37.9	47.5

Figure 4.16

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014, 2015-2019

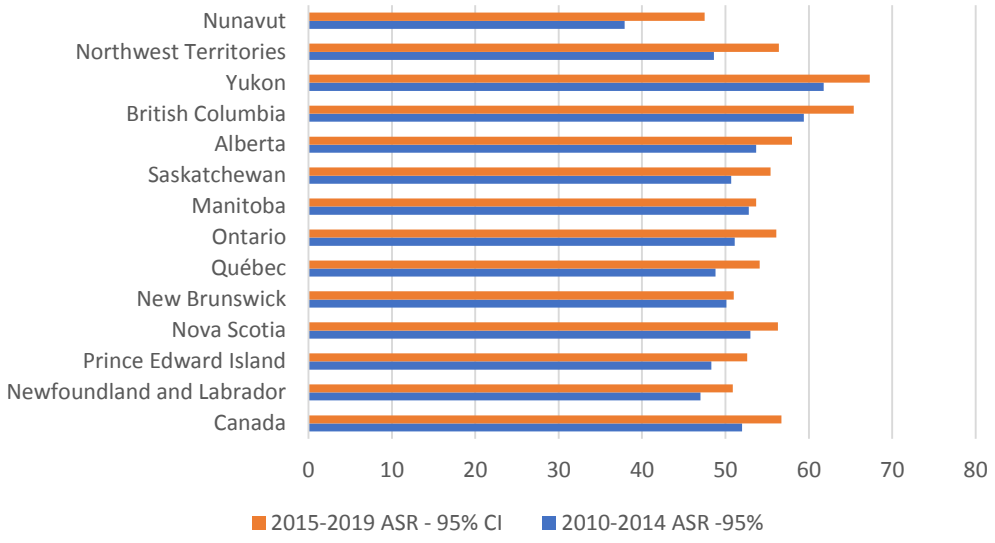


Figure 4.17

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2010-2014, 2015-2019

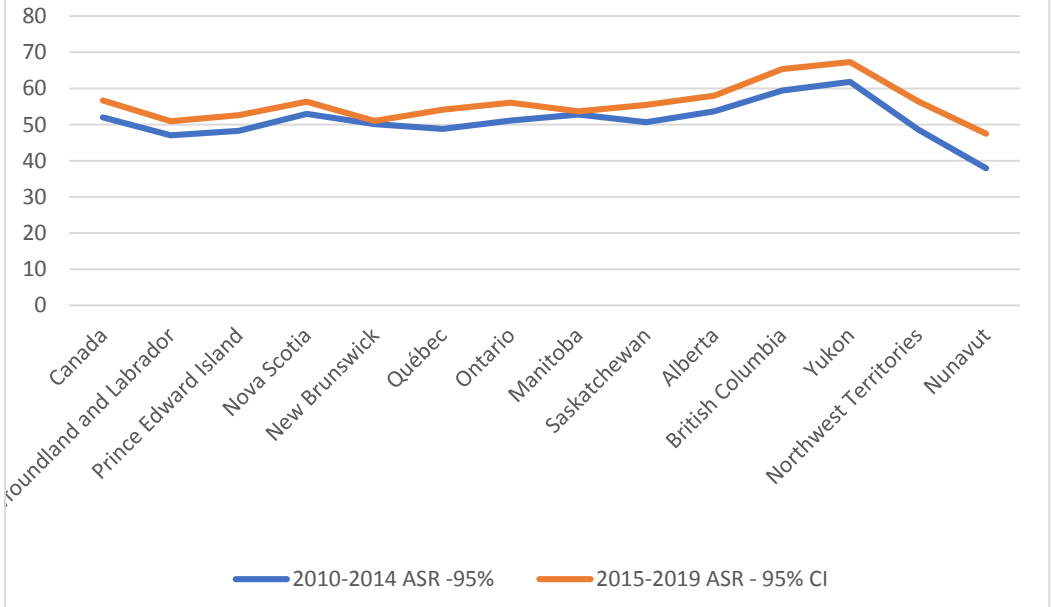


Table 4.40

Physical activity, active or moderately active, seniors (65+ years), crude rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Crude rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	40.1	39.4	40.8
Males	Total [Males]	44.5	43.5	45.5
Females	Total [Females]	36.3	35.4	37.2

4.1.5 Trend and prevalence of Diabetes in Canada

4.1.5.1 Trend of Diabetes by person

Gender: Findings in this study show that more males aged 18 and above present with elevated blood sugar, otherwise termed diabetes, than females. The CCHS data from the HIDT of 2010-2014 shows that 6.9% (males – 7.9%; females - 6% at 95% CI) was the ASR prevalence of Canadians living with diabetes. The ASR prevalence of Canadians with diabetes increased from 6.9% in 2010-14 to 7.4% (males – 8.9; females 6.1%) in 2015-2019. By inferences an upward trajectory with a -7.2% change (male: -12.7%; female: -1.7% change) of the ASR prevalence of diabetes was noticeable in Canada between 2010 and 2019 by gender. The upward trend noticeable in males is significant compared to females. This outcome is reflected in the rate of CVDs in men despite having a higher rate of moderate and active physical activity than females.

Age: In this study, Canadians aged 18 and above were assessed for this (diabetic) risk factor

4.1.5.2 Trend of Diabetes by place

Place: Findings in this study show that Newfoundland and Labrador have the highest rate of Canadians aged 18 and older living with diabetes, followed by PEI (8.2%) and Nova Scotia (8.1%), respectively. In the same period, seven (7) provinces with none of the territories have their diabetes prevalence above the national average of 7%. The province with the lowest rate of diabetes was British Columbia at 5.7%. Unlike the 2010-2014 records, there was an upward trend in the prevalence of diabetes across Canada between 2015 and 2019 at a --10 % change compared with

the 2010-2014 period. While Newfoundland and Labrador (9.6%) maintain the lead in the prevalence ASPR of diabetes, Nova Scotia (9.2%) bumps PEI from her rank, followed by New Brunswick (9.1%) in 2015-2019 respectively. Although Nova Scotia and New Brunswick bump the PEI, the increased trajectory remains noticeable within the past decade, 2010 to 2019, across the Canadian provinces and territories Nunavut (5.3%), where the rate of diabetes has considerably reduced between 2010 and 2019. The Nunavut is noted as the territory with the lowest rate of diabetes across Canada in recent times based on the CCHS 2015-2019 component. See tables 4.42-4.46 and figures4.18-4.23.

Table 4.42

Diabetes, excluding gestational (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada in 2010-2014

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	6.9	6.7	7.1
Males	Total [Males]	7.9	7.7	8.2
Females	Total [Females]	6	5.7	6.2

Table 4.43

Diabetes, excluding gestational (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada in 2015-2019

Sex	Overall	Age-standardized rate	Lower limit – 95% CI	Upper limit – 95% CI
Both sexes	Total	7.4	7.3	7.6
Males	Total [Males]	8.9	8.7	9.2
Females	Total [Females]	6.1	5.8	6.3

Table 4.44

Diabetes, excluding gestational (self-reported), adults (18+ years, both sexes), age-standardized rate, prevalence (%), Canada 2010-2014

Region	2010-2014 Both Sexes Age-standardized rate - 95% CI	Males	Females
Newfoundland and Labrador	8.9	8.5	9.2
Prince Edward Island	8.2	9.6	6.9
Nova Scotia	8.1	8.9	7.5
New Brunswick	7.9	9.5	6.5
Québec	6.5	7.5	5.7
Ontario	7.5	8.5	6.6
Manitoba	7.1	8.5	5.8
Saskatchewan	7.1	8	6.4
Alberta	6.6	7.6	5.6
British Columbia	5.7	6.5	5
Yukon	6.9	7.2	6.6
Northwest Territories	6.1	5.8	6.5
Nunavut	6.6		
Canada	7	7.9	6.1

Figure 4.18
Diabetes, excluding gestational (self-reported), adults (18+ years, both sexes), age-standardized rate, prevalence (%), Canada 2010-2014

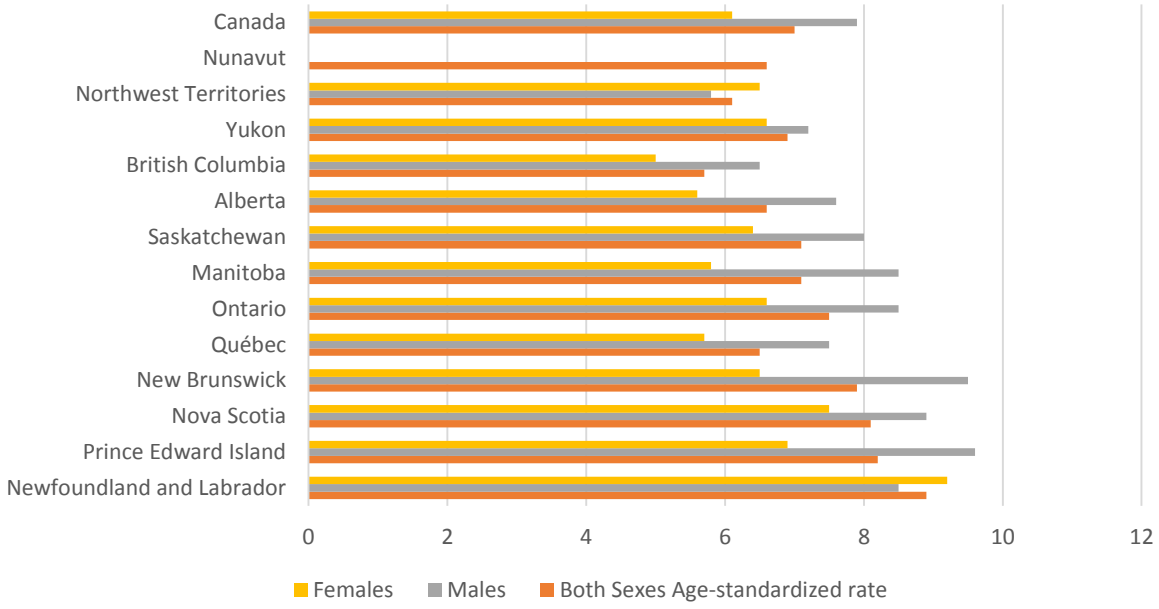


Figure 4.19:
Diabetes, excluding gestational (self-reported), adults (18+ years, both sexes), age-standardized rate, prevalence (%), Canada 2017, 2022

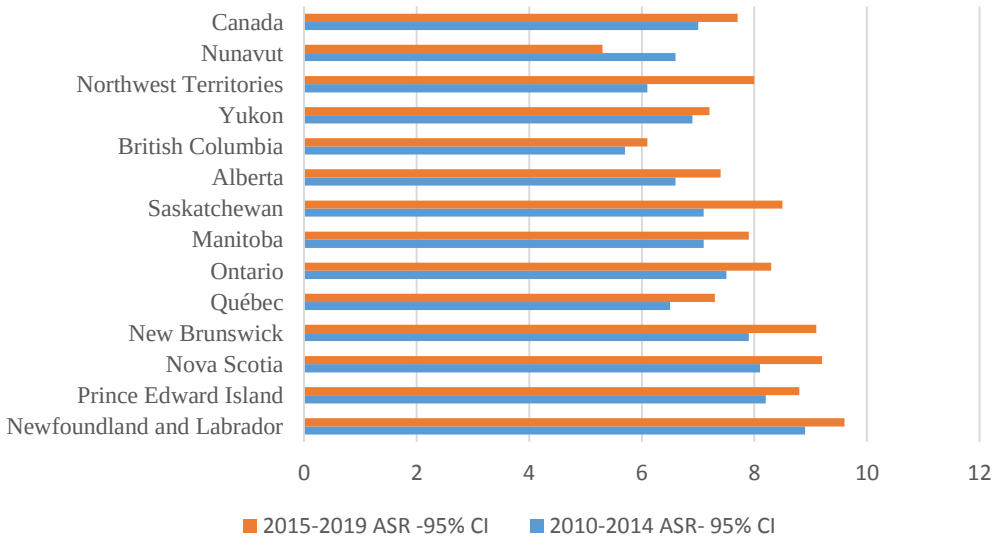


Table 4.45

Diabetes, excluding gestational (self-reported), adults (18+ years, both sexes), age-standardized rate, prevalence (%), Canada 2010-2014, 2015-2019

Region	2010-2014 ASPR	2015-2019 ASPR
Newfoundland and Labrador	8.9	9.6
Prince Edward Island	8.2	8.8
Nova Scotia	8.1	9.2
New Brunswick	7.9	9.1
Québec	6.5	7.3
Ontario	7.5	8.3
Manitoba	7.1	7.9
Saskatchewan	7.1	8.5
Alberta	6.6	7.4
British Columbia	5.7	6.1
Yukon	6.9	7.2
Northwest Territories	6.1	8
Nunavut	6.6	5.3
Canada	7	7.7

Figure 4.20

Diabetes, excluding gestational (self-reported), adults (18+ years, both sexes), age-standardized rate, prevalence (%), Canada 2010-2014, 2015-2019

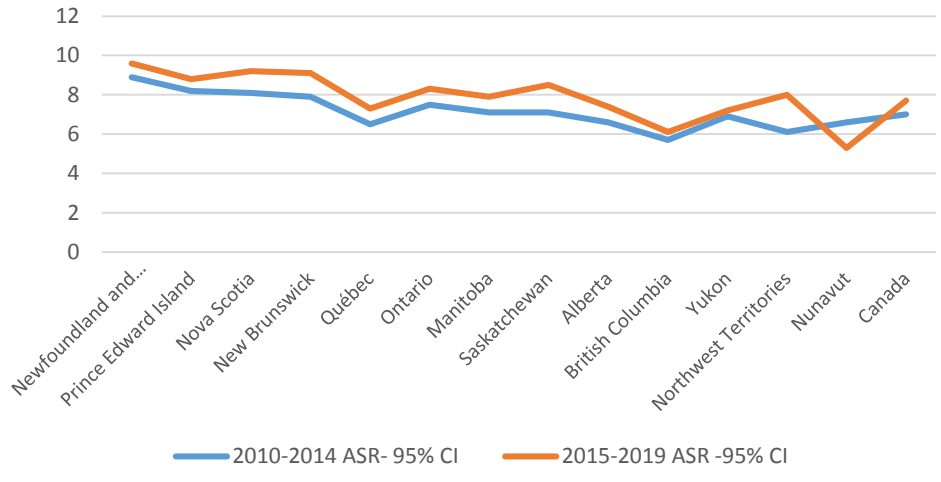


Table 4.46

Diabetes, excluding gestational (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada 2015-2019

Region	2015-2019 Age-standardized rate - 95% CI	Males	Females
Canada	7.7	8.9	6.6
Newfoundland and Labrador	9.3	9.6	10.4
Prince Edward Island	8.3	8.8	10.4
Nova Scotia	8.8	9.2	11
New Brunswick	8.8	9.1	10.6
Québec	7.3	8.4	6.4
Ontario	8.3	9.5	7.2
Manitoba	7.9	9.1	6.7
Saskatchewan	8	8.5	9.4
Alberta	7.4	8.7	6.2
British Columbia	6	6.1	7.4
Yukon	7.2	8.6	5.7
Northwest Territories	7	8	7.4
Nunavut	5.3	4.3	6.9

Figure 4.21

Diabetes, excluding gestational (self-reported), adults (18+ years), age-standardized rate, prevalence (%), Canada 2015-2019

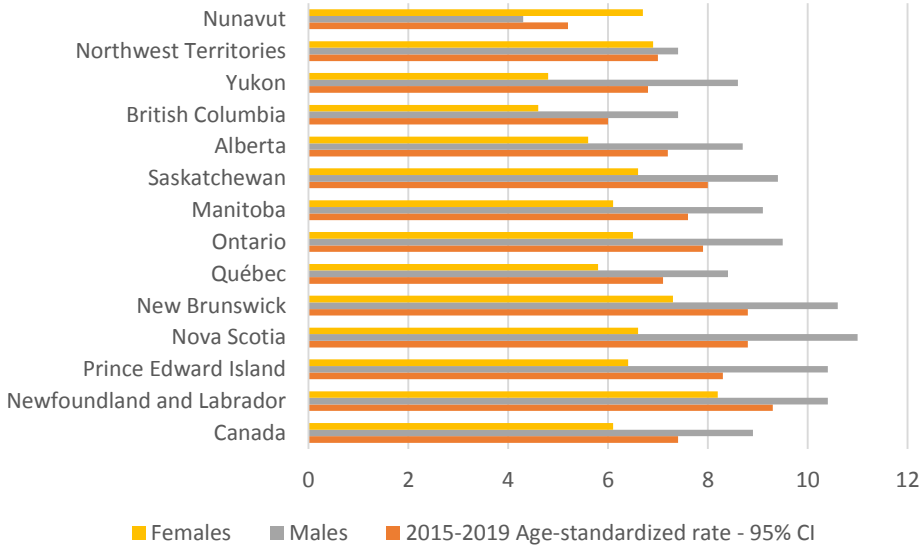
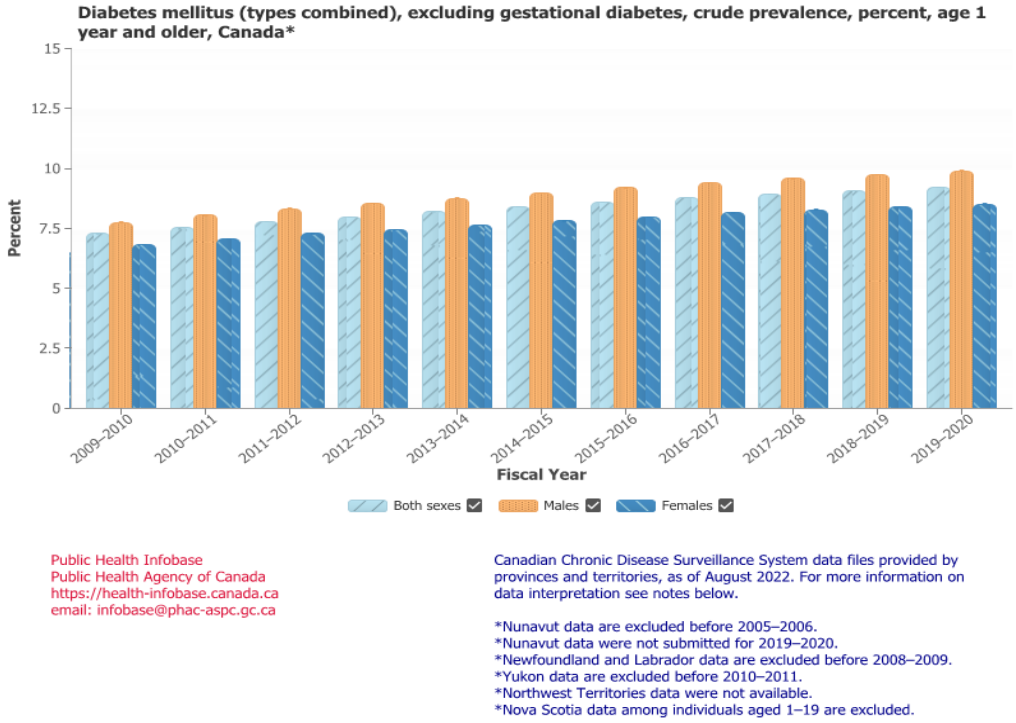


Figure 4.23



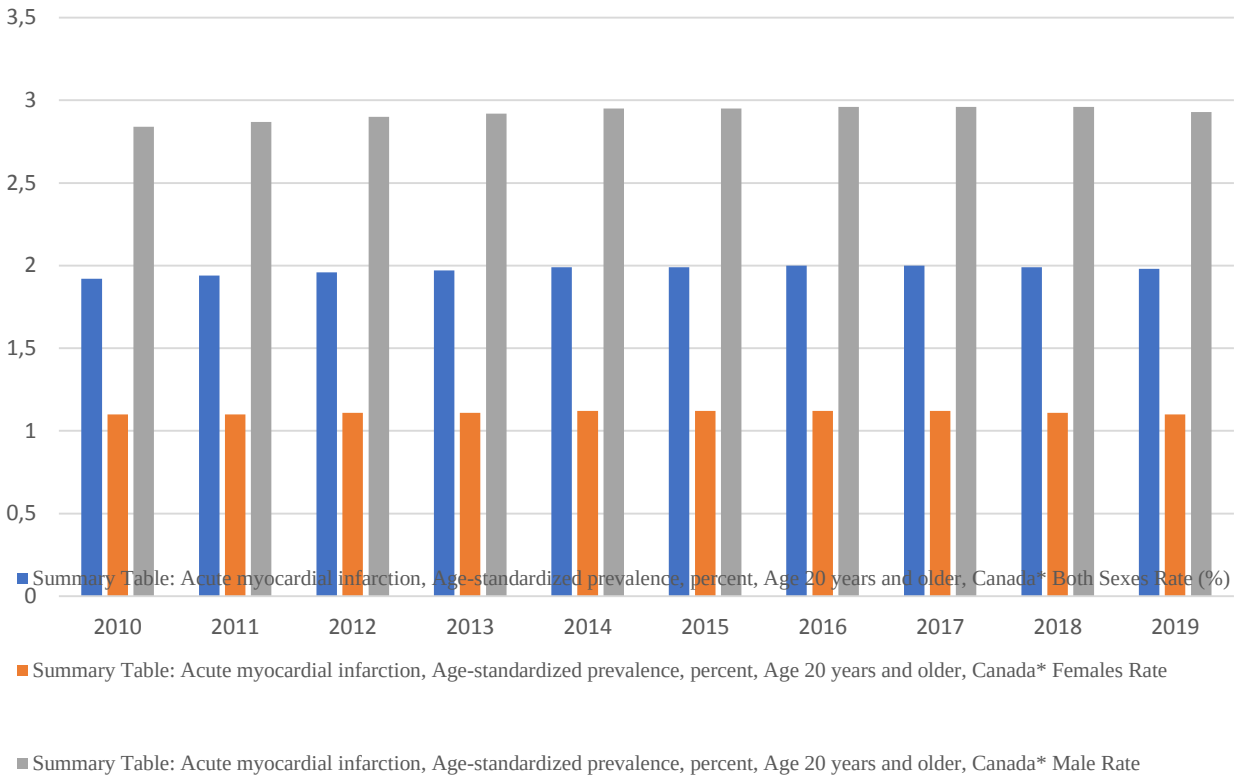
4.2 The trend and age-standardized prevalence of selected CVD conditions in Canada

Five (5) CVD conditions assessed in this study are acute myocardial infarction (AMI), heart failure (HF), hypertension/high blood pressure (HBP), ischemic heart disease (IHF) and stroke/cerebral vascular accident (CVA). Data collected from the Canadian Chronic Disease Surveillance (CCDSS) shows the trend and prevalence of the selected CVDs over a selected period between 2010/2011 and 2019/2020 (Government of Canada, 2023). In this study, ten years are selected while assessing the trend of the selected CVDs by gender, age and place using the concept of descriptive epidemiology.

4.2.1 Trend of Acute Myocardial Infarction (AMI) by Person

In the years 2010-2011, the age-standardized incidence rate of acute myocardial infarction (AMI) for Canadians aged 20 and older was 230 people per 100,000 population – this incidence rate shows an improvement of 300 per 100,000 population that was recorded in the year 2000-2001 with a – ve 23% change over ten years. The AMI incidence rate continues to improve, with findings showing the current age-standardized incidence rate of AMI as 193 persons per 100,000 population in 2019-2020 from 230 per 100,000 population recorded ten years earlier (2010-2011). Notwithstanding the improvement in the AMI incidence rate at -16% change between 2010-2011 and 2019-2020, the CCDSS reveals an increasing trend in the prevalence of acute myocardial infarction (AMI) in Canada over the past decade (Government of Canada, 2023).

Figure 4.24
Summary Table: Acute myocardial infarction, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010 and 2019



Gender: In 2010-2011, 533,980 (male – 361,070; female – 172,910) persons living in Canada were reported to be diagnosed with AMI – this accounts for the AMI age-standardized prevalence rate (ASR) of 1.92% (male – 2.84%; female – 1.10) at 1.92 to 1.93% - 95% CI in 2010-2011. The ASPR prevalence rate of AMI increased from 1.92% in 2010-2011 to 1.98% (male – 2.93%; female – 1.10%) in 2019-2020, with a total count of 712,730 (male – 491,775; female – 220,950). Males continue to lead in the prevalence of AMI with more than twice the rate of females living with AMI between 2010 and 2020. Of note is the steady increase in the –prevalence of AMI between 2000-2001 and 2017-2018, when the ASR prevalence rate and trend of acute myocardial infarction started to decline for a moment.

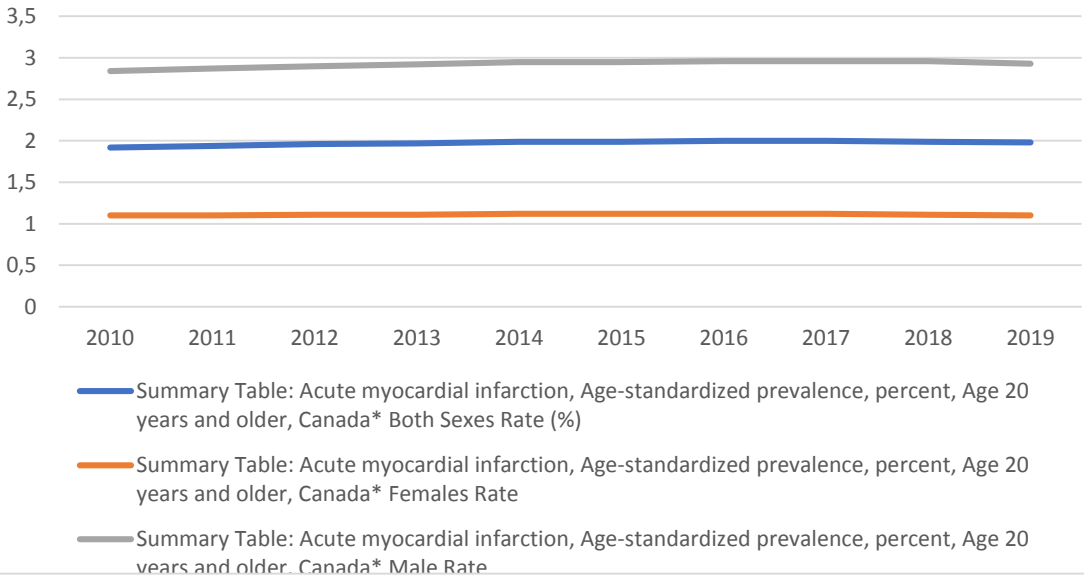
Table 4.47

*Acute myocardial infarction, Age-standardized prevalence, percent, Age 20 years and older, Canada**

Year	Both Sexes Rate (%)	Females Rate (%)	Male Rate (%)
2010	1.92	1.1	2.84
2011	1.94	1.1	2.87
2012	1.96	1.11	2.9
2013	1.97	1.11	2.92
2014	1.99	1.12	2.95
2015	1.99	1.12	2.95
2016	2	1.12	2.96
2017	2	1.12	2.96
2018	1.99	1.11	2.96
2019	1.98	1.1	2.93

Figure 4.25

Acute myocardial infarction, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010 and 2019



Age: In 2010-2011, persons aged 80 and older had the highest prevalence of AMI at 9.34% - this rate gradually increased to 10.55% at age 90 and above, followed by persons aged 65 to 79 years at 5.47%, 60 to 54 (2.22%), 35 to 49 (0.39%) and 20-34 (0.02%) respectively. The prevalence of AMI increased from 9.34% to 10.24% for persons aged 80 and older between 2010-2011 and 2019-2020. The same upward trajectory was recorded across age groups where the AMI prevalence for persons aged 65 to 79 was 5,78% (increased from 5.47%), and 50 to 64 years (2.25% - increased from 2.22%).

Unlike the upward trajectory in the prevalence of AMI for persons aged 50 years and older between 2010 and 2020, a promising trend in the prevalence of AMI is noticeable in persons aged 35 to 49, where findings change a reduced in the prevalence of AMI between 0.39% to 0.32% while no evidence of change in the prevalence of AMI for persons aged 20 and 34 between 2010 and 2020 respectively. By inference, the prevalence of acute myocardial infarction increased steadily for Canadians or its residents aged 50 and older, evident by the trend of AMI between 2001 and 2020. See tables 4.47-4.49 and figures 4.24-4.31.

Figure 4.26
*Acute myocardial infarction, Crude prevalence, percent, aged 20 and older - by person - age in 2010, Canada**

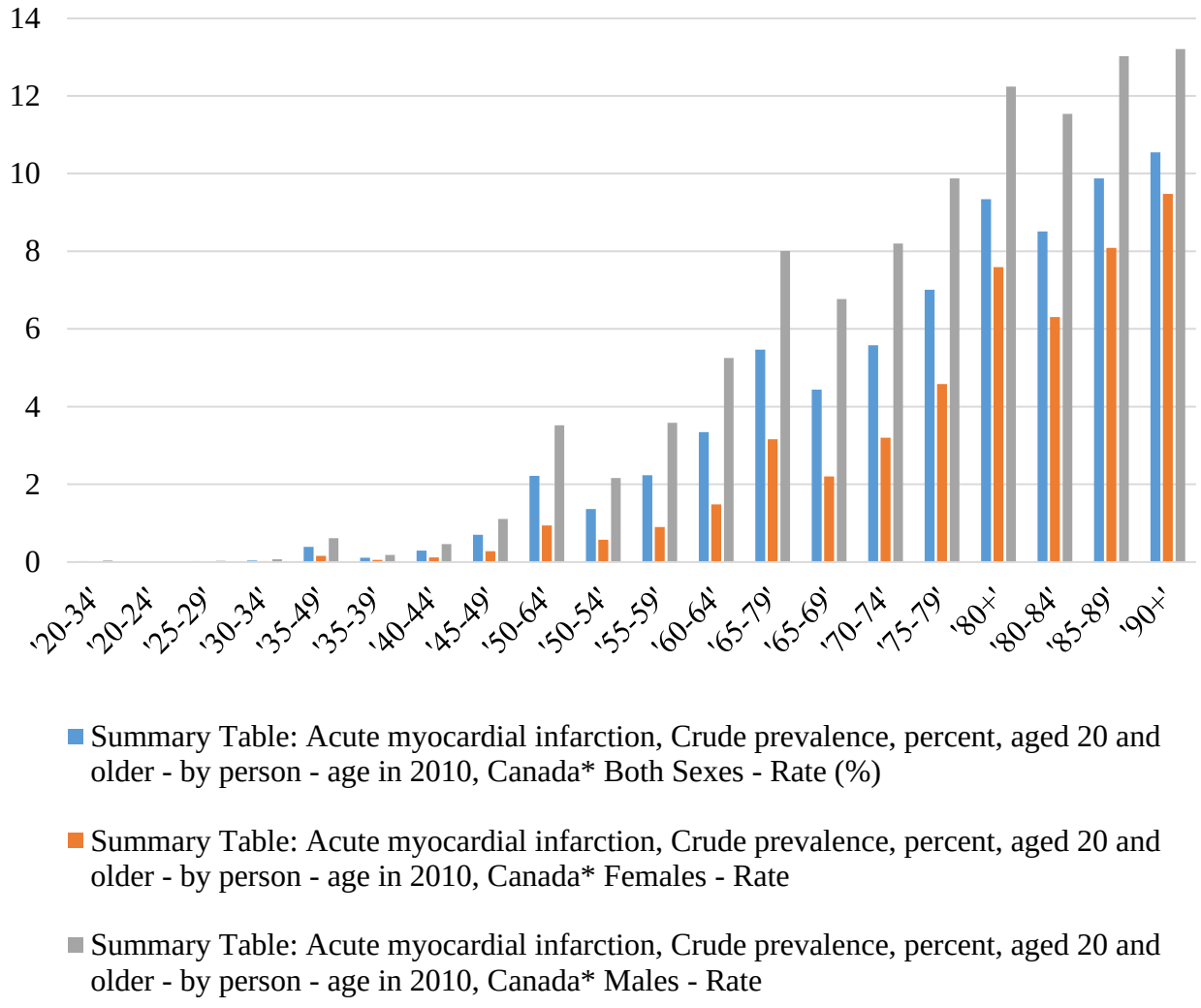


Figure 4.27

*Acute myocardial infarction, Crude prevalence - age 20 and older, percent, by person - age in 2019, Canada**

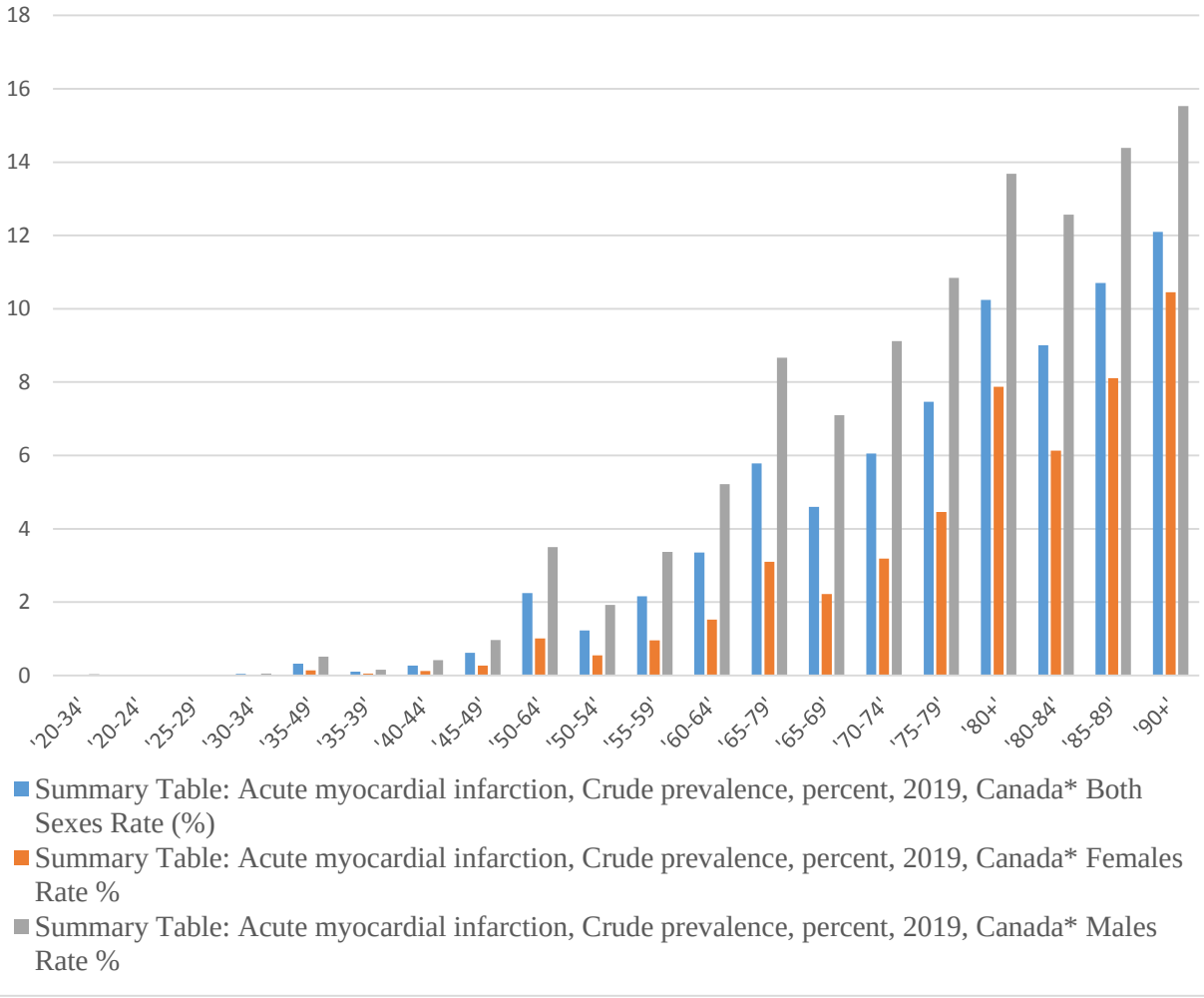


Table 4.48

*Acute myocardial infarction, Crude prevalence, percent, aged 20 and older - by person - age in 2010-2019, Canada**

Age Group	2010 Rate %	2019 Rate %
'20-34'	0.02	0.02
'20-24'	0.01	0
'25-29'	0.02	0.01
'30-34'	0.04	0.04
'35-49'	0.39	0.32
'35-39'	0.11	0.1
'40-44'	0.29	0.27
'45-49'	0.7	0.62
'50-64'	2.22	2.25
'50-54'	1.36	1.23
'55-59'	2.23	2.16
'60-64'	3.34	3.35
'65-79'	5.47	5.78
'65-69'	4.44	4.6
'70-74'	5.58	6.05
'75-79'	7.01	7.46
'80+'	9.34	10.24
'80-84'	8.51	9.01
'85-89'	9.88	10.7
'90+'	10.55	12.1

Figure 4.28

*Acute myocardial infarction, Crude prevalence, percent, aged 20 and older - by person - age in 2010-2019, Canada**

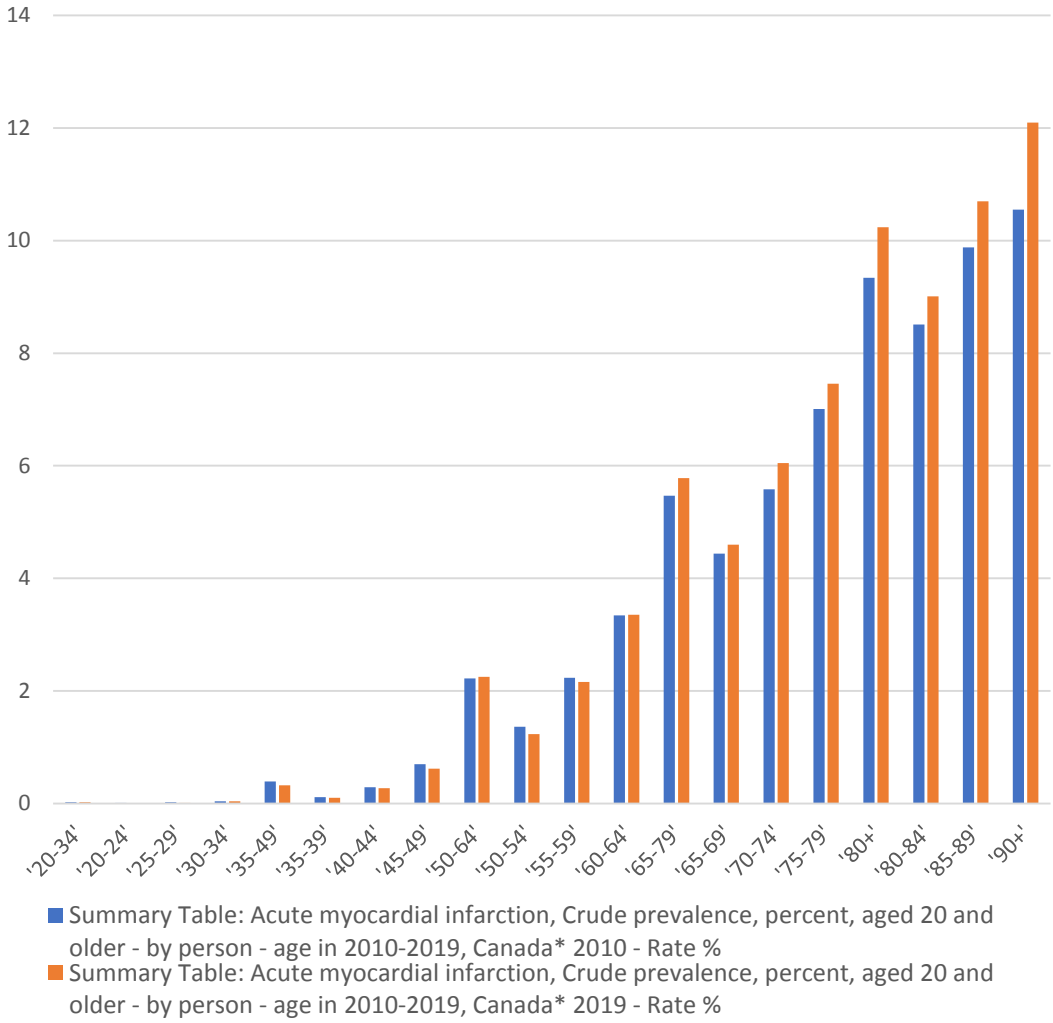
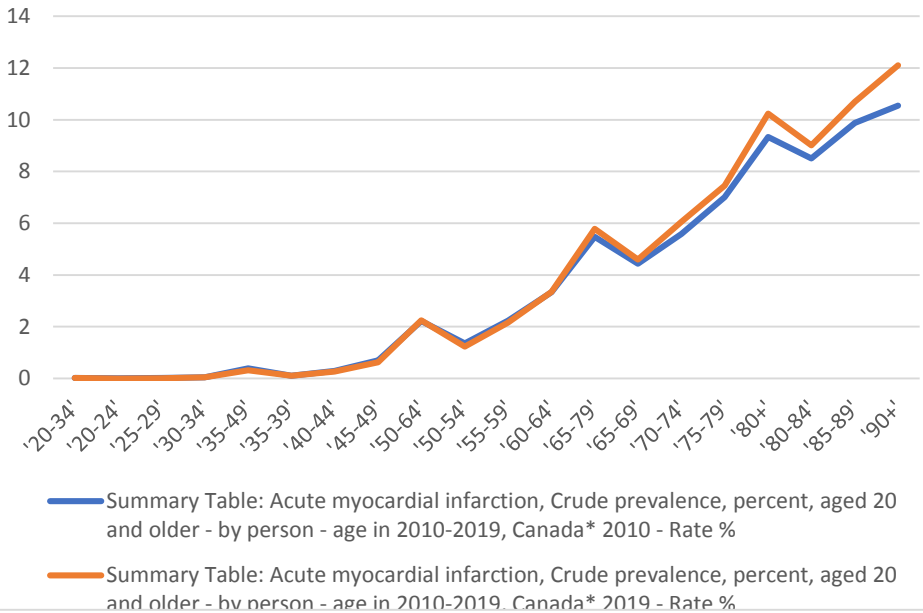


Figure 4.29
Acute myocardial infarction, Crude prevalence, percent, aged 20 and older - by person - age in 2010-2019, Canada



4.2.2 Trend of AMI by Place/Geography location

While the age-standardized prevalence rate of acute myocardial infarction (AMI) was 1.94 % (555,500 counts), the age incidence rate of acute myocardial infarction (AMI) was 230 per 100,000 Canadian population with a count of 61,285 in 2010-2011 fiscal year. In the 2010-2011 fiscal year, Prince Edward Island (PEI) had the highest incidence rate of AMI at 327 per 100,000 population with a count of 390 cases, followed by Newfoundland and Labrador (315 per 100,000) and New Brunswick (296 per 100,000) respectively. British Columbia has the lowest incidence of AMI at 190 per 100,000 population, with a count of 7,010 across Canada in 2010-2011. In the 2019-2020 fiscal year, Newfoundland and Labrador had the highest age-standardized prevalence rate of AMI at 2.66%, followed by New Brunswick (2.58%) and Nova Scotia (2.58%), while British Columbia had the lowest prevalence of AMI at 1.61% in 2019-2020 fiscal year. Of note, the age-standardized prevalence rate of acute myocardial infarction was below the Canadian national value in British Columbia (1.61%), Alberta (1.83%), Ontario (1.85%) and Yukon Territory (1.86%), respectively.

4.2.2 Trend of AMI by Time

While evidence shows a promising trajectory in the age-standardized incidence and upward trajectory in the prevalence rate of acute myocardial infarction in Canada between 2010 and 2020, there is a shift in the provinces and territory that led the age-standardized incidence and prevalence of acute myocardial infarction between 2010 and 2020 across Canada. Unlike in 2010-2011, where PEI had the highest incidence, New Brunswick (258 per 100,000) and Yukon Territory (258 per 100,000) have the highest incidence of AMI in 2019-2020, followed by Newfoundland and Labrador (246 per 100,000) and Quebec (241 per 100,000) respectively. British Columbia continues (167 per 100,000) to be the province with the lowest incidence rate of AMI across Canada between 2010 and 2020. Over a decade – between 2010 and 2020- evidence of improvement in the age-standardized prevalence rate of acute myocardial infarction is noticeable in only Ontario and Saskatchewan, while the prevalence of AMI continues to rise in all other Canadian provinces and territories. However, the other Canadian provinces and Territories need to explore the interventional approaches explored by Ontario and Saskatchewan in keeping the Acute Myocardial Infarction rate below their records over ten years.

Table 4.49

Acute myocardial infarction, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

	2010-2011 Rate %	2019-2020 Rate %
Canada	1.92	1.98
Newfoundland and Labrador	2.55	2.66
Prince Edward Island	2.31	2.37
Nova Scotia	2.37	2.47
New Brunswick	2.42	2.58
Quebec	2.04	2.27
Ontario	1.92	1.85
Manitoba	2.02	2.14
Saskatchewan	2.01	2
Alberta	1.8	1.83

British Columbia	1.52	1.61
Yukon Territory	1.06	1.86
Nunavut	1.26	

Figure 4.30

Acute myocardial infarction, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

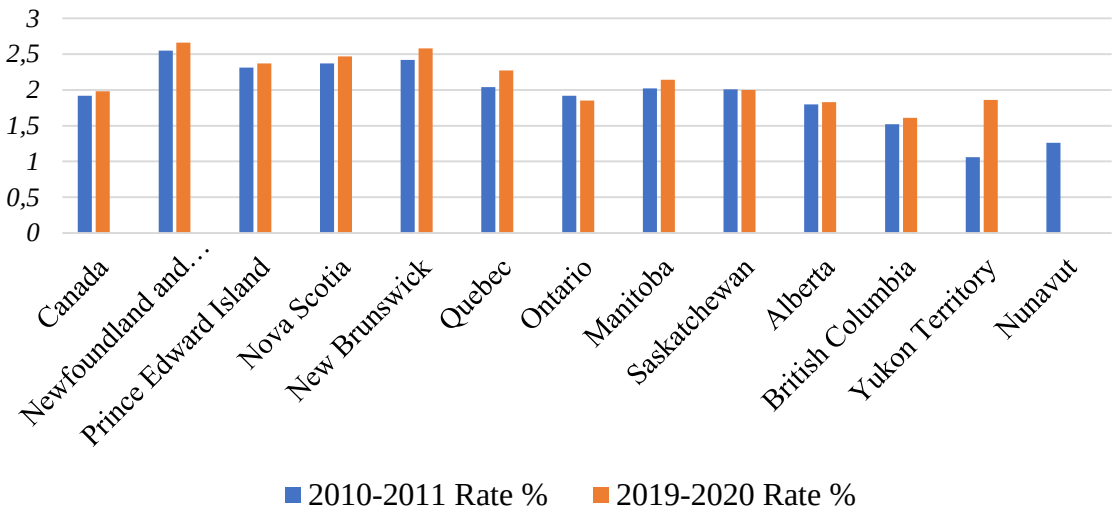
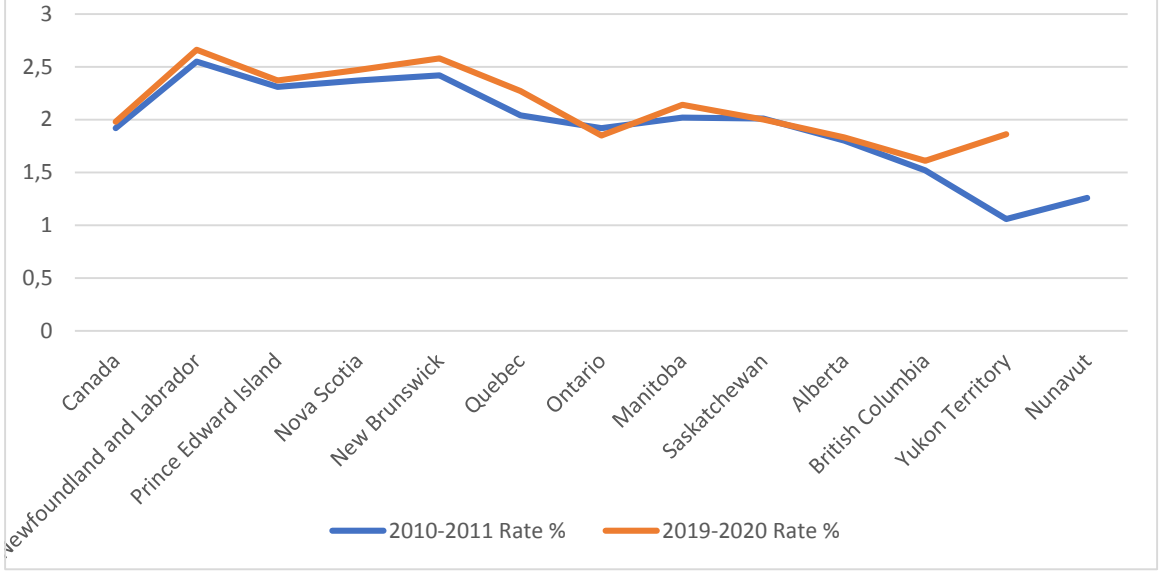
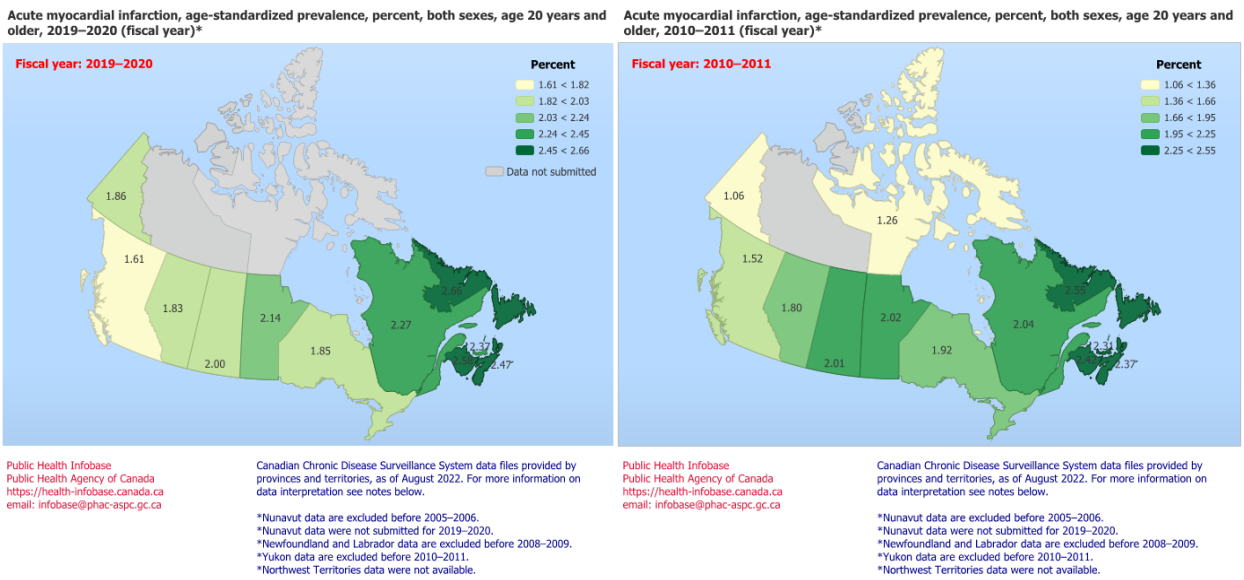


Figure 4.31

Acute myocardial infarction, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year





4.2.2 The trend and prevalence of Heart Failure (HF) in Canada

The age-standardized incidence rate of heart failure (HF) of persons aged 40 and older decreased from 549 to 512 cases per 100,000 population in Canada, with an increased incidence of heart failure from 90,845 to 111,035 in Canada between 2010-2011 and 2019-2020 fiscal year according

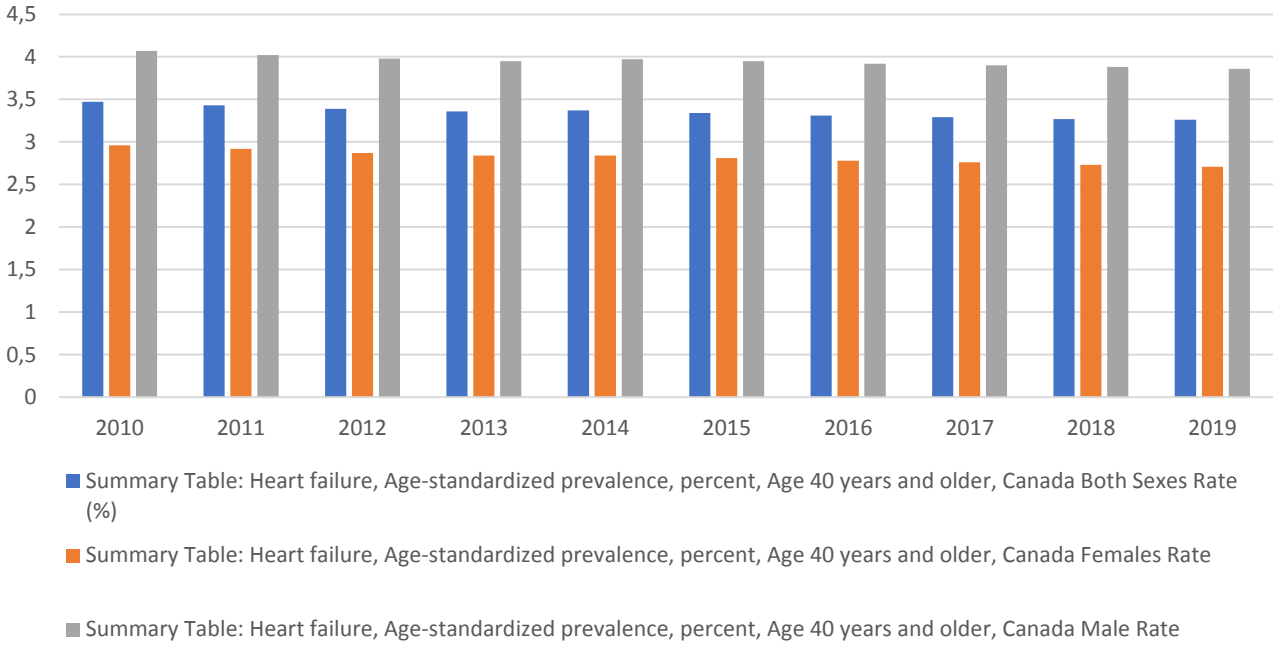
to the CCDSS (Government of Canada, 2023). The same trajectory is noticeable in the age-standardized prevalence rate of heart failure, which decreases from 3.47% to 3.27% (95% CI) with an increased count from 642,210 (male: 322,930; females: 318,280) to 787,605 (males: 417,195; females:370,405 cases) between 2010-2011 and 2019-2020 fiscal year. Unlike the acute myocardial infection trajectory, where the incidence rate decreases while its prevalence increases, both the prevalence and incidence of heart failure increased between the 2010-2011 and 2019-2020 fiscal years. 3.47% (641,210 cases) to 3.27% (787,605 **cases**). An improvement of -5.76% changes in the prevalence of heart failure and -6.74% changes in the incidence rate of heart failure were recorded in Canada between the 2010-2011 and 2019-2010 fiscal years. By inference, evidence of chronic diseases –heart disease management intervention implemented in Canada over the past decade cannot be over-emphasized.

Table 4.50

Summary table Heart failure, Age-standardized prevalence, percent, Age 40 years and older, Canada

Year	Both Sexes Rate (%)	Females Rate (%)	Males Rate (%)
2010	3.47	2.96	4.07
2011	3.43	2.92	4.02
2012	3.39	2.87	3.98
2013	3.36	2.84	3.95
2014	3.37	2.84	3.97
2015	3.34	2.81	3.95
2016	3.31	2.78	3.92
2017	3.29	2.76	3.9
2018	3.27	2.73	3.88
2019	3.26	2.71	3.86

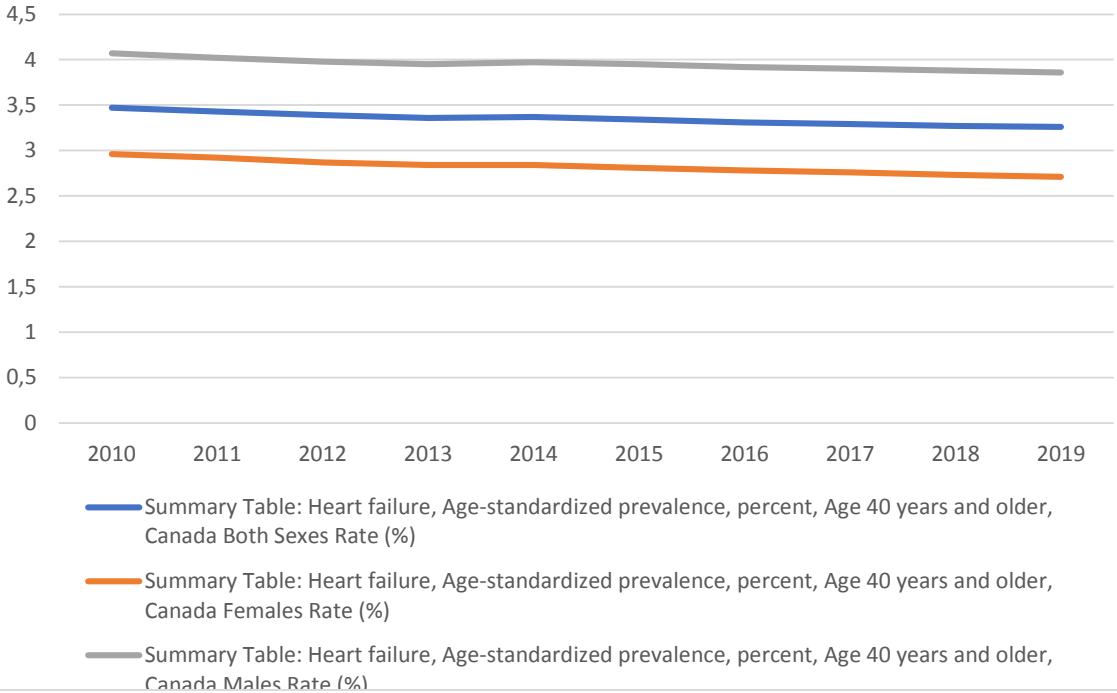
Figure 4.32
Hear failure, Age-standardized prevalence, percent, Age 40 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



4.2.2.1 Trend and Prevalence of HF by Person

Gender: In 2010-2011, 641,210 (male – 322,930; female – 318,280) persons living in Canada were reported to be living with heart failure (HF) diagnoses, which accounts for the HF age-standardized prevalence rate (ASPR) of 3.47% (male: 4.07%; female: 2.96%) at 3.46 to 3.48% - 95% CI in 2010-2011. The ASR prevalence rate of heart failure decreased from 3.47 in 2010-2011 to 3.26% (male: 3.86%; female: 2.71%) in the 2019-2020 fiscal year. While the male population continues to lead in the prevalence of HF, evidence of a decrease in the prevalence of heart HF was noticeable in both sexes.

Figure 4.33
Heart failure, Age-standardized prevalence, percent, Age 40 years and older, Canada



Age: Between the 2010-2011 and 2019-20 fiscal years, the crude prevalence rate of heart failure directly correlates with the age as individuals continue to grow. Persons aged 90 and above have the highest prevalence of heart failure in Canada at 27.53%, followed by 85-89 (20.77%), 80+ (19.14%), 65-79 (6.31%), 50-64 (1.46%) and 40-49 (0.27%) in 2010-2011 fiscal year respectively. Although the crude prevalence of heart rate for people aged 90 and older declined from 27.53% in 2010-2011 to 26.96% in the 2019-2020 fiscal year, this age group continues to record the highest prevalence of heart failure in Canada. In the 2019-2020 fiscal year, the crude prevalence of heart failure slightly increased ten years later for persons aged 40-49 (0.30%) and 50-64 (1.51%). Unlike the noticeable upward trajectory for persons aged 40 and 64, there was a downward trend in the crude prevalence of heart failure for persons aged 65-79 (5.67%), 80+ (18.33%) and 85-89 (19.41%) in 2019-2020 fiscal year respectively. While it is unclear why an upward trend in the prevalence of heart failure is recorded for adults aged 40 and 64, what seems apparent is the decline

in the prevalence rate of heart failure in older adults. This trend may be connected to the aging population and perhaps the inception of COVID-19.

Exploring the effect of COVID-19 on older adults may provide insight into the vital contributory factors to the heart failure outlook in Canada. That notwithstanding, the increasing trend in the crude prevalence of heart failure among the working-class groups aged 40 to 64 could pose some challenges as the same would have an impact on the disability and rate of productivity, which ultimately impact the economic growth of a nation. It is imperative to revolutionize heart disease intervention with more attention on the working class to limit potential disability and mortality. See tables 4.50-4.53 and figures 4.32-4.37.

Table 4.51

*Summary Table, Heart failure, Crude prevalence, percent, 2010-2011 fiscal year, Canada**

Age Group	Both Sexes Rate (%), 2010-2011	Females Rate (%)	Males Rate (%)
'40-49'	0.27	0.21	0.32
'40-44'	0.14	0.12	0.16
'45-49'	0.38	0.3	0.46
'50-64'	1.46	1.09	1.83
'50-54'	0.75	0.58	0.92
'55-59'	1.39	1.03	1.76
'60-64'	2.46	1.81	3.13
'65-79'	6.31	5.19	7.54
'65-69'	4.05	3.1	5.04
'70-74'	6.37	5.14	7.73
'75-79'	9.88	8.42	11.6
'80+'	19.14	18.37	20.41
'80-84'	14.78	13.27	16.85
'85-89'	20.77	19.5	23.02
'90+'	27.53	27.23	28.28

Figure 4.34

Heart failure, Crude prevalence, percent, aged 40 and older - by person - age in 2010-2011, Canada

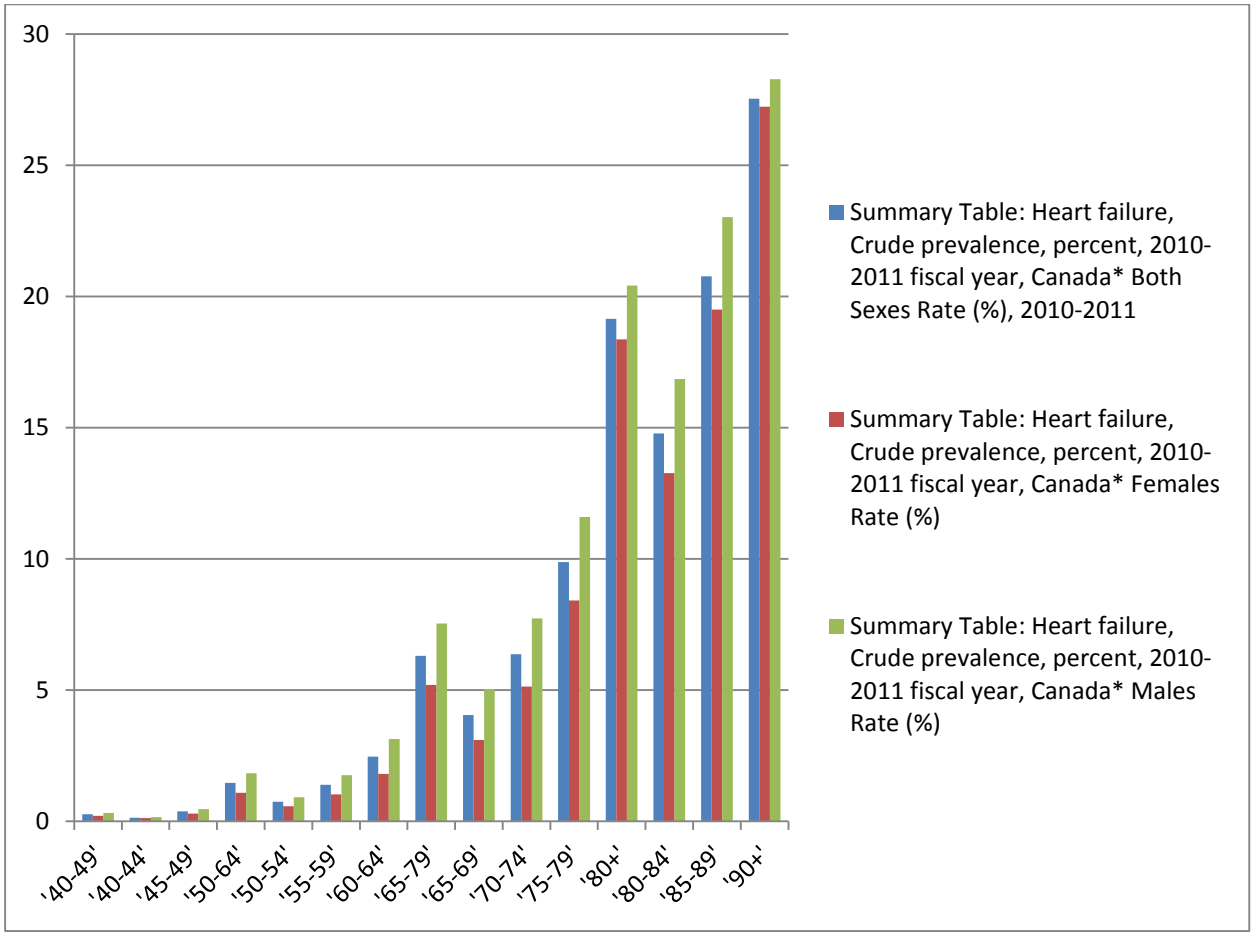


Table 4.52

Summary Table: Heart failure, Crude prevalence, percent, 2019-2020, Canada

Age Group	Both Sexes Rate (%), 2019-2020	Females Rate (%)	Males Rate (%)
'40-49'	0.3	0.23	0.37
'40-44'	0.17	0.14	0.21
'45-49'	0.43	0.33	0.54
'50-64'	1.51	1.1	1.91
'50-54'	0.82	0.62	1.03
'55-59'	1.39	1.01	1.78
'60-64'	2.3	1.67	2.94
'65-79'	5.67	4.49	6.94
'65-69'	3.69	2.75	4.68
'70-74'	5.81	4.53	7.2
'75-79'	8.94	7.38	10.68
'80+'	18.33	17.46	19.59
'80-84'	13.32	11.79	15.21
'85-89'	19.41	17.96	21.48
'90+'	26.96	26.22	28.5

Figure 4.35

Heart failure, Crude prevalence, percent, aged 40 and older - by person - age in 2010, Canada

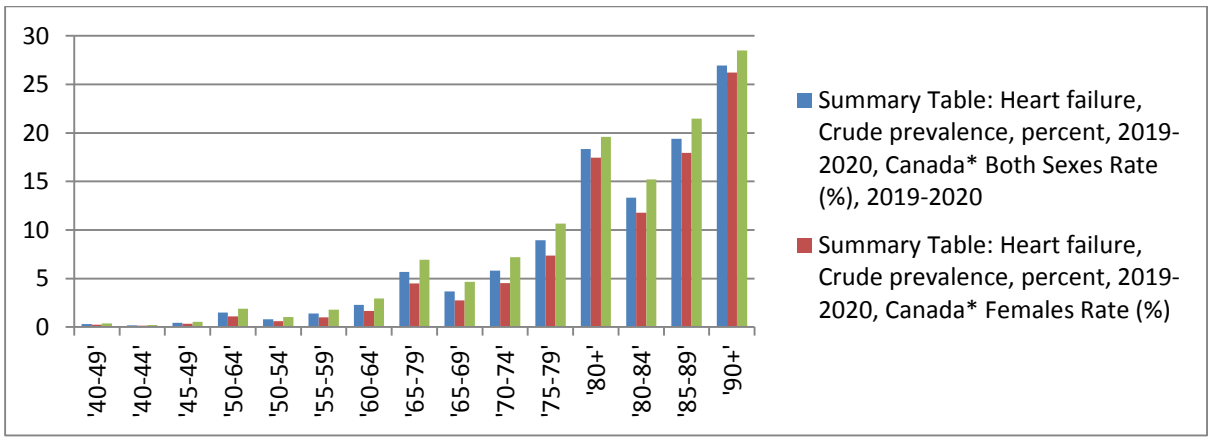


Table 4.53

Summary Table: Heart failure, Crude prevalence, age 40 and older, percent, 2010-2011 to 2019-2020 fiscal years, Canada

Age Group	HF Rate (%) 2010-2011	HF Rate (%) 2019-2020
'40-49'	0.27	0.3
'40-44'	0.14	0.17
'45-49'	0.38	0.43
'50-64'	1.46	1.51
'50-54'	0.75	0.82
'55-59'	1.39	1.39
'60-64'	2.46	2.3
'65-79'	6.31	5.67
'65-69'	4.05	3.69
'70-74'	6.37	5.81
'75-79'	9.88	8.94
'80+'	19.14	18.33
'80-84'	14.78	13.32
'85-89'	20.77	19.41
'90+'	27.53	26.96

Figure 4.36

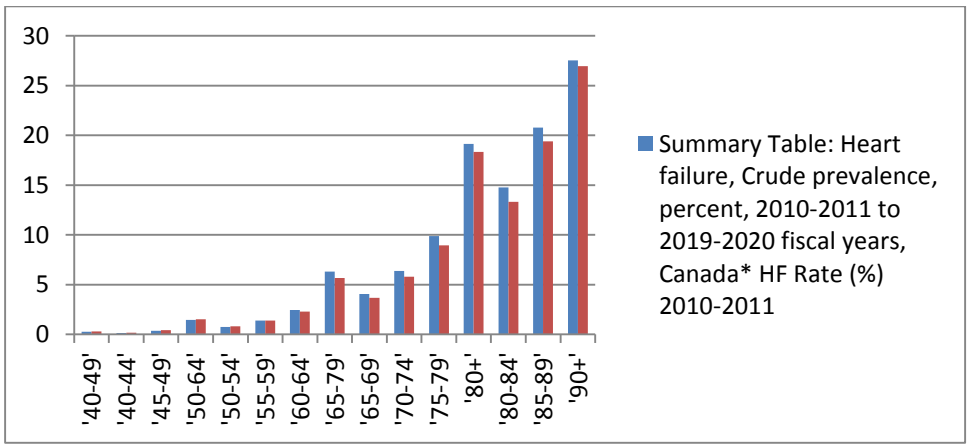
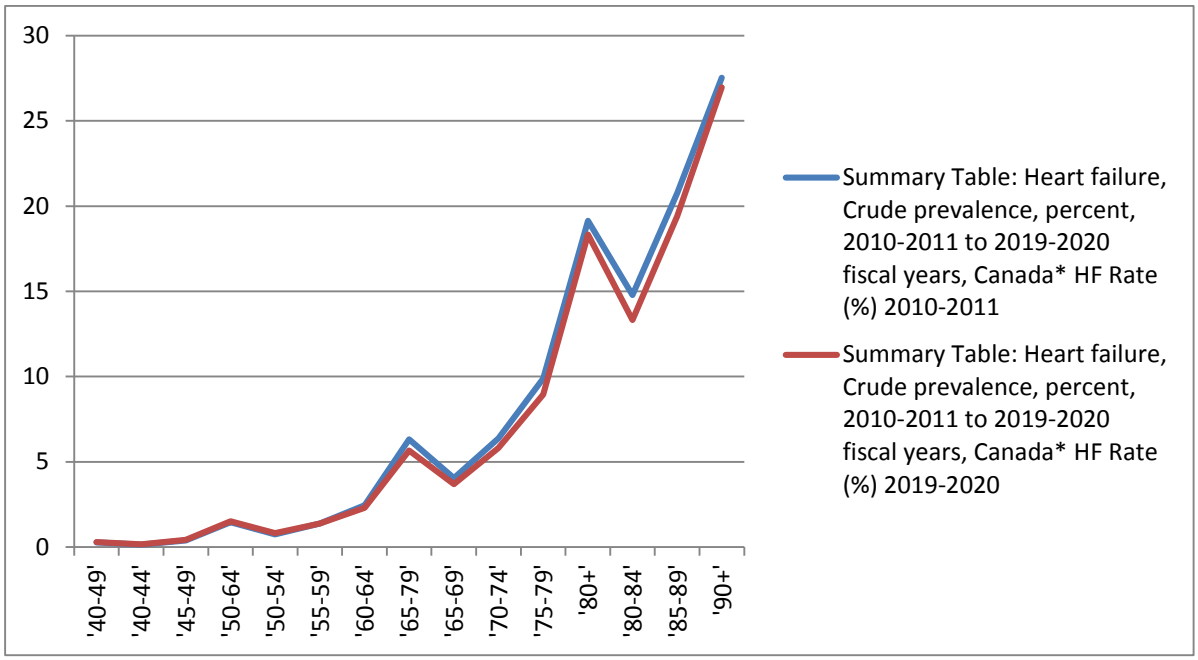


Figure 4.37



4.2.2.1 Trend and prevalence of HF by place/geography location and time

Geography: Findings in this study show a decline in heart failure trajectory in Canada. While the age-standardized prevalence rate of heart failure decreased from 3.47% to 3,26% between 2010-2011 and 2019-2020 fiscal year, five (5) provinces, namely Nova Scotia (2.59%), Prince Edward Island (2.85%), New Brunswick (2.87%), Ontario (3.14%), and Quebec (3.16%) are below the national average of the heart rate prevalence in Canada in 2019-2020 respectively. Nova Scotia has the lowest age-standardized prevalence rate of heart failure, with an age-standardized incident rate of 449 per 100,000 population. In comparison, Yukon Territory, with an age-scandalized incident rate of 701 per 100,000 populations, has the highest age-standardized prevalence rate of 4.48% of heart failure in Canada in the 2019-2020 fiscal year.

Time: Comparatively, Nova Scotia (3.11%) has the lowest prevalence of heart failure in the preceding ten years, while Nunavut (6.7%) has the highest prevalence of heart failure in the same period – 2010-2011 fiscal years. What is apparent is an improvement in the trend of heart failure across Canada but British Columbia, where the age-standardized prevalence rate of heart failure rose from 3.53% to 3,62%, and Yukon Territory, with a rise in the age-scandalized prevalence rate of heart failure from 3.57% to 4.48% between 2010-2011 and 2019-2020 fiscal years. Although

the rise in heart failure in the Yukon Territory may be attributable to the disproportionate social determinant of health, what seems astounding is the rise in the trend of heart failure in British Columbia, where many health indicators and risk factors are adjudged favourable comparatively. The heart failure profile in British Columbia calls for a further study to explore the effect of immigration and other potential contributory factors on the rise in heart failure in the region. Other provinces and territories will record positive outcomes if the effective heart disease management model is explored in regions with promising health disease management outlooks. See table 4.54 and figures 4.38-4.39

Table 4.54

Summary Table: Heart failure, age-standardized prevalence, percent, both sexes, age 40 years and older, between 2010-2011 and 2019–2020 fiscal year

Geography	2010-2011 Rate %	2019-2020 Rate %
Canada	3.47	3.26
Newfoundland and Labrador	4.95	3.78
Prince Edward Island	3.34	2.85
Nova Scotia	3.11	2.59
New Brunswick	3.39	2.87
Quebec	3.27	3.16
Ontario	3.36	3.14
Manitoba	3.84	3.54
Saskatchewan	4.31	3.55
Alberta	3.86	3.49
British Columbia	3.53	3.62
Yukon Territory	3.57	4.48
Nunavut	6.70	

Figure 4.38

Haert failure, age-standardized prevalence, percent, both sexes, age 40 years and older, between 2010-2011 and 2019–2020 fiscal year

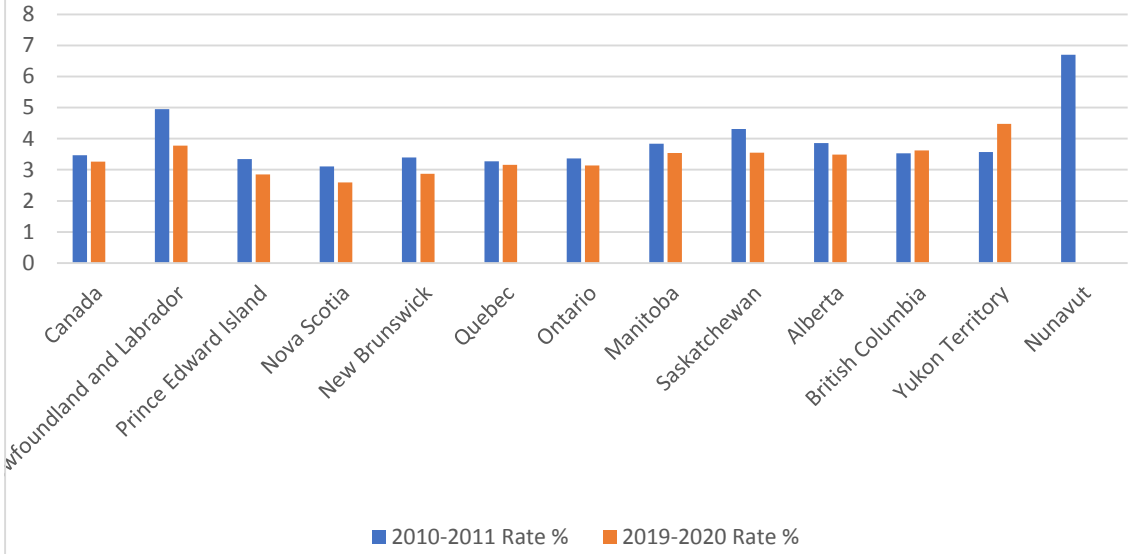
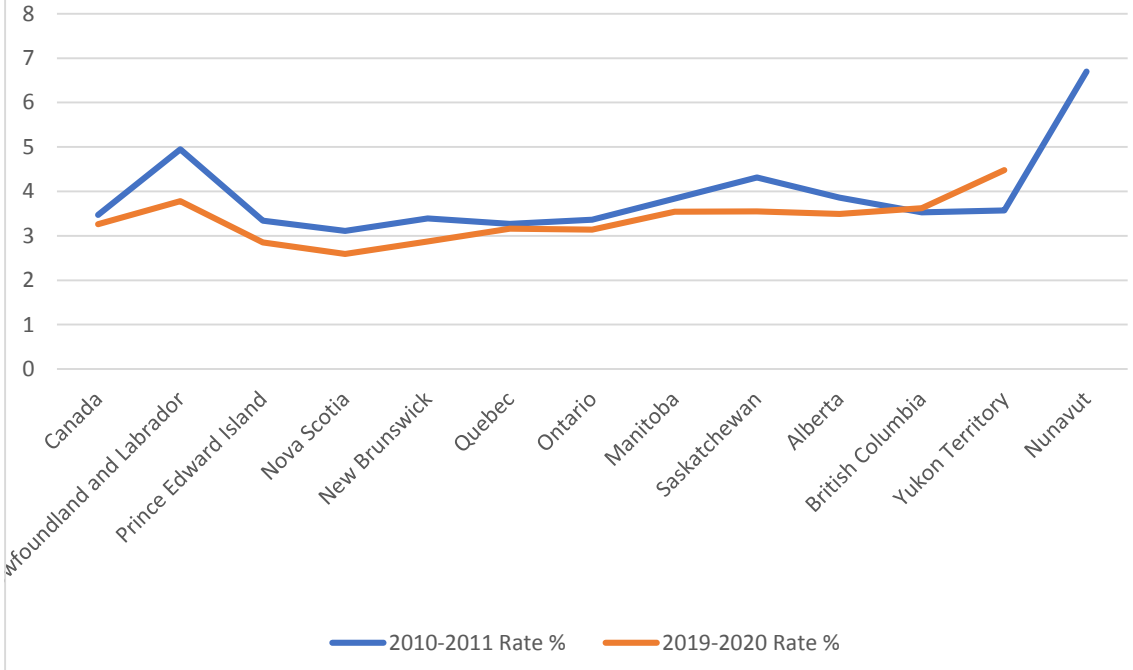
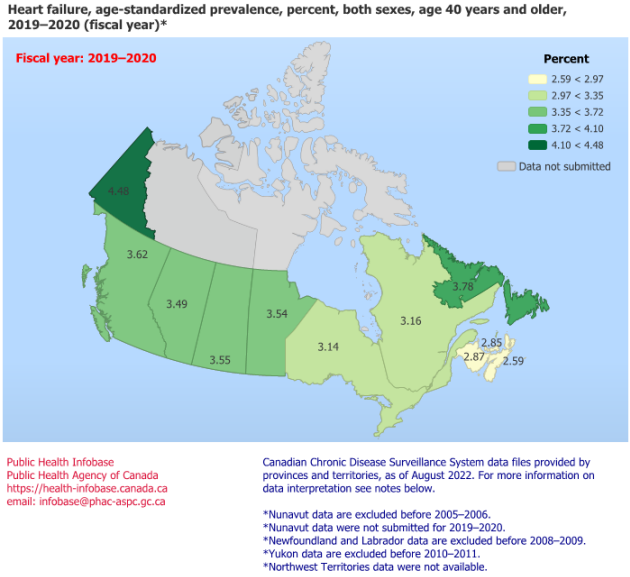
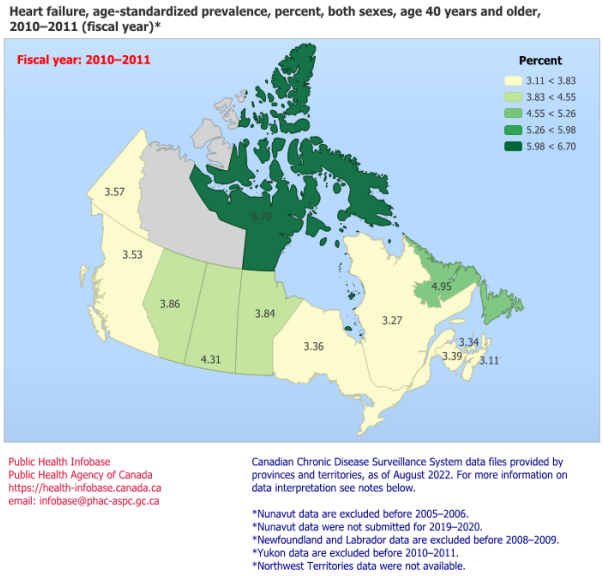


Figure 4.39

Heart failure, age-standardized prevalence, percent, both sexes, age 40 years and older, between 2010-2011 and 2019–2020 fiscal year







4.2.3 The trend and prevalence of Hypertension, excluding gestational hypertension

In this study, the age-standardized incidence rate of hypertension (high blood pressure - HBP) of persons aged 20 and older decreases from 2,526 cases per 100,000 population with 384,695 new cases in Canada in 2010-2011 fiscal year to 1,947 cases per 100,000 population with 360,280 new cases in Canada in 2019-2020 fiscal year. Evidence of a downward trajectory of hypertension incidences is noticeable over the decades, with a -22.92% change in the incident rate of hypertension between the 2010-2011 and 2019-2020 fiscal years. The same trajectory is noticeable in the age-standardized prevalence rate of hypertension, which also decreases from 24.07% to 23.09% (95% CI) with an increased count from 6,684,300 (male: 3,158,440; females: 3,525,890) to 7,975,240 (males: 3,967,340; females: 4,007,900 cases) between 2010-2011 and 2019-2020 fiscal year. There was -4.07% change in the age-standardized prevalence rate of hypertension in Canada between the 2010-2011 and 2019-2020 fiscal years, which is indicative of improvement in the rate of hypertension as equally noticeable in the rate of heart failure in Canada between 2010 and 2020 (PHAC, 2023).

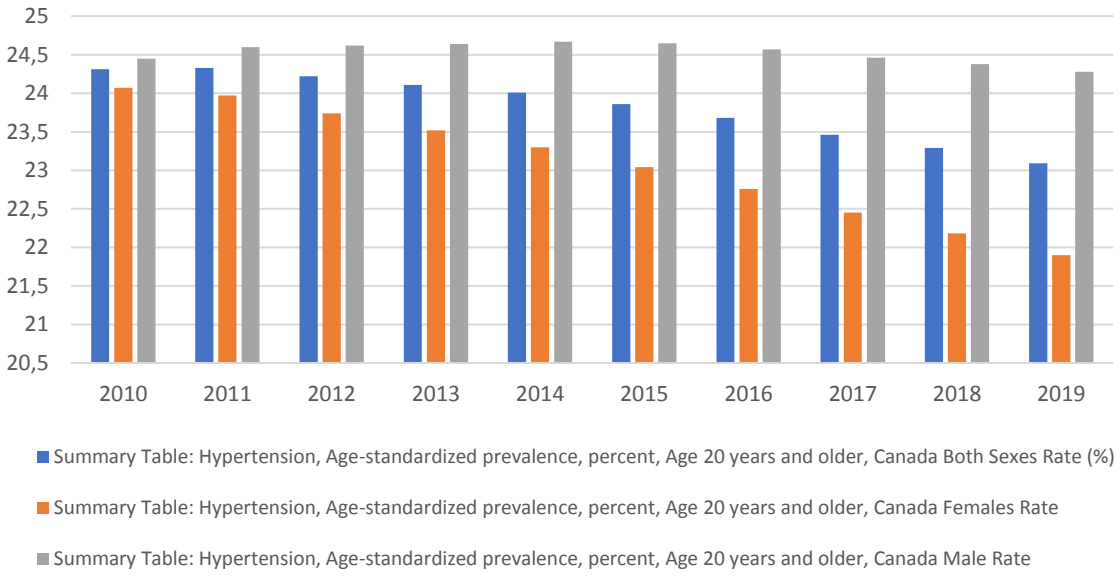
Table 4.55

Summary Table: Hypertension, Age-standardized prevalence, percent, Age 20 years and older, Canada between 2010-2011 and 2019-2020 fiscal year

Year	Both Sexes Rate (%)	Females Rate (%)	Males Rate (%)
2010	24.31	24.07	24.45
2011	24.33	23.97	24.6
2012	24.22	23.74	24.62
2013	24.11	23.52	24.64
2014	24.01	23.3	24.67
2015	23.86	23.04	24.65
2016	23.68	22.76	24.57
2017	23.46	22.45	24.46
2018	23.29	22.18	24.38
2019	23.09	21.9	24.28

Figure 4.40

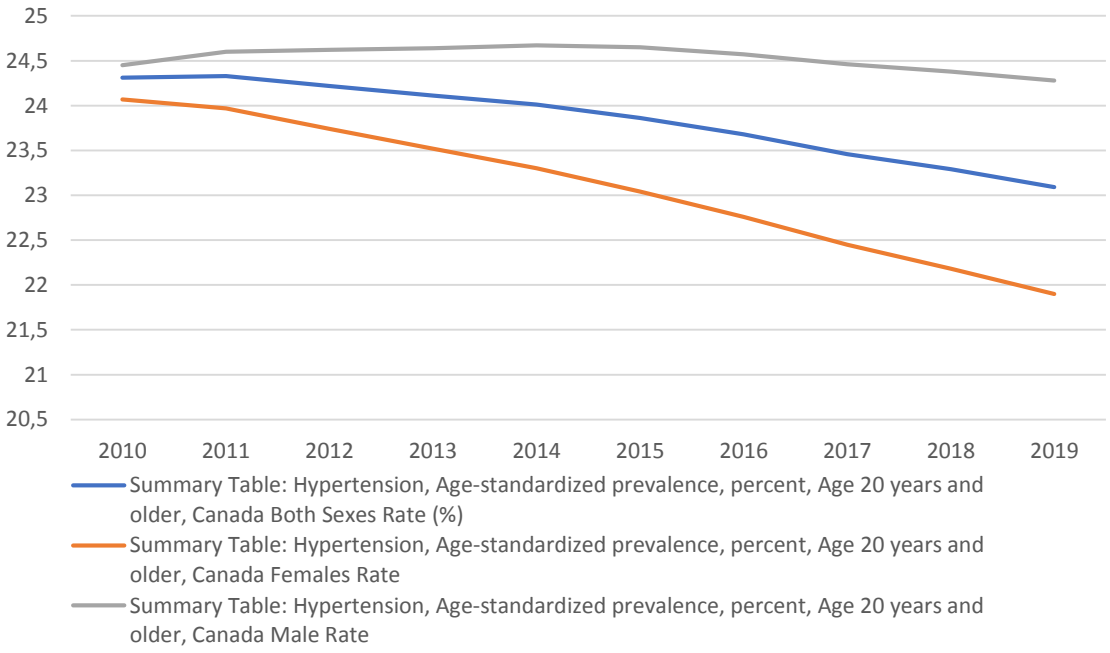
Hypertension, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



4.2.3.1 The trend and prevalence of hypertension by person

Gender: As of the 2019-2020 fiscal year, 7,975,240 (females: 4,007,900; males: 3,967,340) of persons living with hypertension excluding gestational hypertension were reported. In 2010-2011, 6,684,300 (male: 3,158,440; females: 3,525,890) reportedly lived with hypertension in Canada. The ASR prevalence rate of hypertension was 24.31% (females: 24.07%; males: 24.45% at 95% CI) in 2010 2011 fiscal year. While the ASR prevalence of hypertension reduced from 24.31% to 23.09% (-5.02 % change) for both genders between 2010 and 2010, the decline in the ASR prevalence is more apparent for females compared with the male population in Canada. The ASR for females decreased from 24.07% to 21.9% (-9.02% change), while the ASR prevalence rate of hypertension slightly decreased from 24.45% to 24.28 (-0.7%) between 2010 and 2020, respectively. A remarkably favourable trajectory is noticeable for females at the time that the decrease in the ASR prevalence of hypertension is insignificant for males in Canada between 2010 and 2020

Figure 4.41
Hypertension, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



Age: Based on empirical evidence, there is a correlation between age and risk for elevated blood pressure. In this study, persons aged 80 and older have the highest prevalence of hypertension at 80.61% (77.79% in 2010), followed by persons aged 65 to 79 at 58.3% (61.88% in 2010-2011), while persons aged 20 to 34 has the lowest ASR prevalence of hypertension of 1.44% (1.75% in 2010-2011) in Canada as of 2020. Although an improvement is noticeable in the ASR prevalence of hypertension, the epidemiological outlook by age continues to mirror its trend over the past decades. Of note is the remarkable increased risk of developing hypertension at the age of 35 years and older as only 1.44% of persons aged 20-34 and a jump in the ASR presence of hypertension for persons aged 35 and 49 estimated as 9.28%. The ASR prevalence of hypertension increased exponentially from the lower age group to the higher age group.

Although the rise in heart failure in the Yukon Territory between 2010 and 2020 is evident, there is no correlation in the trend of heart failure compared with hypertension in the Yukon Territory as the Yukon Territory HBP outlook is more promising across Canada comparatively. That notwithstanding, Quebec takes the lead in terms of the most promising province for an improved ASR prevalence of hypertension. More work is necessary to address the record-high ASR hypertension in Manitoba. Quebec, Yukon, Nova Scotia, Ontario, and PEI are provinces and territories whose model may be studied for a better outlook on the rate of hypertension in other provinces and territories. See tables 4.55-4.58 and figures 4.40-4.44.

Table 4.56

Summary Table: Hypertension, Crude prevalence, percent, 2010-2011 fiscal year, Canada

Age Group	Both Sexes Rate (%), 2010-2011	Females Rate (%)	Males Rate (%)
'20-34'	1.75	1.59	1.9
'20-24'	0.47	0.4	0.54
'25-29'	1.53	1.39	1.67
'30-34'	3.24	2.95	3.55
'35-49'	10.5	9.68	11.33
'35-39'	5.87	5.3	6.43

'40-44'	9.64	8.75	10.54
'45-49'	15.15	14.2	16.09
'50-64'	31.91	31.27	32.55
'50-54'	22.76	21.97	23.55
'55-59'	32.3	31.6	33.02
'60-64'	43.5	43.01	44.01
'65-79'	61.88	62.85	60.81
'65-69'	54.15	54.24	54.06
'70-74'	63.87	64.92	62.73
'75-79'	71.89	73.51	69.98
'80+'	77.79	80.04	74.05
'80-84'	76.94	78.88	74.28
'85-89'	79.55	81.77	75.63
'90+'	77.01	79.88	69.92

Figure 4.42

Hypertension, Crude prevalence, percent, aged 20 and older - by person - age in 2010-2011, Canada

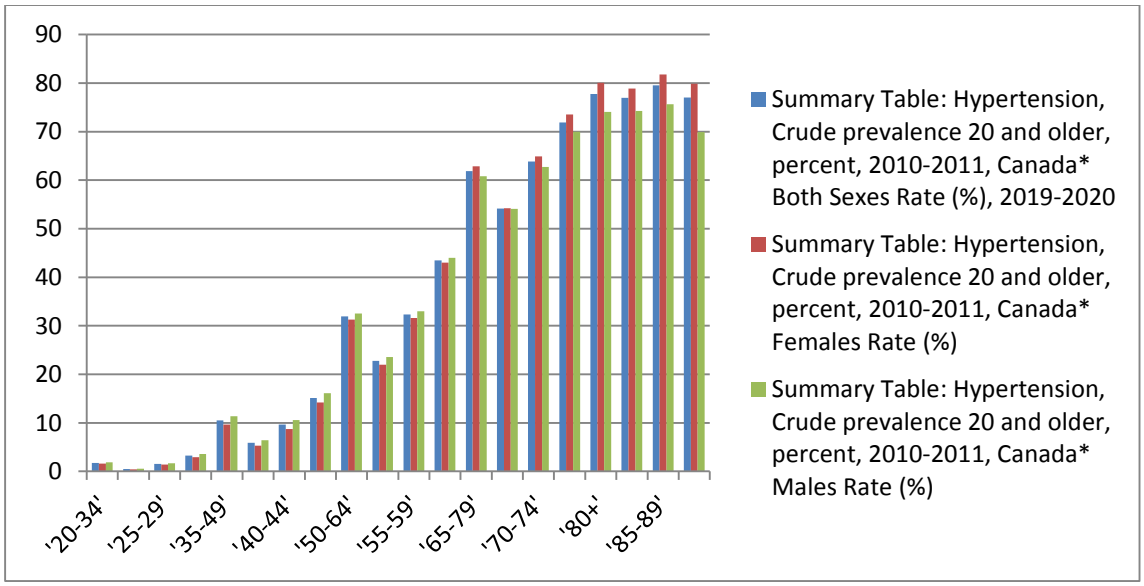


Table 4.57

Summary Table: Hypertension failure, Crude prevalence 20 years and older, percent, 2019-2020, Canada

Age Group	Both Sexes Rate (%), 2019-2020	Females Rate (%)	Males Rate (%)
'20-34'	1.44	1.2	1.68
'20-24'	0.39	0.32	0.46
'25-29'	1.17	0.96	1.37
'30-34'	2.61	2.15	3.07
'35-49'	9.65	8.51	10.79
'35-39'	5.14	4.41	5.86
'40-44'	9.28	8.17	10.38
'45-49'	14.94	13.32	16.56
'50-64'	30.27	27.97	32.57
'50-54'	21.88	19.84	23.91
'55-59'	29.71	27.35	32.08
'60-64'	39.09	36.51	41.71
'65-79'	58.3	56.69	60.03
'65-69'	49.64	47.18	52.23
'70-74'	60.71	59.07	62.48
'75-79'	69.97	69.45	70.56
'80+'	80.61	81.91	78.74
'80-84'	77.46	78.09	76.68
'85-89'	82.73	83.88	81.08
'90+'	84.12	85.89	80.45

Figure 4.43

Hypertension, Crude prevalence, percent, aged 20 and older - by person - age in 2019-2020 fiscal year, Canada

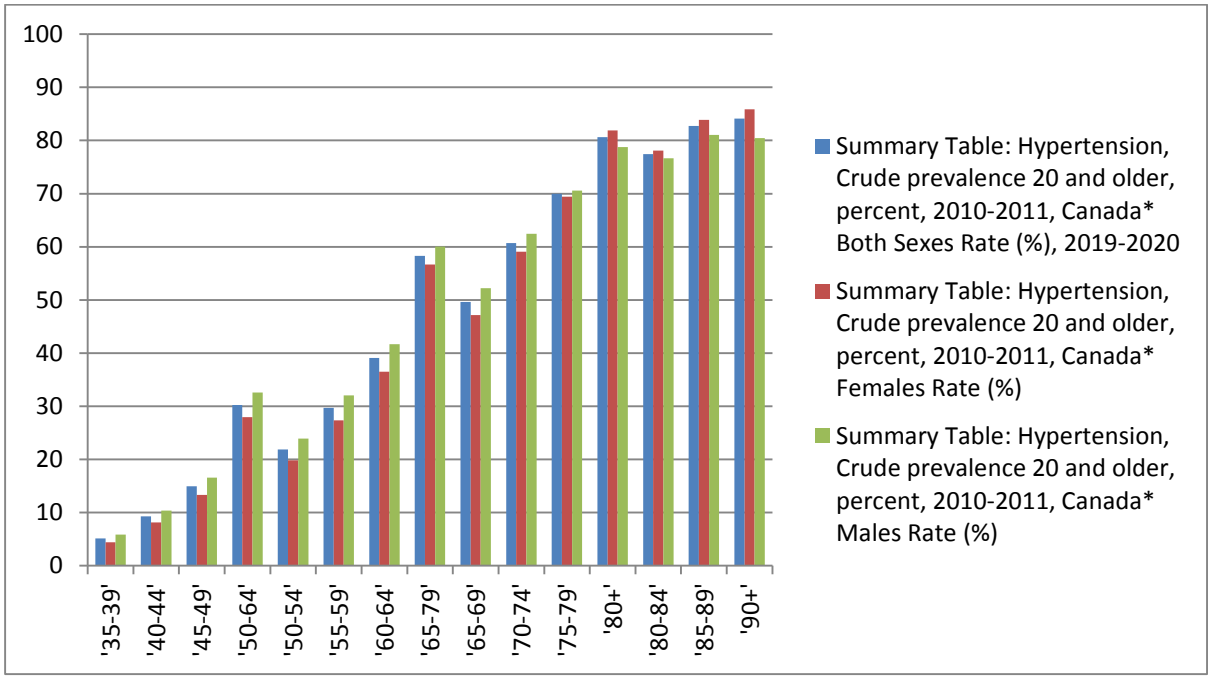


Table 4.58

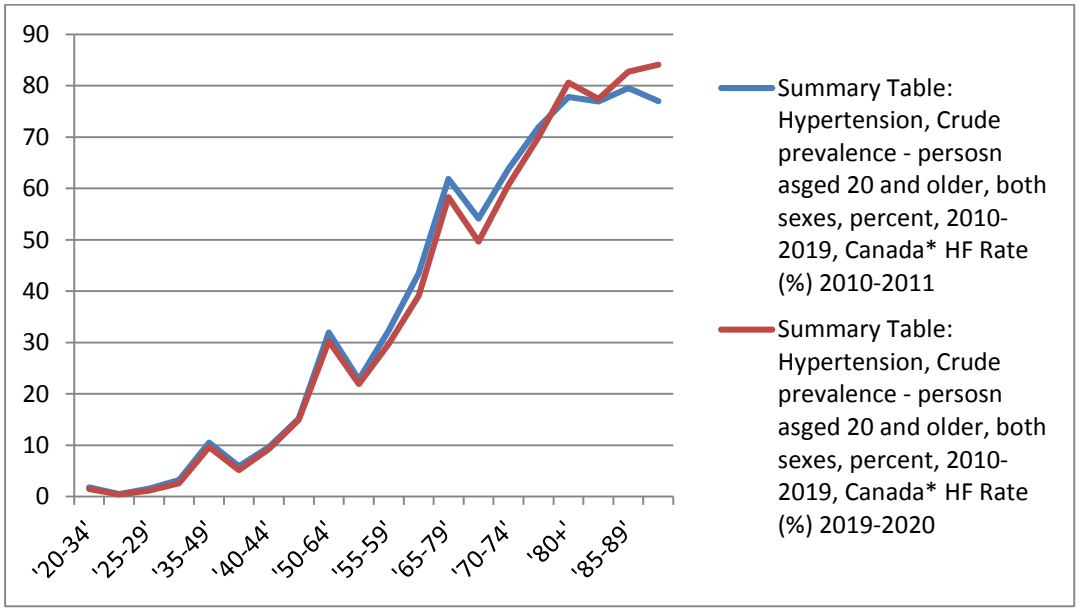
Summary Table: Hypertension, Crude prevalence, age 20 and older, percent, 2010-2011 to 2019-2020 fiscal years, Canada

Age Group	HBP Rate (%) 2010-2011	HBP Rate (%) 2019-2020
'20-34'	1.75	1.44
'20-24'	0.47	0.39
'25-29'	1.53	1.17
'30-34'	3.24	2.61
'35-49'	10.5	9.65
'35-39'	5.87	5.14
'40-44'	9.64	9.28

'45-49'	15.15	14.94
'50-64'	31.91	30.27
'50-54'	22.76	21.88
'55-59'	32.3	29.71
'60-64'	43.5	39.09
'65-79'	61.88	58.3
'65-69'	54.15	49.64
'70-74'	63.87	60.71
'75-79'	71.89	69.97
'80+'	77.79	80.61
'80-84'	76.94	77.46
'85-89'	79.55	82.73
'90+'	77.01	84.12

Figure 4.44

Hypertension, Crude prevalence, age 20 and older, percent, 2010-2011 and 2019-2020 fiscal years, Canada



4.2.3.2 The trend and prevalence of Hypertension by place/geography location

Geography: A decline in the ASR prevalence of hypertension is noticeable in this study. Yorkton Territory (20.83%) and Quebec (22.07%) are the only territories and provinces with an ASR rate of hypertension below the national average in the 2010-2011 fiscal year. In the 2019-2020 fiscal year, Quebec's (19.82%) and Yorkton Territory (21.73%) rates continue to be below the national average with only British Cumbia (23.06% decreasing to 22.14%) joining the region whose ASR hypertension prevalence rate was below the national average. While the ASR prevalence of hypertension is 23.09% in Canada in the 2019-2020 CCHS report, Newfoundland and Labrador has the highest ASR prevalence of hypertension at 30.23%, followed by Manitoba (28.17%) and New Brunswick (27.90%), with Quebec having the least ASR prevalence of hypertension of 19.82% in 2019-2020 fiscal year respectively. See table 4.59 and figure 4.45.

4.2.3.3 The trend and prevalence of hypertension by Time

Comparatively, there was an improvement in the ASR prevalence of hypertension in Newfoundland and Labrador with a -2.4% change and Quebec with a -10.19% change, ASPR prevalence of hypertension increased from 25.55% to 28.17% (+10.25% change) in Canada for ten years between 2010-2011 and 2019-2020 fiscal year respectively. To improve the rate of hypertension across Canada, the model explored and implemented in Quebec may be considered.

Table 4.59

Summary Table: Hypertension, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

Geography	2010-2011 HBP Rate %	2019-2020 HBP Rate %
Canada	24.31	23.09
Newfoundland and Labrador	30.97	30.23
Prince Edward Island	25.56	23.91
Nova Scotia	28.27	25.90
New Brunswick	27.23	27.20
Quebec	22.07	19.82

Ontario	25.09	23.46
Manitoba	25.55	28.17
Saskatchewan	25.72	25.41
Alberta	24.49	24.72
British Columbia	23.06	22.14
Yukon Territory	20.83	21.73
Nunavut	26.14	

Table 4.60

Summary Table: Hypertension, excluding gestational hypertension, Age-						
Area	Sex	Year	Rate (per	Rate_95%	Rate_95%	Counts
Canada	Both sexe	2019	1947	1941	1954	363,820
Newfoun	Both sexe	2019	2200	2135	2268	5,500
Prince Ed	Both sexe	2019	2110	2002	2225	1,685
Nova Scot	Both sexe	2019	2055	2012	2098	10,675
New Brun	Both sexe	2019	2645	2590	2703	10,115
Quebec	Both sexe	2019	1472	1459	1485	61,570
Ontario	Both sexe	2019	1840	1829	1851	135,840
Manitoba	Both sexe	2019	2911	2862	2961	16,860
Saskatche	Both sexe	2019	2418	2370	2466	12,475
Alberta	Both sexe	2019	2584	2558	2610	52,555
British Col	Both sexe	2019	2137	2118	2156	55,845
Yukon Ter	Both sexe	2019	2847	2569	3167	605
Nunavut	Both sexe	2019				

Figure 4.45

Hypertension, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

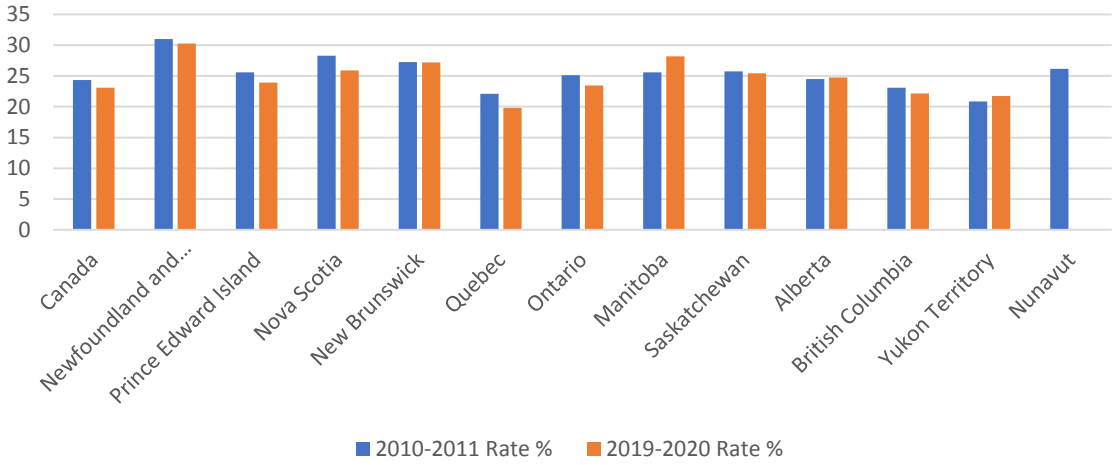
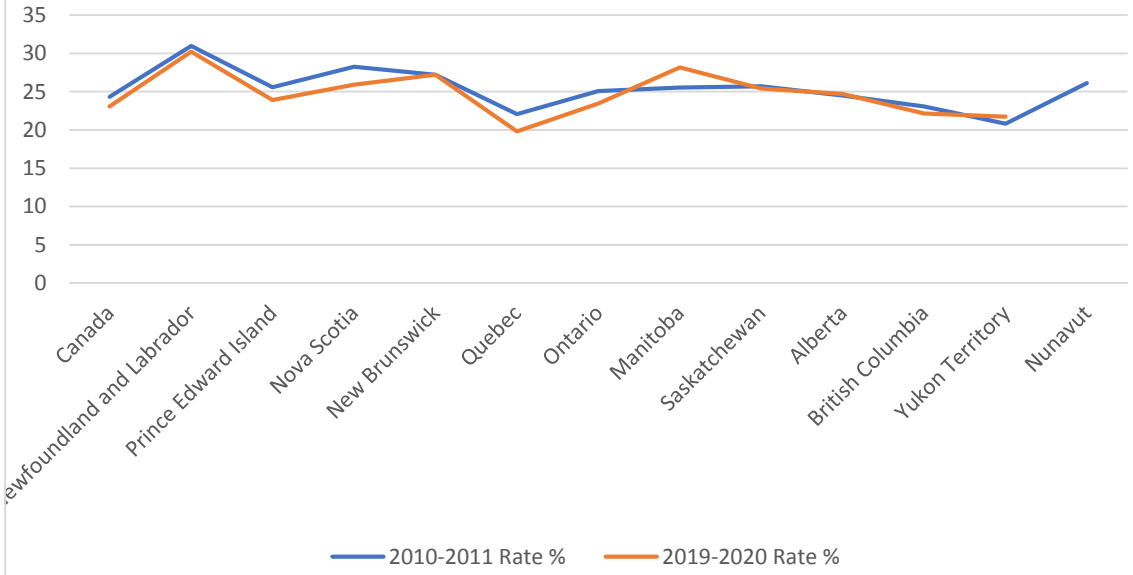
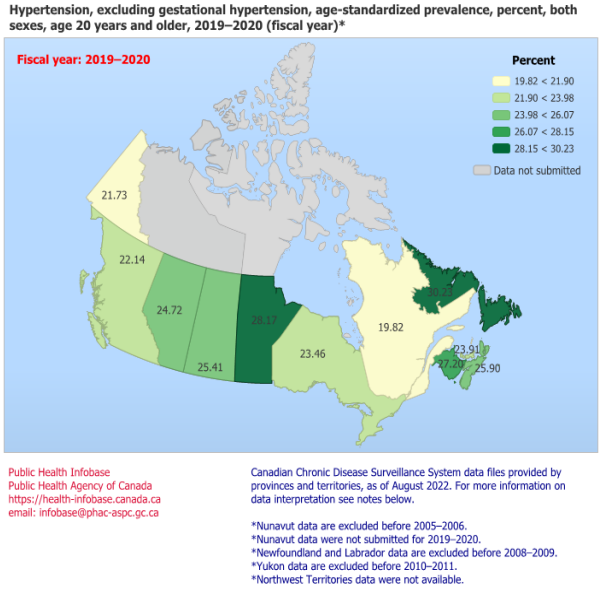
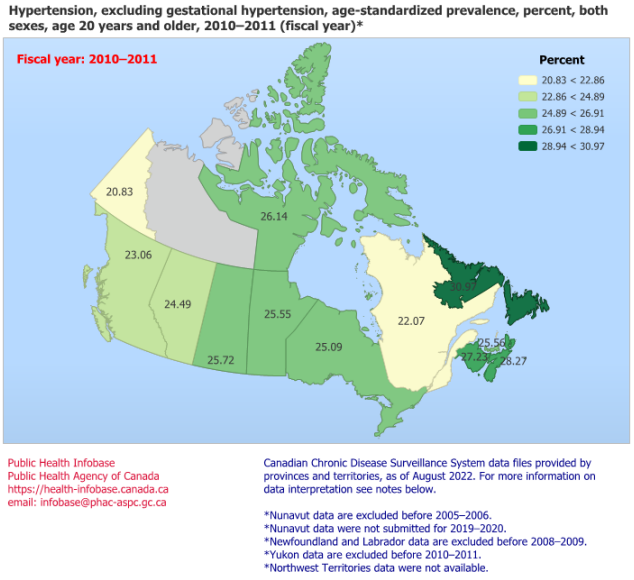


Figure 4.46

Hypertension, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year







4.2.4 The trend and prevalence of ischemic heart disease in Canada

As of 2020, the age-standardized incidence rate of ischemic heart disease (IHD) is 589 per 100,000 population, with an incidence of 166,545 cases in Canada. A decline in the incidence with evidence of -20% change compared with the preceding ten years record, which was 737 per 100,000 population with 162,530 counts based on the 2010-2011 fiscal year report shows an improvement in the rate of IHD in Canada. Within the past decade, a promising trajectory is evident in the prevalence of ischemic heart disease for persons aged 20 and older. In this study, a total count of 2,633,165 persons aged 20 and older are living with ischemic heart disease with an age-standardized prevalence of 7.34% (7.33 – 7.35% 95% CI) based on the CCHS 2019-2020 fiscal year report.

Although an increase in prevalence is in tandem with the Canadian population growth, there is a downward trajectory in the ASR prevalence of ischemic heart disease, with a 10.49% change between 2010 and 2020. In the 2010-2011 fiscal year, the ASR prevalence of ischemic heart disease was 8.20% (8.19-8.22% 95% CI), at which time the total count was 2,275,815 IHD cases in Canada (PHAC, 2023). A decline in the incidence and prevalence rate of IHD points to the effectiveness of the cardiovascular care intervention implemented across Canada (PHAC, 2021). Although an improvement is noticeable in the rate of IHD in Canada recently, this feat was recorded in the early

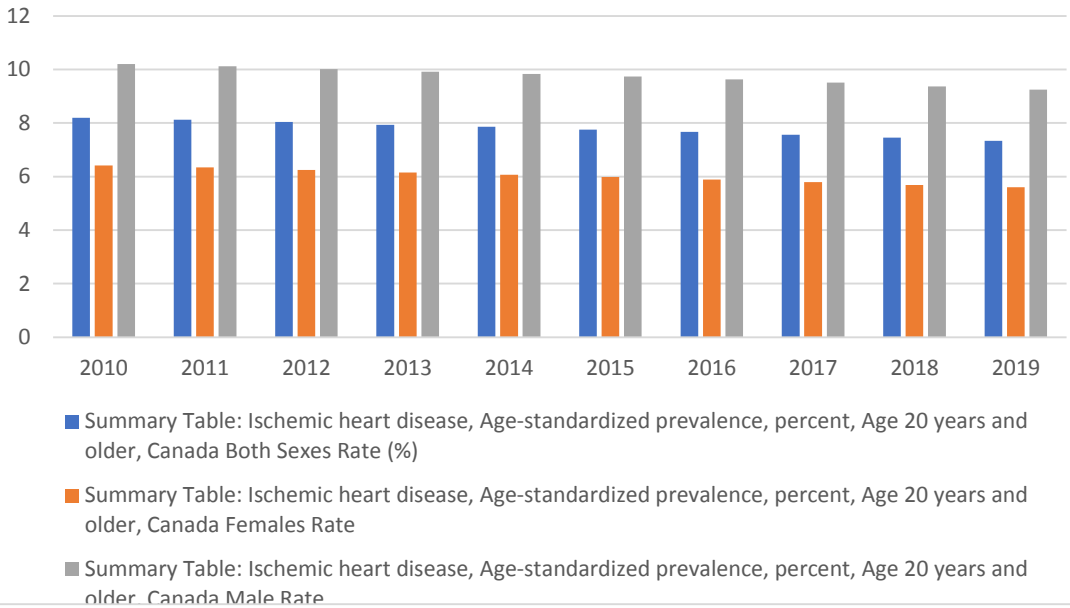
millennia when the ASR prevalence of IHD was 7.16% based on the 2000-2001 CCHS fiscal year report. While the bell shape in the trajectory IHD is evident between 2000 and 2020, some data may have yet to be captured 20 years ago, unlike in recent times where increased accuracy in health indicator surveillance and data collection cannot be overemphasized (ref.) It would be beneficial to assess the contributory factor to a better ASR prevalence of IHD in the early 2000. See table 4.461 and figure 4.47.

Table 4.61

Summary Table: Ischemic heart disease, Age-standardized prevalence, percent, Age 20 years and older, Canada between the 2010-2011 and 2019-2020 fiscal years

Year	Both Sexes IHD Rate (%)	Females IHD Rate (%)	Males IHD Rate (%)
2010	8.2	6.41	10.2
2011	8.13	6.34	10.12
2012	8.04	6.25	10.02
2013	7.94	6.15	9.92
2014	7.86	6.07	9.84
2015	7.76	5.98	9.74
2016	7.67	5.89	9.63
2017	7.56	5.79	9.51
2018	7.45	5.69	9.37
2019	7.34	5.6	9.25

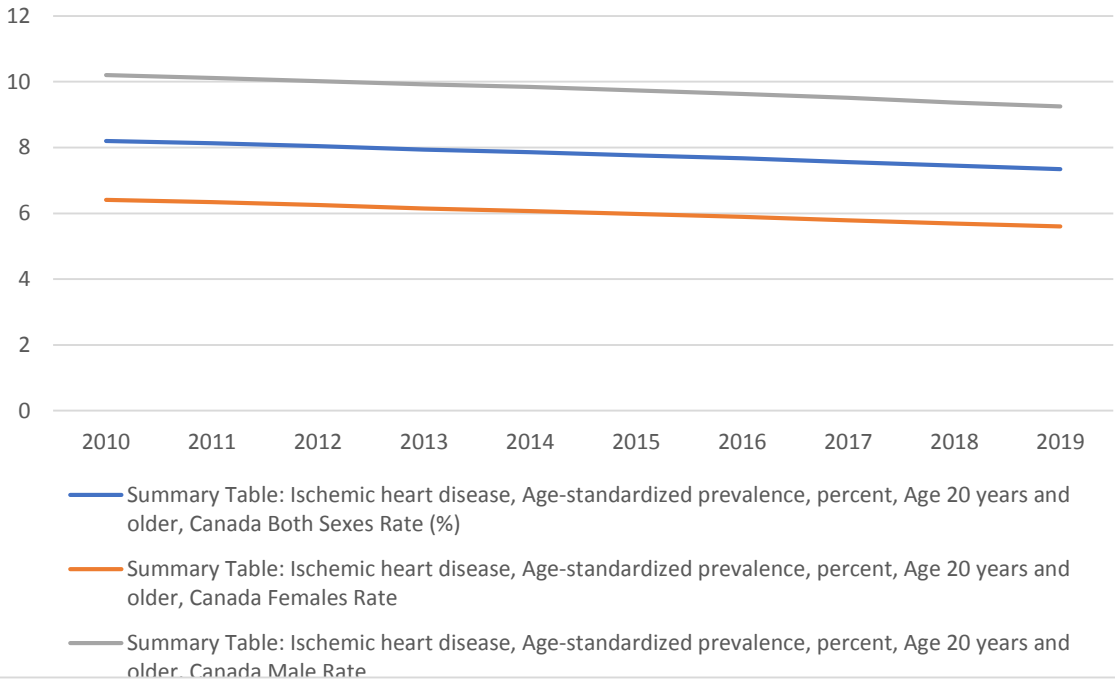
Figure 4.47
Ischemic heart disease, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



4.2.4.1 The trend and prevalence of ischemic heart disease by person

Gender: In 2020, the population of females to males living with ischemic heart disease is nearly in the ration 2:3. By inference, more males are diagnosed with IHD than females. Based on the 2019-2020 CCHS report, where 2,633,165 persons reportedly lived with ischemic heart disease in Canada, 1,088,580 were females, while 1,544,580 were males. The ASR prevalence of ischemic heart disease was 5.6% for females and 9.25% for males. Although the total cases were in the ratio of 1:1.5 for males to females, the prevalence of ischemic heart disease nearly doubled in males compared with the female's rate in Canada as of the 2019-2020 fiscal year. In the 2010-2011 fiscal year, the ASR prevalence of IHD was 8.20% (females: 6.41%; males: 10.2%). Although the ASR prevalence of IHD continues to decline, the trajectory is more promising for females with -12.63% change, unlike males, which had -9.31% change between the 2010-2011 and 2019-2020 fiscal years. See figure 4.48.

Figure 4.48
Ischemic heart disease, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



Age: While increasing evidence shows a correlation between age and risk for ischemic heart disease, the outcome of this study is not in isolation either. As of 2020, persons aged 80 and older have the highest age-standardized prevalence of ischemic heart disease of 38.03% (-3.62% change since 2010) followed by 65-79 reported as 21.31% (-12.77% change since 2010), 35-49 reported as 1.56% (-12.36% change since 2010) and the least is noted in the age group of persons aged 20-34 with ASR IHD prevalence of 0.23% (-4.17% change since 2010).

Although more older people present with ischemic heart disease in Canada, the trend of ischemic heart disease in the past decade is more favourable for persons aged 65-79, closely followed by persons aged 35-49, while persons aged 80 and older and persons aged 20-34 has the least promising ASR prevalence of IHD in Canada based on the percentage change in the ASR prevalence of IHD between 2010-2011 and 2019-2020 fiscal years respectively. While the population dynamics, migration effect and ageing play a pivotal role in the dynamics of IHD, it is imperative to buff the health promotion and cardiovascular prevention model for all age groups

with an increased focus on the young adults aged 20-34 and Canadians aged 80 and older, respectively. See tables 4.62-4.67 and figures 4.49-4.51.

Table 4.62

Summary Table: Ischemic heart disease, Crude prevalence, percent, 2010-2011 fiscal year, Canada

Age Group	Both Sexes IHD Rate (%) 2010-2011	Females Rate (%)	Males Rate (%)
'20-34'	0.24	0.22	0.25
'20-24'	0.08	0.07	0.08
'25-29'	0.21	0.19	0.22
'30-34'	0.42	0.38	0.46
'35-49'	1.78	1.28	2.28
'35-39'	0.77	0.62	0.92
'40-44'	1.49	1.1	1.88
'45-49'	2.88	1.99	3.77
'50-64'	8.69	6.08	11.34
'50-54'	5.16	3.56	6.76
'55-59'	8.58	5.93	11.28
'60-64'	13.47	9.55	17.5
'65-79'	24.43	19.19	30.18
'65-69'	19.2	14.21	24.4
'70-74'	25.32	19.78	31.41
'75-79'	31.8	26.05	38.59
'80+'	39.46	35.64	45.78
'80-84'	37.31	32.13	44.43
'85-89'	41.17	37.3	47.66
'90+'	42.09	40.44	45.65

Figure 4.49

Ischemic heart disease, Crude prevalence, percent, aged 20 and older - by person - age in 2010-2011, Canada

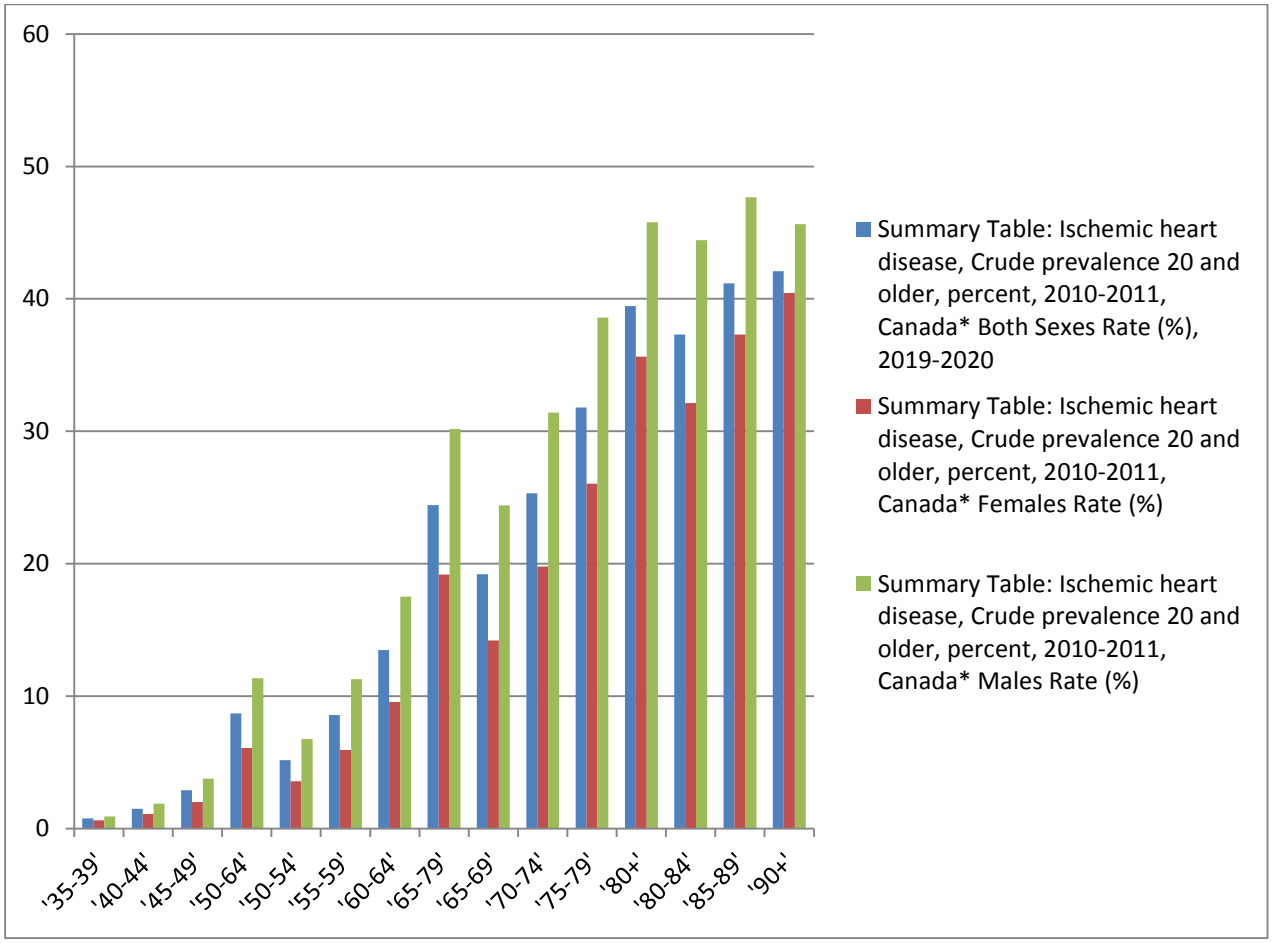


Table 4.63

Summary Table: Ischemic heart disease, Crude prevalence 20 years and older, percent, 2019-2020, Canada

Age Group	Both Sexes Rate (%), 2019-2020	Females Rate (%)	Males Rate (%)
'20-34'	0.23	0.2	0.25
'20-24'	0.08	0.07	0.08
'25-29'	0.2	0.18	0.22

'30-34'	0.39	0.34	0.43
'35-49'	1.56	1.18	1.93
'35-39'	0.72	0.6	0.84
'40-44'	1.41	1.11	1.73
'45-49'	2.61	1.89	3.33
'50-64'	7.8	5.45	10.16
'50-54'	4.59	3.27	5.9
'55-59'	7.43	5.15	9.72
'60-64'	11.35	7.88	14.88
'65-79'	21.31	15.92	27.11
'65-69'	16.19	11.48	21.13
'70-74'	22.36	16.61	28.56
'75-79'	28.76	22.47	35.83
'80+'	38.03	33.18	45.06
'80-84'	34.73	28.73	42.13
'85-89'	39.82	34.49	47.45
'90+'	42.28	38.97	49.13

Figure 4.50

Ischemic heart disease, Crude prevalence, percent, aged 20 and older - by person - age in 2019-2020 fiscal year, Canada

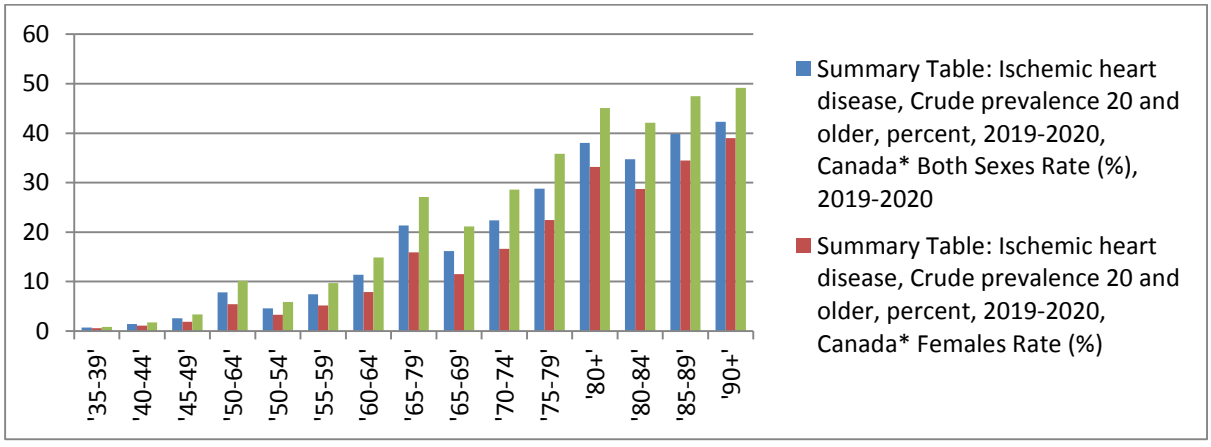
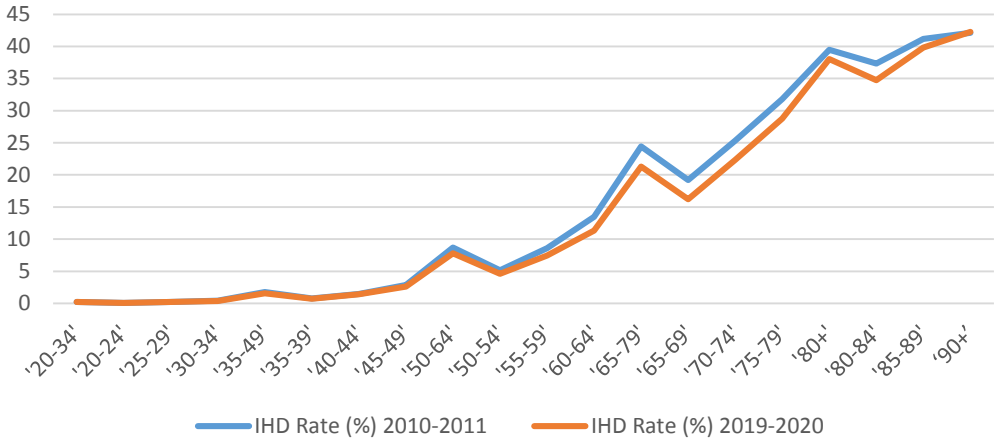


Table 4.67

Summary Table: Ischemic heart disease, Crude prevalence, age 20 and older, percent, 2010-2011 to 2019-2020 fiscal years, Canada

Age Group	IHD Rate (%) 2010-2011	IHD Rate (%) 2019-2020
'20-34'	0.24	0.23
'20-24'	0.08	0.08
'25-29'	0.21	0.2
'30-34'	0.42	0.39
'35-49'	1.78	1.56
'35-39'	0.77	0.72
'40-44'	1.49	1.41
'45-49'	2.88	2.61
'50-64'	8.69	7.8
'50-54'	5.16	4.59
'55-59'	8.58	7.43
'60-64'	13.47	11.35
'65-79'	24.43	21.31
'65-69'	19.2	16.19
'70-74'	25.32	22.36
'75-79'	31.8	28.76
'80+'	39.46	38.03
'80-84'	37.31	34.73
'85-89'	41.17	39.82
‘90+’	42.09	42.28

Figure 4.51
*Ischemic heart disease, Crude prevalence, age 20 and older, percent, 2010-2011 and 2019-2020 fiscal years, Canada**



4.2.4.2 The trend and prevalence of ischemic heart disease by place/geography location

Geography: Findings in this study show that as of the year 2019-2020, New Brunswick has the highest ASR prevalence of ischemic heart disease at 8.57% (-9.12% change since 2010), followed by Ontario at 7.55% (-13.71% change since 2010) and Quebec with 7.54% (-12.22% change since 2010) while Yukon Territory has the least ASR prevalence of ischemic heart diseases. See table 4.68 and figures 4.52-4.53.

4.2.4.3 The trend and prevalence of ischemic heart disease by Time:

Although a decline in the prevalence of ischemic heart disease was recorded in Canada between 2010 and 2020, an upward trajectory is noticeable in the prevalence of ischemic heart disease in both British Columbia (6.83% from 6.77%) and Yukon Territory (4.61% from 3.84%) respectively. While the actual contributory factors to the increased prevalence of ischemic heart disease in both British Columbia and the Yukon Territory are unknown, the surge in migration into British Columbia and a potential increased surveillance effort in the Yukon Territories may be explored. Even with the increased rate of IHD in the said province and territory, the record in the region is below the national average. To improve the rate of ischemic heart disease across Canada, the model explored and implemented in Yukon Territory and Prince Edward Island may be explored if

changes in population dynamics and surveillance system/data collection are not contributing to the feat in the regions.

Table 4.68

Summary Table: Ischemic heart disease, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

Geography	2010-2011 IHD Rate %	2019-2020 IHD Rate %
Canada	8.20	7.34
Newfoundland and Labrador	8.36	7.26
Prince Edward Island	7.16	5.77
Nova Scotia	8.17	6.65
New Brunswick	9.43	8.57
Quebec	8.59	7.54
Ontario	8.75	7.55
Manitoba	6.67	6.00
Saskatchewan	7.96	6.99
Alberta	7.41	7.25
British Columbia	6.77	6.83
Yukon Territory	3.84	4.61
Nunavut	5.33	

Figure 4.52

Ischemic heart disease, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

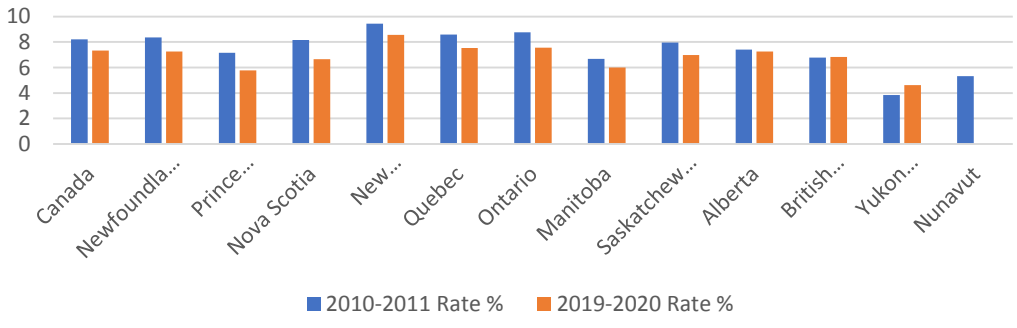
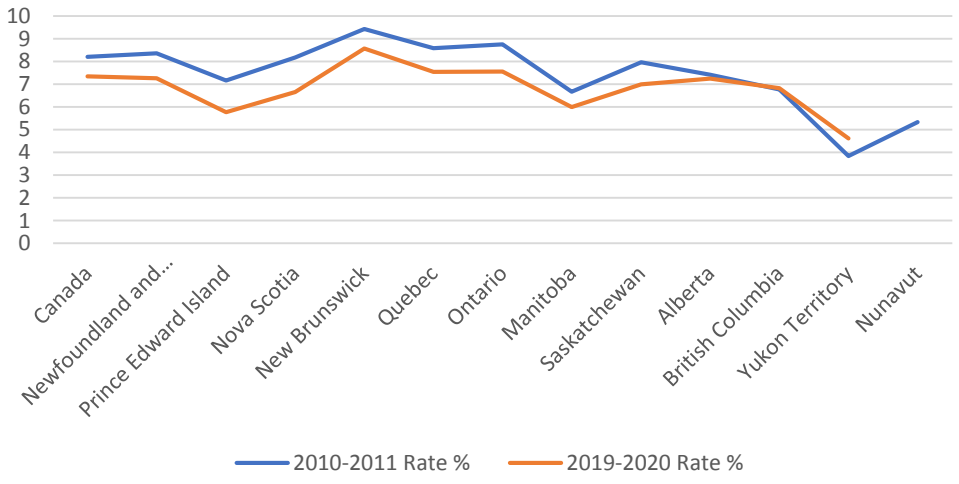
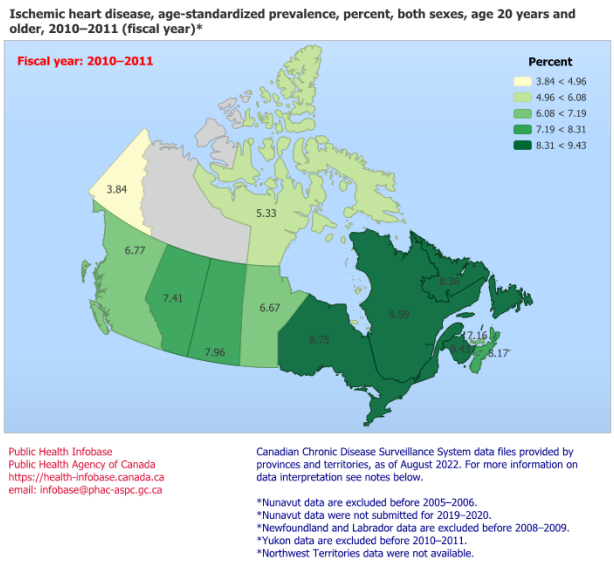
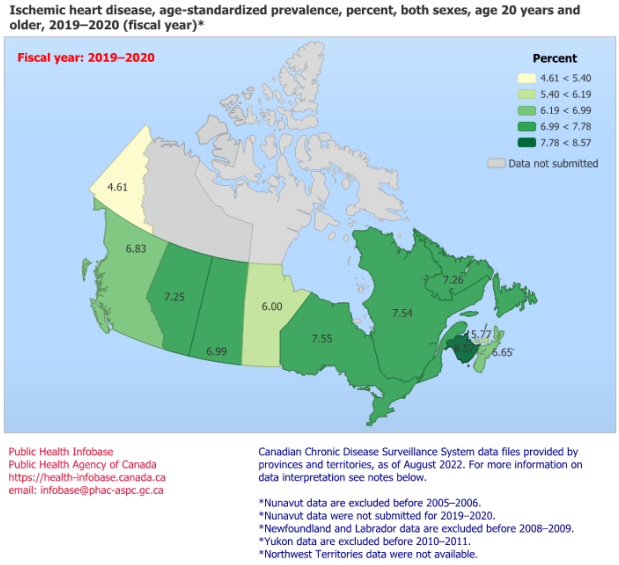


Figure 4.53
Ischemic heart disease, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year







4.2.5 The trend and prevalence of stroke (CVA) in Canada

In Canada, the age-standardized incidence rate of stroke–cerebrovascular accident (CVA) is 280 per 100,000 population (males: 311; females: 252), with the incidence of 92,010 (males: 46,915; females: 41,500) cases as of 2020. A decline in the incidence with a -13.31% change compared with the preceding ten-year record, which was 323 per 100,000 population with 80,585 counts

based on the 2010-2011 fiscal year report shows an improvement in the rate of IHD in Canada. Unlike the incidence trend, there is an upward trajectory in the age-standardized prevalence of stroke between 2010 and 2020. Based on the 2019-2020 fiscal year, the prevalence of stroke in Canada was 2.57% (males: 2.81%; females: 2.31%), with a total count of 924,475 (715,980 counts in the 2010-2011 fiscal year).

A significant increase of +0.78% change was recorded in the ASR prevalence of stroke between 2010 and 2020. The lack of improvement in the outlook of stroke in Canada has been consistent over the past decade. Between 2010 and 2014, the ASR prevalence rate of stroke remains pegged at 2.55. An increase in stroke rate was noticeable between 2015 and 2018, with an average of 2.57%. While the age-standardized prevalence rate of hypertension, heart failure, and ischemic heart disease have improved over the years, the increasing upward trajectory of AMI and CVA raises some concerns about the contributory factors that require a stern and indeed deliberate intervention in managing the upward trend. Increased health literacy, health promotion and early detection of this CVD may be promising in managing the disease burden in Canada. See tables 4.69 and figure 4.54.

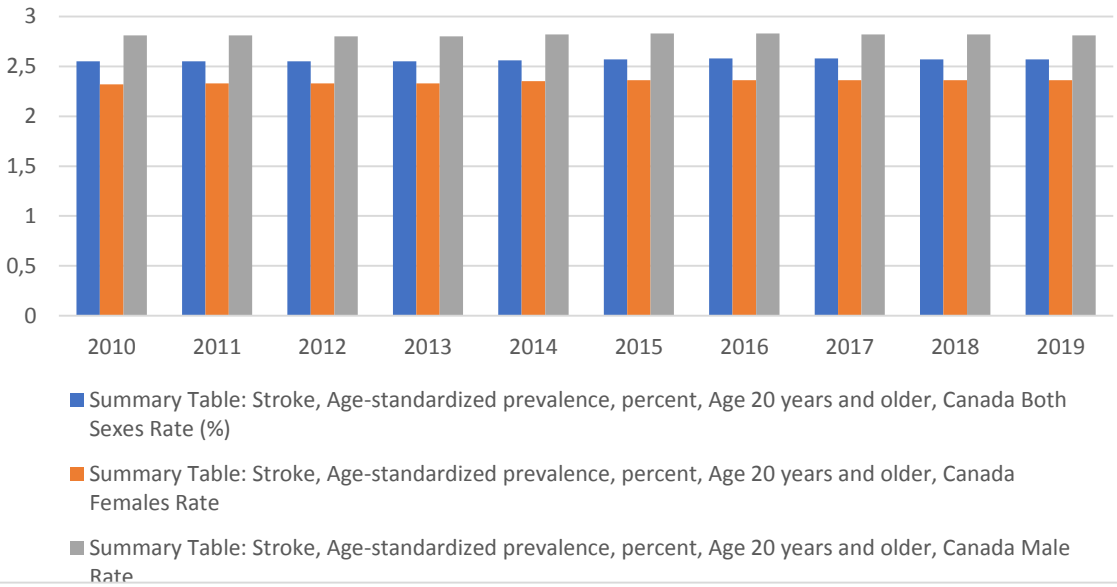
Table 4.69

Summary Table: Stroke, Age-standardized prevalence, percent, Age 20 years and older, Canada between 2010-2011 and 2019-2020 fiscal year

Year	Both Sexes Rate (%)	Females Rate (%)	Males Rate (%)
2010	2.55	2.32	2.81
2011	2.55	2.33	2.81
2012	2.55	2.33	2.8
2013	2.55	2.33	2.8
2014	2.56	2.35	2.82
2015	2.57	2.36	2.83
2016	2.58	2.36	2.83

2017	2.58	2.36	2.82
2018	2.57	2.36	2.82
2019	2.57	2.36	2.81

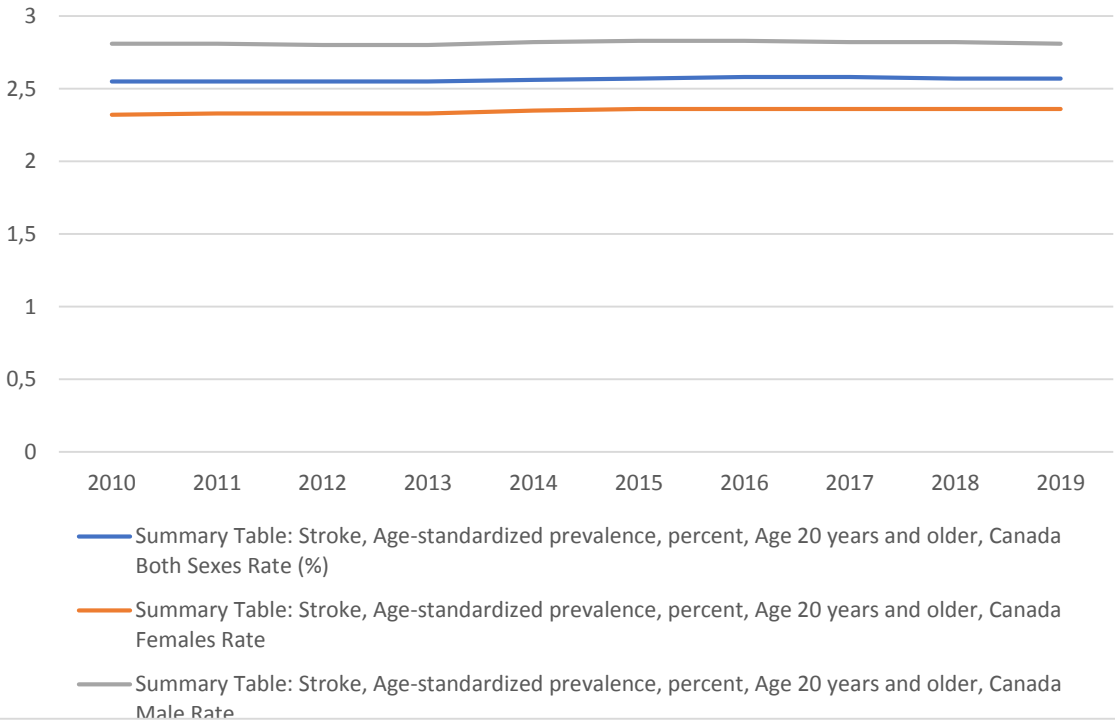
Figure 4.54
Stroke, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



4.2.5.1 The trend and prevalence of stroke (CVA) by person

Gender: As of 2019-2020 CCHS, more Canadian males are diagnosed with stroke with an age-standardized prevalence rate of 2.81%, while the females were 2.36%. Although there has been a steady, insignificant increase in the prevalence rate of stroke in Canada's male population since 2015, the rate has been consistent for females between 2015 and 2020. While there were no changes in the prevalence of stroke for males between 2010 and 2020, an increase in the prevalence of stroke is noticeable for females, with a +1.72% change within the past decade comparatively. Notwithstanding the increasing rate of stroke for females between 2010 and 2020, the population of males (465,995) living with stroke continues to be above the females (461,485) in Canada based on the CCHS 2019-2020 fiscal year report (PHAC, 2023). See figure 4.55.

Figure 4.55
Ischemic heart disease, Age-standardized prevalence, percent, Age 20 years and older by person - gender, Canada between 2010-2011 and 2019-2020 fiscal year



Age: As evident in other CVDs, there is a correlation between age and risk for stroke. As of 2020, persons aged 80 and older have the highest age-standardized prevalence rate of stroke at 16.81% with a -0.83% change since 2010, followed by persons aged 65-79 (6.71%), 50-64 (2.35%), 35-49 (0.62%) while the least is persons aged 20-34 (0.13%). Although there is an increase in the prevalence of stroke in Canada between the years 2010 and 2020 with a +0.78% change at 95% CI, findings in this study provide insight into the age groups where the increase is more noticeable. A downward trajectory in the prevalence of stroke is noticeable in the older adult population aged 65 and older. Conversely, an upward trajectory is noticeable in the prevalence of stroke in young and middle-adult Canadians aged 20- to 64 years old. What is more apparent is that the most pronounced upward trajectory in the prevalence of stroke is noticeable in Persons aged 50-60, with a +14.63% change between 2010 and 2020. With this evidence, an optimal intervention should be

more focused on the person aged 20 and 64 with a more deliberate focus on persons aged 50-64. See tables 4.70-4.72 and figure 4.56.

Table 4.70

Summary Table: Stroke, Crude prevalence, percent, 2010-2011 fiscal year, Canada

Age Group	Both Sexes Stroke Rate (%), 2010-2011	Females Rate (%)	Males Rate (%)
'20-34'	0.12	0.14	0.11
'20-24'	0.04	0.05	0.04
'25-29'	0.12	0.13	0.1
'30-34'	0.2	0.23	0.18
'35-49'	0.56	0.59	0.53
'35-39'	0.32	0.37	0.28
'40-44'	0.5	0.54	0.46
'45-49'	0.81	0.82	0.8
'50-64'	2.05	1.86	2.25
'50-54'	1.28	1.23	1.34
'55-59'	1.97	1.8	2.15
'60-64'	3.15	2.74	3.57
'65-79'	7.07	6.16	8.07
'65-69'	4.85	4.13	5.59
'70-74'	7.18	6.2	8.27
'75-79'	10.53	9.21	12.08
'80+'	16.95	16.17	18.23
'80-84'	14.39	13.07	16.2
'85-89'	18.36	17.35	20.16
'90+'	21.1	20.82	21.78

Table 4.71

Summary Table: Stroke, Crude prevalence 20 years and older, percent, 2019-2020, Canada

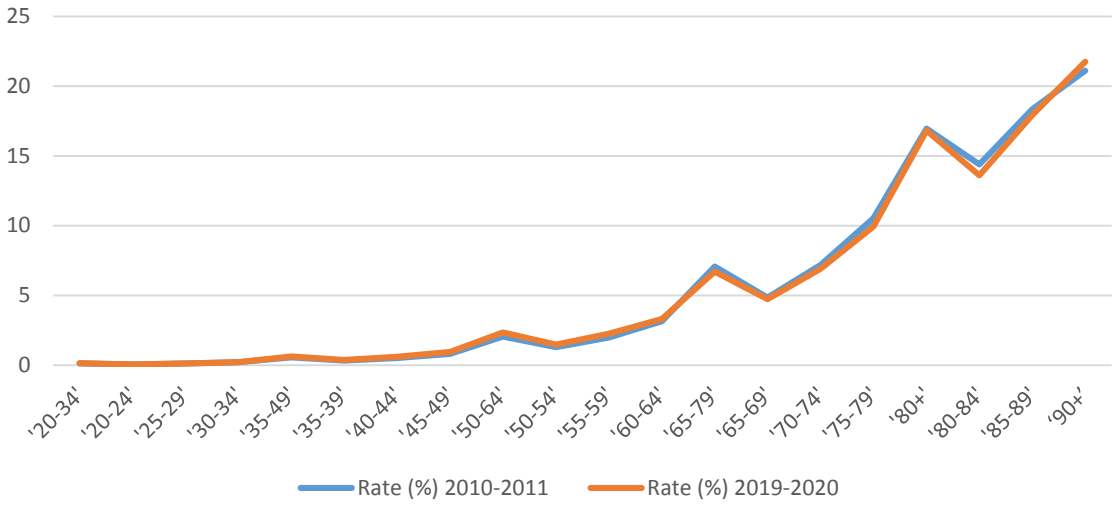
Age Group	Both Sexes Stroke Rate (%), 2019-2020	Females Rate (%)	Males Rate (%)
'20-34'	0.13	0.15	0.12
'20-24'	0.05	0.06	0.04
'25-29'	0.12	0.13	0.11
'30-34'	0.22	0.24	0.19
'35-49'	0.62	0.66	0.58
'35-39'	0.36	0.4	0.31
'40-44'	0.59	0.63	0.54
'45-49'	0.94	0.97	0.9
'50-64'	2.35	2.15	2.54
'50-54'	1.48	1.46	1.49
'55-59'	2.25	2.07	2.41
'60-64'	3.31	2.91	3.68
'65-79'	6.71	5.86	7.59
'65-69'	4.72	4.04	5.38
'70-74'	6.91	6.01	7.82
'75-79'	9.93	8.76	11.16
'80+'	16.81	16.07	17.79
'80-84'	13.6	12.37	15
'85-89'	17.93	16.75	19.45
'90+'	21.75	21.35	22.35

Table 4.72

Summary Table: Stroke, Crude prevalence, age 20 and older, percent, 2010-2011 to 2019-2020 fiscal years, Canada

Age Group	Stroke Rate (%) 2010-2011	Stroke Rate (%) 2019-2020
'20-34'	0.12	0.13
'20-24'	0.04	0.05
'25-29'	0.12	0.12
'30-34'	0.2	0.22
'35-49'	0.56	0.62
'35-39'	0.32	0.36
'40-44'	0.5	0.59
'45-49'	0.81	0.94
'50-64'	2.05	2.35
'50-54'	1.28	1.48
'55-59'	1.97	2.25
'60-64'	3.15	3.31
'65-79'	7.07	6.71
'65-69'	4.85	4.72
'70-74'	7.18	6.91
'75-79'	10.53	9.93
'80+'	16.95	16.81
'80-84'	14.39	13.6
'85-89'	18.36	17.93
‘90+’	21.1	21.75

Figure 4.56
Stroke, Crude prevalence, age 20 and older, percent, 2010-2011 and 2019-2020 fiscal years, Canada



4.2.5.2 The trend and prevalence of stroke (CVA) by place/geography location

Geography: Findings in this study show that as of the year 2019-2020, Prince Edward Island has the highest ASR prevalence of stroke of 3.02% (-9.12% change since 2010) followed by Ontario 7.55% (-13.71% change since 2010) and Quebec with 7.54% (+1% change since 2010) while Nova Scotia has the least ASR prevalence of stroke of 1.94% (-5.37% change since 2010). The provinces and territories whose ASR prevalence of stroke is below the national average are namely Nova Scotia (1.94%), Yukon Territory (2.10%), Newfoundland and Labrador, New Brunswick (2.21%), Quebec (2.40%) and Alberta (2.44%). Unlike the disease burden of AMI, HF, and Hypertension, the stroke epidemiological outlook in British Columbia also calls for prompt action as the rate is above the Canadian average with a +8.79% change within the past decade. Although, as of 2019-2020, Yukon Territory has an ASPR prevalence of stroke below the national average, a significant upward trajectory of +46.85% change between 2010 and 2010 is alarming. Assessing the cause of the upward trend in stroke in Yukon Territory and the other provinces with a marked upward trend is expedient.

4.2.5.3 The trend and prevalence of stroke (CVA) by Time

Between 2010-2011 and 2019-2020 fiscal years, findings in this study shows an increase in the prevalence of stroke in Newfoundland and Labrador (2.12 from 2.08%), Prince Edward Island (3.02 from 2.99%), Quebec (2.40 from 2.36%), Alberta (2.44 from 2.40%), British Columbia, 2.60% (2.39% in 2010), Yukon Territory (1,43% in 2010) and Nunavut, 2.57% (2.53 in 2010) respectively. There is no change in the prevalence of stroke in Manitoba, 2.94%. Although a decline in the prevalence of ischemic heart disease was recorded in Canada between 2010 and 2020, an upward trajectory is noticeable in the prevalence of ischemic heart disease in both British Columbia (6.83% from 6.77%) and Yukon Territory (4.61% from 3.84%) respectively. To improve the prevalence of stroke across Canada, the model explored and implemented in Yukon, Ontario, Saskatchewan and Nova Scotia may be explored by other regions. See tables 4.73 and figures 4.57-4.62.

Table 4.73

Summary Table: Stroke, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

Geography	2010-2011 Stroke Rate %	2019-2020 Stroke Rate %
Canada	2.55	2.57
Newfoundland and Labrador	2.08	2.12
Prince Edward Island	2.99	3.02
Nova Scotia	2.05	1.94
New Brunswick	2.25	2.21
Quebec	2.36	2.40
Ontario	2.76	2.72
Manitoba	2.94	2.94
Saskatchewan	2.95	2.82
Alberta	2.40	2.44
British Columbia	2.39	2.60

Yukon Territory	1.43	2.10
Nunavut	2.53	2.57

Figure 4.57
Stroke, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

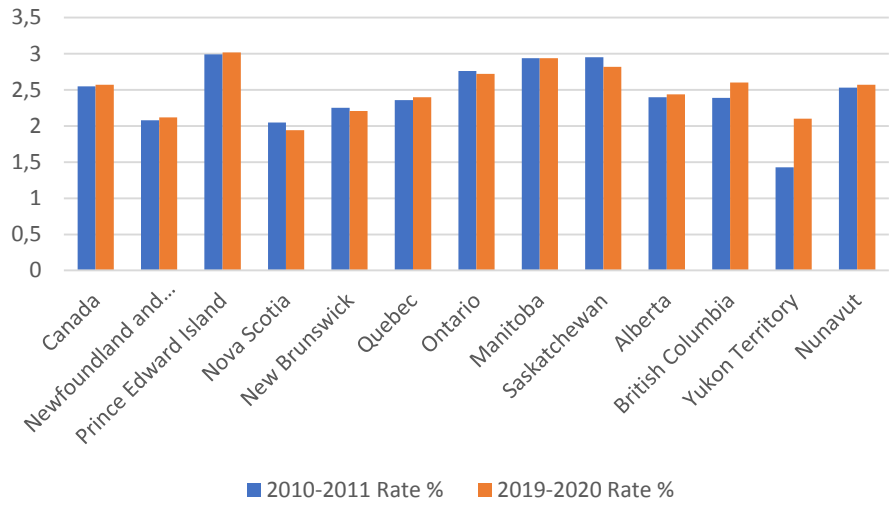


Figure 4.58
Stroke, age-standardized prevalence, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

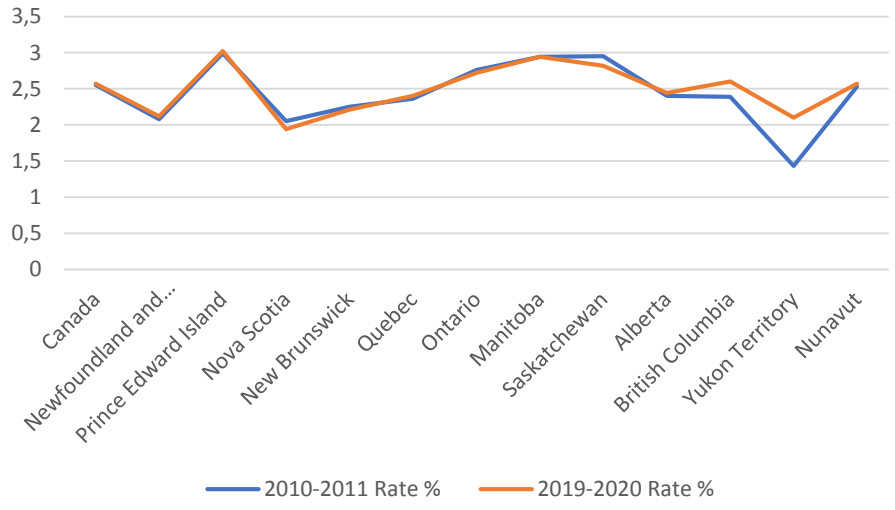


Figure 4.59
*Stroke, Crude prevalence, percent, 2010, Canada**
Sum of Rate (%) by Age Group and Sex

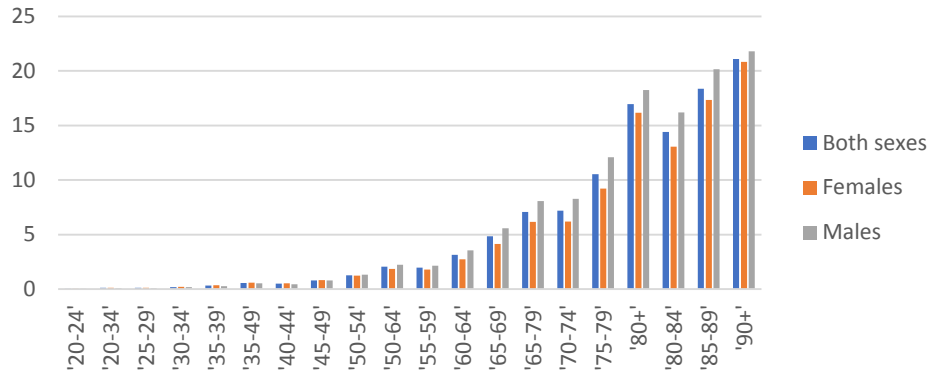


Figure 4.60
*Stroke, Crude prevalence, percent, 2010, Canada**
Sum of Rate (%) by Age Group and Sex

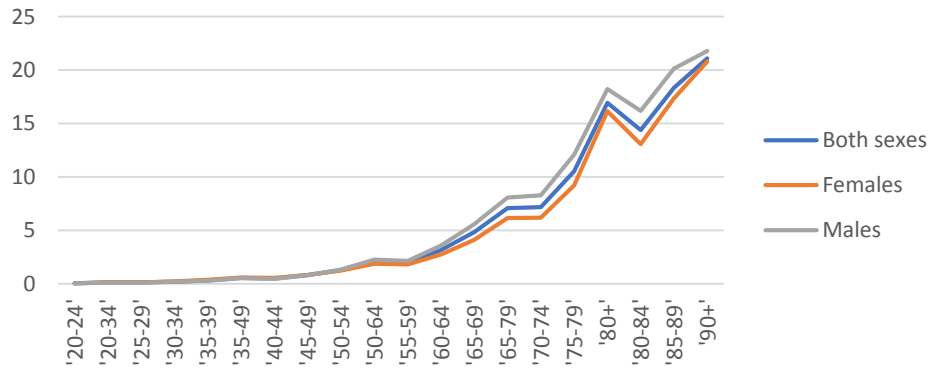


Figure 4.61
Stroke, Crude prevalence, percent, 2019, Canada Sum of Rate (%) by Age Group and Sex*

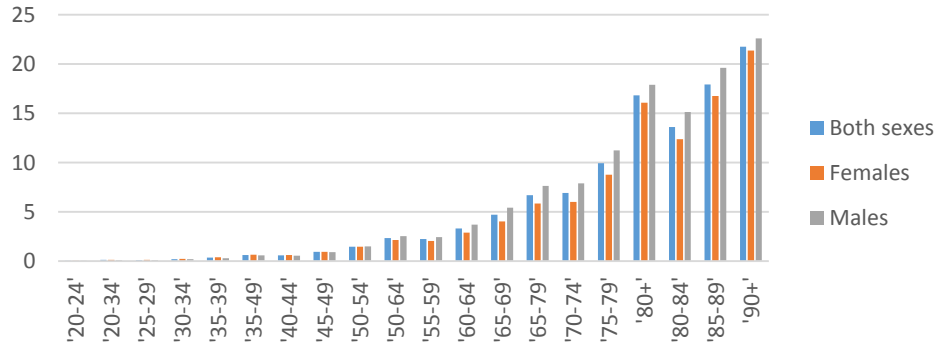
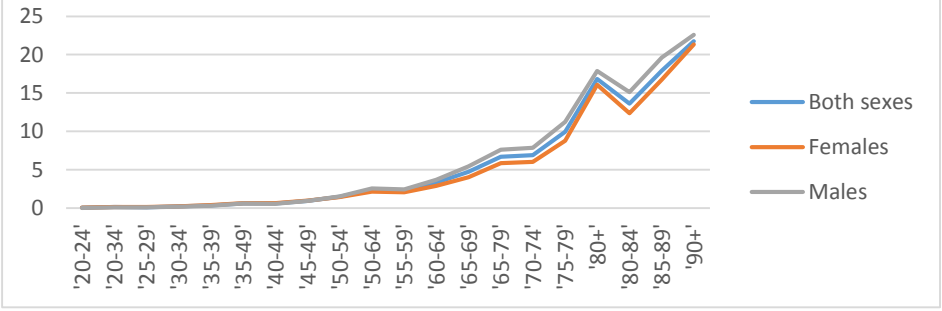
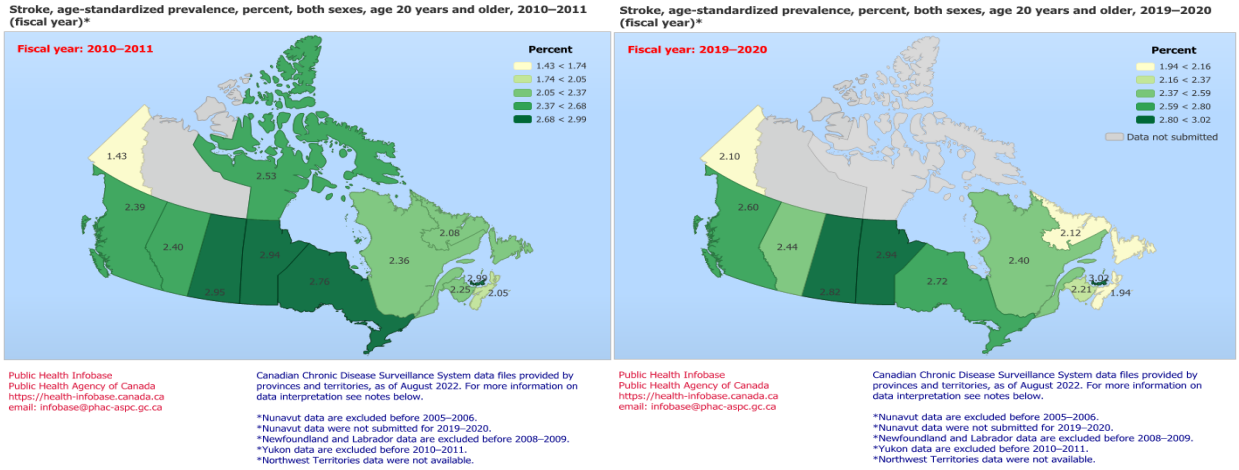


Figure 4.62
*Stroke, Crude prevalence, percent, 2019, Canada**
Sum of Rate (%) by Age Group and Sex





4.3 The trend and quantification of age-standardized mortality attributable to CVD in Canada

A total of 307,205 (males: 159,076; females: 148,129) deaths were recorded from all causes of death. Out of all causes of death, a total of 72,677 (males: 38,005; females: 34,672) deaths, which accounts for 23.66% of all deaths, were attributable to cardiovascular disease (CVD) recorded as the second leading cause of death next to cancer (Statistics Canada, 2022). Comparatively, there was a decline in the number of deaths attributable to CVD in Canada between 2010 and 2020. In 2010, 28.07% of all deaths were attributable to CVD, which is about 2 in every seven deaths, while the rate declined to about 1 in 4 deaths attributable to CVD in 2020. The same trajectory is noticeable in the age-standardized mortality rate (ASMR) attributable to CVD, which declined from 197.5 deaths per 100,000 populations in 2010 to 191.3 deaths per 100,000 populations in 2020 (Statistics Canada, 2022).

Although the improvement in the ASMR for CVD-related death spans over 20 years, as the CVD mortality rate was 247.1 deaths per 100,000 population (76,046 major CVD-related deaths) in the year 2000, the downward trajectory of the CVD mortality rate slowed down when the records are compared at every ten year-interval since the year 2000 (Statista, 2023; Statistics Canada, 2022). Between 2000 and 2010, there was a -20.04% change in the age-standardized mortality rate of CVD, while a -3.29% change was recorded between 2010 and 2020, respectively. Although the actual cause of the disparity in the percentage of the CVD mortality rate is not explored in this study, assessing the migration effect, improved surveillance system, aging population, possible change in Canada's demographic outlook, cultural influence, and the intervention model explored in the past decade will provide an insight into the reduced decline in the ASMR of CVD-related deaths in the recent times. See tables 4.74-4.77 and figures 4.63-4.67.

Table 4.74

Age-standardized mortality rate per 100,000 population, heart disease (CVD), 2010-2020, Canada

Geography, places of residence	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canada	143.0	135.6	136.4	134.8	133.3	130.5	126.0	128.6	126.5	120.7	118.3
Newfoundland and Labrador	190.7	180.5	178.0	182.8	178.1	197.5	174.9	163.3	169.4	153.8	158.1
Prince Edward Island	179.2	177.2	156.7	167.6	191.9	164.0	144.3	153.3	159.2	145.5	128.2
Nova Scotia	154.9	147.3	144.8	156.0	145.3	146.1	138.0	147.0	144.1	140.3	136.9
New Brunswick	154.4	150.3	148.2	148.2	146.5	141.3	141.0	148.9	142.5	127.0	114.9
Québec	136.1	124.8	126.0	120.2	119.8	119.9	111.3	117.6	120.2	112.4	107.3
Ontario	138.4	131.7	131.5	130.7	129.9	124.7	122.2	123.5	122.1	117.6	118.2
Manitoba	160.7	159.1	162.1	158.3	163.0	158.5	154.6	159.7	133.3	143.6	137.1
Saskatchewan	172.0	162.8	167.0	164.4	161.4	162.8	152.9	150.7	155.3	137.0	137.9
Alberta	167.5	163.5	165.6	166.2	160.7	154.3	153.6	149.4	147.7	145.1	138.8
British Columbia	130.8										108.9
Yukon	205.0	187.0	153.3	144.4	118.2	108.4	74.1	..	..	..	.
Northwest Territories	183.4	171.0	160.9	182.0	136.9	168.8	143.4	258.2	184.2	118.4	173.4
Nunavut	171.5	122.7	177.9	214.8	142.6	150.2	259.5	217.0	220.5	246.6	134.9

Table 4.75

Summary Table: Total number of deaths, both sexes, males and females, by all causes in Canada, 2010 to 2020

	Total # of deaths from all causes	# of Deaths Males	# of Deaths Females
2010	240,075	120,638	119,437
2011	243,511	122,251	121,260
2012	246,596	124,235	122,361
2013	252,338	126,973	125,365
2014	258,821	130,761	128,060
2015	264,333	133,441	130,892
2016	267,213	135,772	131,441
2017	278,298	142,135	136,163
2018	285,675	145,758	139,917
2019	285,270	146,324	138,946
2020	307,205	159,076	148,129

Figure 4.63

Total number of deaths, sexes, males and females by all causes in Canada, 2010 to 2020

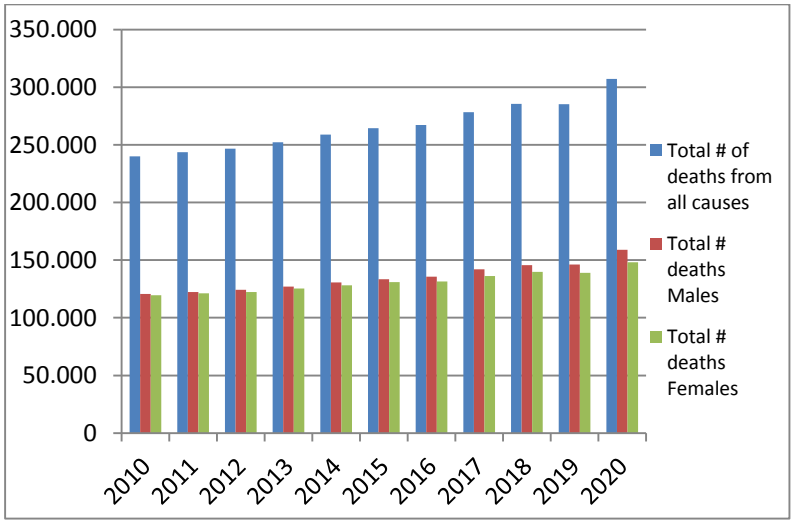


Figure 4.64

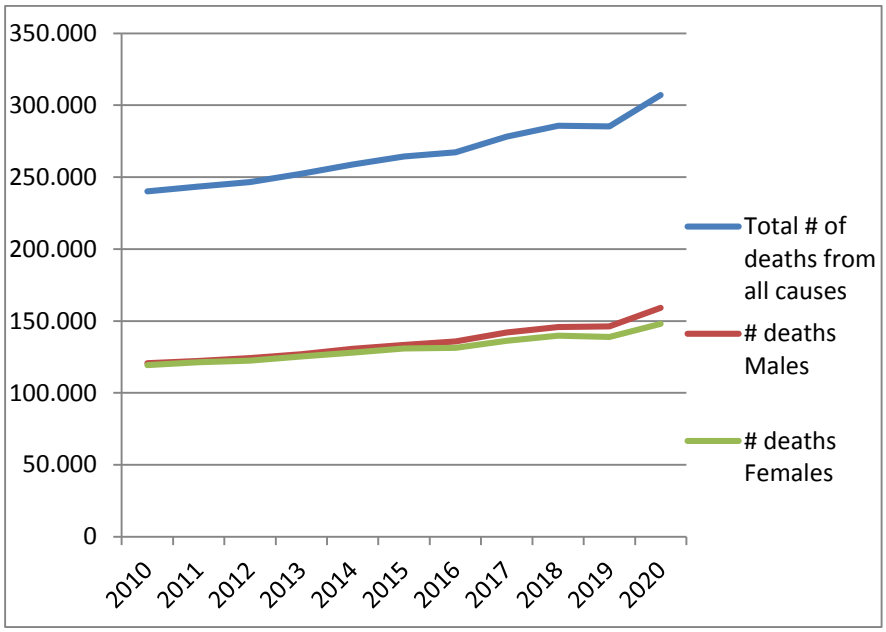


Table 4.76

Number of deaths, sexes, males and females by cardiovascular disease (CVD) in Canada, 2010 to 2020

	Total # of deaths by CVD	# Deaths Males	# Deaths Females
2010	67,383	33,590	33,793
2011	66,179	33,146	33,033
2012	66,598	33,602	32,996
2013	68,064	34,257	33,807
2014	69,260	34,957	34,303
2015	70,036	35,284	34,752
2016	69,576	35,424	34,152
2017	72,203	37,305	34,898
2018	72,483	37,495	34,988
2019	71,954	37,241	34,713
2020	72,677	38,005	34,672

Figure 4.65

Number of deaths, sexes, males and females by cardiovascular disease (CVD) in Canada, 2010 to 2020

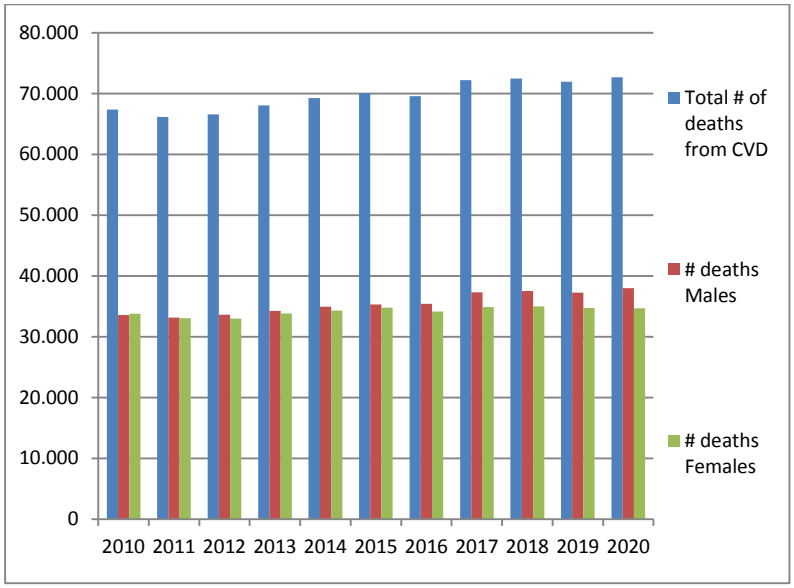


Figure 4.66

Total number of deaths from CVD

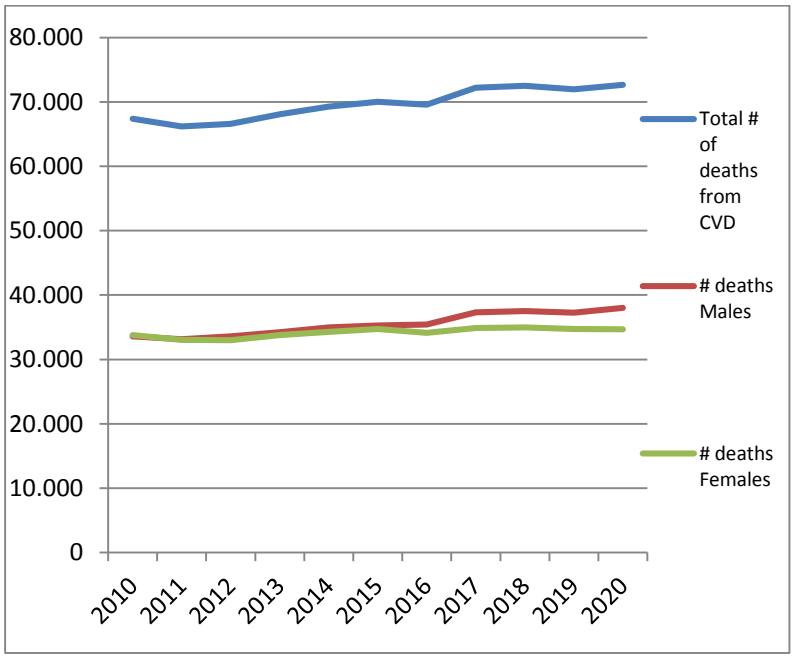


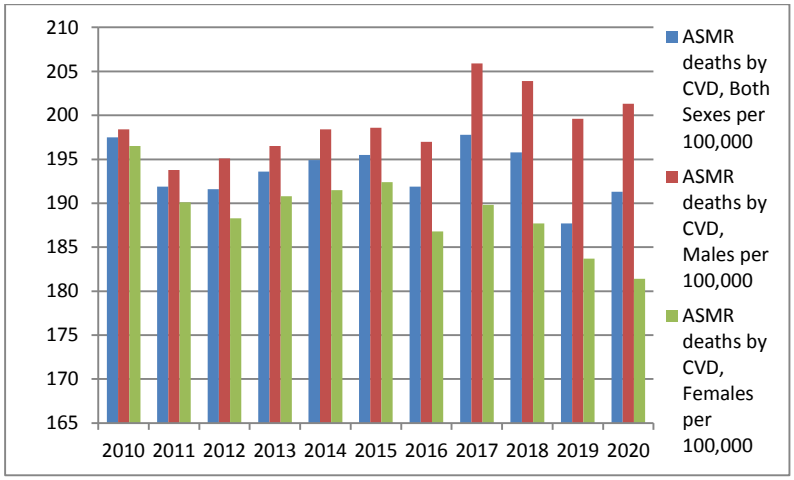
Table 4.77

Age-standardized mortality (ASMR) rate per 100,000 populations, major cardiovascular disease (CVD), both sex, males and females, in Canada, 2010 and 2020

	ASMR deaths by CVD, Both Sexes per 100,000	ASMR deaths by CVD, Males per 100,000	ASMR deaths by CVD, Females per 100,000
2010	197.5	198.4	196.5
2011	191.9	193.8	190.1
2012	191.6	195.1	188.3
2013	193.6	196.5	190.8
2014	194.9	198.4	191.5
2015	195.5	198.6	192.4
2016	191.9	197.0	186.8
2017	197.8	205.9	189.8
2018	195.8	203.9	187.7
2019	187.7	199.6	183.7
2020	191.3	201.3	181.4

Figure 4.67

Age-standardized mortality (ASMR) rate per 100,000 populations, cardiovascular disease (CVD), both sex, males and females, in Canada, 2010 to 2020



4.3.1 Trend and prevalence of CVD-mortality rate by person

Gender: While there was a -3.14% change in the ASMR attributable to CVD between 2010 and 2020, an increased trajectory is noticeable in the cardiovascular disease age-standardized mortality rate (CVD-ASMR) for males, unlike the females' population. In 2010, the ASMR attributable to CVD was 198.4 deaths per 100,000 populations for males, at which time the rate was 196.5 deaths per 100,000 populations. A decade later, the ASMR of CVD-related deaths declined for females from 196.5 in 2010 to 181.4 in 2020 by -7.68% change. Unlike the noticeable improvement in the ASMR for females, the ASMR of CVD rose from 198.4 deaths per 100,000 male populations to 201.3 – indicative of +1.46% changes between 2010 and 2020 in Canada.

Although the disparity in the trajectory of the ASMR attributable to CVD for different genders is not assessed in this study, the healthcare utilization uptake is arguably high for women compared to men. Increasing evidence suggests that men tend to wait until they present with acute symptoms before visiting the health center/hospital. While the masculinity factor plays a pivotal role in the healthcare service uptake for men, females' increased need to visit the clinic or hospital throughout their young and middle adulthood for prenatal and maternal care increases their healthcare uptake. In perspective, at each visit for either prenatal or maternal health, physical assessment and blood work are completed for the female population, hence promoting early CVD detection that prompts necessary treatment. Assessing the possible disparity in the health literacy and CV care/heart health care uptake across genders will provide insight into the disparity in the epidemiologic CVD outlook across the genders.

Age: Findings in this study show a directly proportional correlation between the ASMR CVD mortality rate and age, with evidence of persons aged 90 and older taking the lead in the age-standardized mortality rate of CVD at 5,953.9 deaths per 100,000 deaths in Canada, followed by persons aged 85 to 89 (2,479 deaths per 100,000) persons aged 80 to 84 (1,258.1 deaths per 100,000) population respectively. Of note, factors such as reduced elasticity of blood vessels and the aging of physiological systems of the human body as we age play a significant role in older adults' cardiovascular status. Notwithstanding the direct proportionality between the ASMR for CVD and age, the exception is noticeable in infants (ASMR- CVD 5.4 deaths per 100,000) as the age group with the least ASMR CVD mortality rate is 1 to 9 at 0.3 deaths per 100,000 population. The probable

cause for more infants (under one year) dying from CVD complications could be traceable to congenital heart defects. See table 4.78 and figure 4.68 – 4.69.

Table 4.78

Age-standardized mortality (ASMR) rate for major cardiovascular disease (CVD), both sexes by age per 100,000 populations, Canada, 2020

Age Group	ASMR CVD Deaths per100,000
Under 1	5.4
1 to 4	0.3
5 to 9	0.3
10 to 14	0.5
15 to 19	0.9
20 to 24	1.6
25 to 29	2.7
30 to 34	5.1
35 to 39	8.2
40 to 44	15.8
45 to 49	31.4
50 to 54	54.4
55 to 59	94.6
60 to 64	154.3
65 to 69	238.1
70 to 74	382.4
75 to 79	657.7
80 to 84	1258.1
85 to 89	2479
90 and older	5953.9

Data Source: Statista (2023); Statistics Canada (2022)

Figure 4.68

Age-standardized mortality (ASMR) rate for major cardiovascular disease (CVD), both sexes by age per 100,000 populations, Canada, 2020

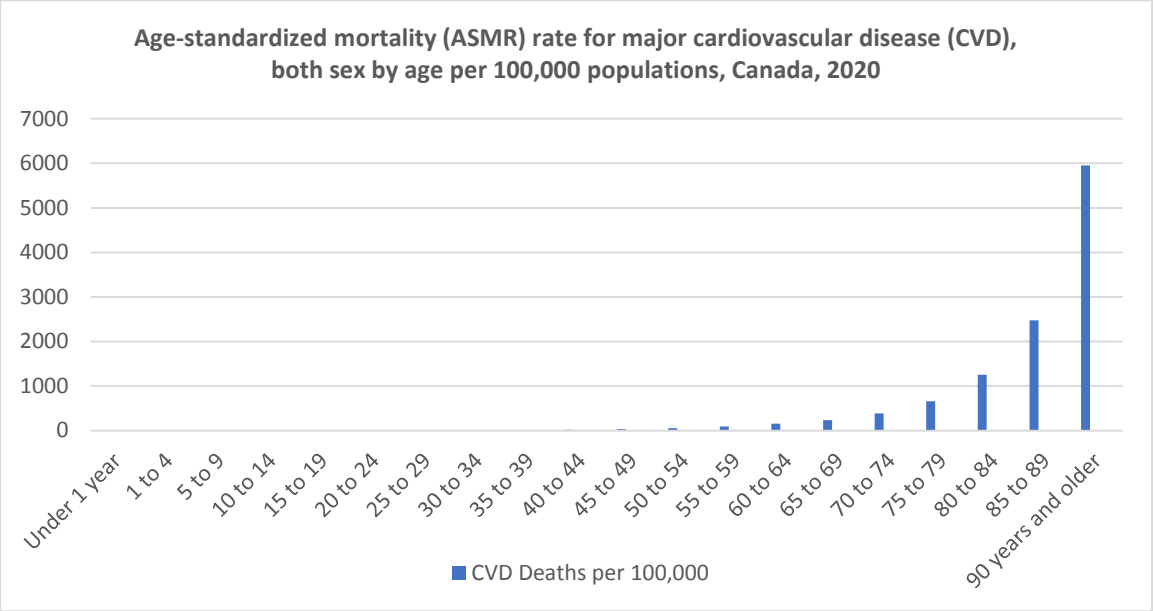
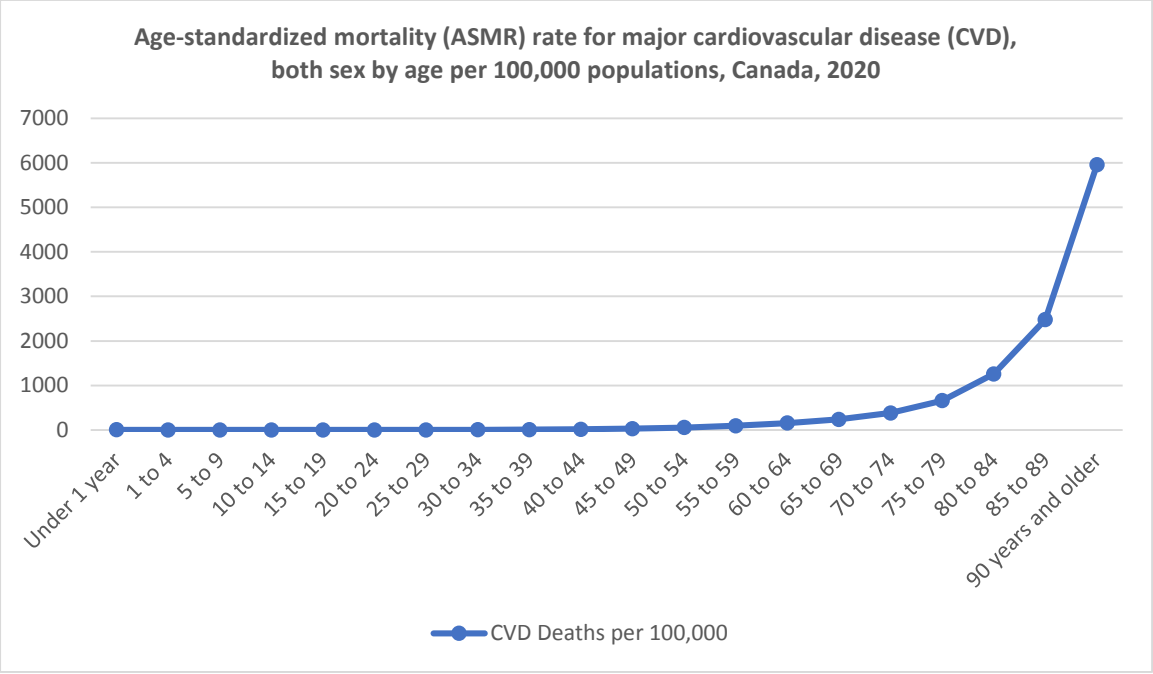


Figure 4.69



4.3.2 Trend and prevalence of CVD-mortality rate by place/geography location

Geography: With a mean national ASMR of selected CVD-related deaths of 118.3 deaths per 100,000 population (-95% CI) and ASMR of CVA of 30.2 deaths per 100,000 population, Northwest Territory has the highest age-standardized prevalence rate of CVD-related death of 173.4 deaths per 100,000 population followed by Newfoundland and Labrador158.1 deaths per 100,000 population while the province with the least ASMP – CVD-related death is Quebec with 107.3 deaths per 100,000 population followed by British Columbia with 108.3 deaths per 100,000 population IN Canada in 2020. However, the region with the highest ASMR of CVA is Northwest Territories, with 48.7 deaths per 100,000 population, followed by Newfoundland and Labrador, with 42.7 deaths per 100,000 population, while the region with the least ASMR of CVA (stroke) in 2020 is Nunavut, with 15.9 deaths per 100,000 population followed by Quebec with 25.3 deaths per 100,000 population in Canada. See tables 4.80-4.82 and figures 4.70-4.71.

4.3.3 Trend and prevalence of CVD-mortality rate by Time

The noticeable -3.29 % change improvement in the ASMR of CVD-related deaths in Canada between 2010 and 2020 is evident across Canada as findings show a downward trajectory in CVD-related mortality in all of the Canadian provinces and territories. However, the only provinces whose ASMR CVD-related mortality rate is below the national average were Quebec and Ontario in 2020, unlike in 2010, where British Columbia, Ontario, and Quebec ASMR values were below the national average. See tables 4.83-4.84 and figures 4.72-4.73.

Table 4.80

Age-standardized mortality rate per 100,000 population, heart disease (CVD), 2010-2020, Canada

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canada	143.0	135.6	136.4	134.8	133.3	130.5	126.0	128.6	126.5	120.7	118.3
Newfoundland and Labrador	190.7	180.5	178.0	182.8	178.1	197.5	174.9	163.3	169.4	153.8	158.1
Prince Edward Island	179.2	177.2	156.7	167.6	191.9	164.0	144.3	153.3	159.2	145.5	128.2
Nova Scotia	154.9	147.3	144.8	156.0	145.3	146.1	138.0	147.0	144.1	140.3	136.9

New Brunswick	154.4	150.3	148.2	148.2	146.5	141.3	141.0	148.9	142.5	127.0	114.9
Québec	136.1	124.8	126.0	120.2	119.8	119.9	111.3	117.6	120.2	112.4	107.3
Ontario	138.4	131.7	131.5	130.7	129.9	124.7	122.2	123.5	122.1	117.6	118.2
Manitoba	160.7	159.1	162.1	158.3	163.0	158.5	154.6	159.7	133.3	143.6	137.1
Saskatchewan	172.0	162.8	167.0	164.4	161.4	162.8	152.9	150.7	155.3	137.0	137.9
Alberta	167.5	163.5	165.6	166.2	160.7	154.3	153.6	149.4	147.7	145.1	138.8
British Columbia	130.8										108.9
Yukon	205.0	187.0	153.3	144.4	118.2	108.4	74.1	..	..	..	.
Northwest Territories	183.4	171.0	160.9	182.0	136.9	168.8	143.4	258.2	184.2	118.4	173.4
Nunavut	171.5	122.7	177.9	214.8	142.6	150.2	259.5	217.0	220.5	246.6	134.9

Table 4.81

Age-standardized mortality rate per 100,000 population, heart disease (CVD), both sexes, males and females, 2010 and 2020, Canada

	2010			2020		
	Both Sexes	Males	Females	Both sexes	Males	Females
Canada	143.0	186.1	109.2	118.3	153.5	88.9
Newfoundland and Labrador	190.7	243.6	146.3	158.1	200.9	122.5
Prince Edward Island	179.2	268.1	115.4	128.2	168.9	92.1
Nova Scotia	154.9	215.0	111.1	136.9	186.8	97.4
New Brunswick	154.4	205.5	116.0	114.9	149.8	88.0
Québec	136.1	172.6	107.6	107.3	135.5	83.0
Ontario	138.4	181.3	105.2	118.2	154.1	88.3
Manitoba	160.7	215.2	117.5	137.1	183.5	99.3
Saskatchewan	172.0	227.7	127.0	137.9	185.2	99.2
Alberta	167.5	216.2	127.2	138.8	177.1	106.6
British Columbia	130.8	168.0	100.4	108.9	142.5	80.4

Yukon	205.0	250.5	161.3			
Northwest Territories	183.4	181.2	184.0	173.4	266.7	64.8
Nunavut	171.5	210.3	103.5	134.9	237.2	24.0

Table 4.82

Age-standardized mortality rate per 100,000 population, heart disease (CVD), both sexes, males and females, 2010 and 2020, Canada

Geography	ASMR – CVD 2010	ASMR – CVD 2020
Canada	143.0	118.3
Newfoundland and Labrador	190.7	158.1
Prince Edward Island	179.2	128.2
Nova Scotia	154.9	136.9
New Brunswick	154.4	114.9
Quebec	136.1	107.3
Ontario	138.4	118.2
Manitoba	160.7	137.1
Saskatchewan	172.0	137.9
Alberta	167.5	138.8
British Columbia	130.8	108.9
Yukon Territory	205.0	
Northwest Territories	183.4	173.4
Nunavut	171.5	134.9

Figure 4.70

Age-standardized mortality rate per 100,000 population, heart disease (major CVD), both sexes, males and females, 2010 and 2020, Canada

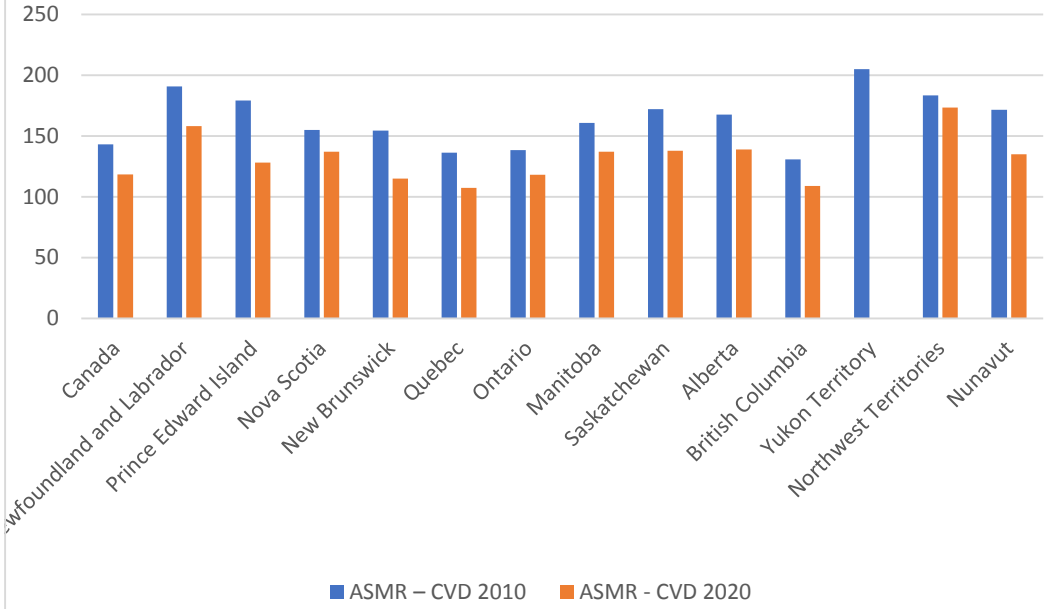


Figure 4.71

Age-standardized mortality rate per 100,000 population, heart disease (major CVD), both sexes, males and females, 2010 and 2020, Canada

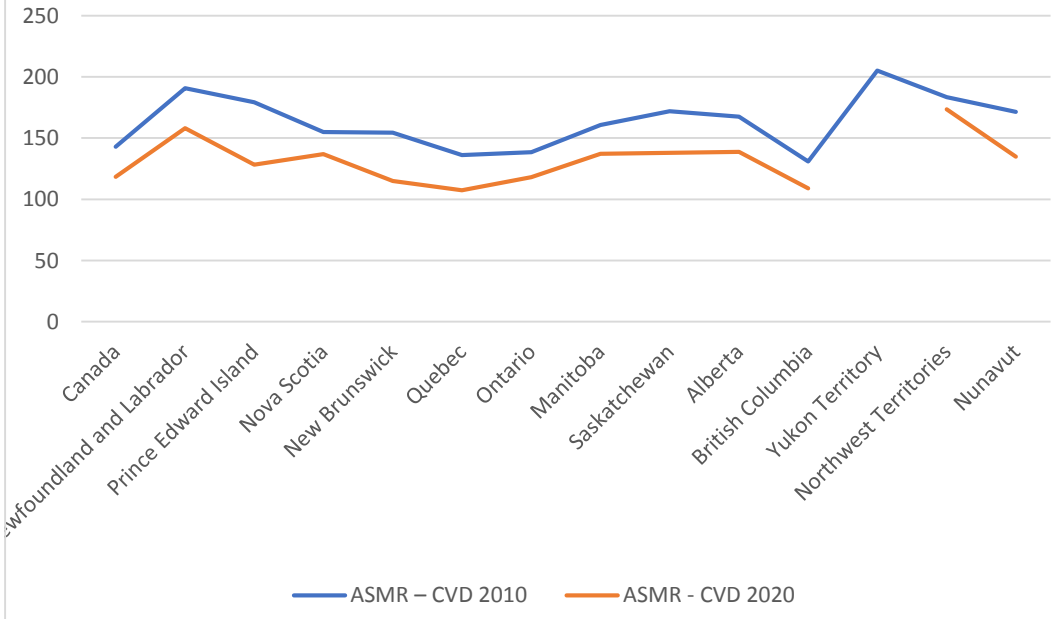


Table 4.83

Age-standardized mortality rate per 100,000 population, Stroke (CVA), 2010-2020, Canada

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canada	40.1	37.6	36.9	36.1	35.4	34.9	33.1	33.4	31.6	30.9	30.2
Newfoundland and Labrador	59.0	52.0	49.0	54.6	51.9	55.0	46.7	41.5	44.8	43.5	42.7
Prince Edward Island	45.9	51.5	40.3	38.7	42.4	39.5	32.8	43.5	40.4	48.3	39.9
Nova Scotia	45.0	44.6	45.3	41.8	42.4	43.7	41.2	39.8	44.0	40.5	40.6
New Brunswick	39.5	39.6	43.3	40.0	40.2	42.3	33.5	38.2	35.2	35.1	33.6
Québec	33.7	31.4	30.3	31.8	31.2	31.1	28.6	30.0	28.2	27.4	25.3
Ontario	40.7	36.6	35.9	34.5	34.5	32.9	32.3	31.3	30.1	29.5	29.8
Manitoba	48.7	43.8	45.8	44.6	46.9	42.5	42.3	44.3	35.7	40.4	33.1
Saskatchewan	39.4	44.6	41.5	39.3	37.4	37.0	35.6	36.4	30.3	28.1	30.7
Alberta	38.7	38.8	37.8	36.2	34.9	36.3	33.1	31.8	30.1	30.6	29.9
British Columbia	30.3	30.7	28.6	30.4	29.7	32.0	31.5	31.2	29.0	28.5	25.0
Yukon	65.2	79.6	41.8	34.0	29.4	20.3	48.5	..	..	..	.
Northwest Territories	27.2	75.0	71.0	34.9	45.3	41.9	86.1	51.9	36.8	29.8	48.7
Nunavut	29.9	85.8	35.0	35.2	16.3	75.7	19.5	74.4	46.5	54.6	15.

Table 4.84

Age-standardized mortality rate per 100,000 population, stroke (CVA), both sexes, males and females, 2010 and 2020, Canada

	2010			2020		
	Both Sexes	Males	Females	Both sexes	Males	Females
Canada	40.1	42.2	37.9	30.2	32.1	28.3
Newfoundland and Labrador	59.0	66.2	51.3	42.7	47.1	39.5
Prince Edward Island	45.9	44.6	46.6	39.9	41.9	38.0
Nova Scotia	45.0	45.9	43.0	40.6	43.4	39.2
New Brunswick	39.5	35.6	41.4	33.6	36.9	30.9
Québec	33.7	35.3	32.1	25.3	25.5	24.6
Ontario	40.7	43.6	38.0	29.8	32.7	27.4
Manitoba	48.7	51.1	45.6	33.1	36.0	30.0
Saskatchewan	39.4	39.3	38.3	30.7	35.6	26.7
Alberta	38.7	40.2	36.2	29.9	30.5	29.0
British Columbia	44.8	46.6	42.8	34.5	36.0	32.9
Yukon	65.2	67.7	58.1			
Northwest Territories	27.2	37.8	16.2	48.7	71.9	21.1
Nunavut	29.9	24.3	36.4	15.9	6.5	25.7

Table 4.85

Age-standardized mortality rate per 100,000 population, stroke (CVA), both sexes, males and females, 2010 and 2020, Canada

Geography	ASMR – CVA 2010	ASMR – CVA 2020
Canada	40.1	30.2
Newfoundland and Labrador	59.0	42.7
Prince Edward Island	45.9	39.9
Nova Scotia	45.0	40.6
New Brunswick	39.5	33.6
Quebec	33.7	25.3
Ontario	40.7	29.8
Manitoba	48.7	33.1
Saskatchewan	39.4	30.7
Alberta	38.7	29.9
British Columbia	44.8	34.5
Yukon Territory	65.2	
Northwest Territories	27.2	48.7
Nunavut	29.9	15.9

Figure 4.72

Age-standardized mortality rate per 100,000 population, stroke (major CVA), both sexes, males and females, 2010 and 2020, Canada

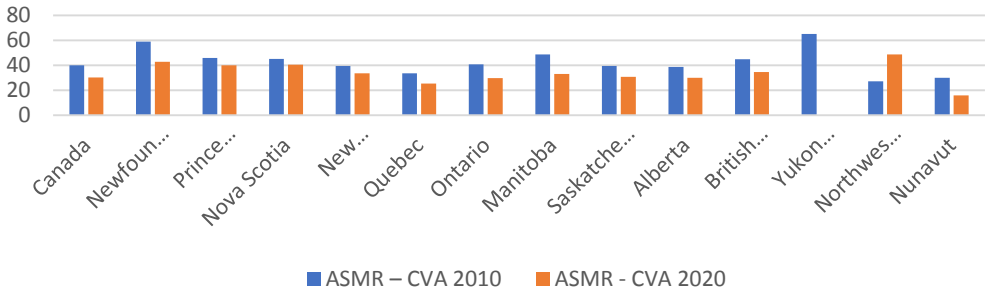
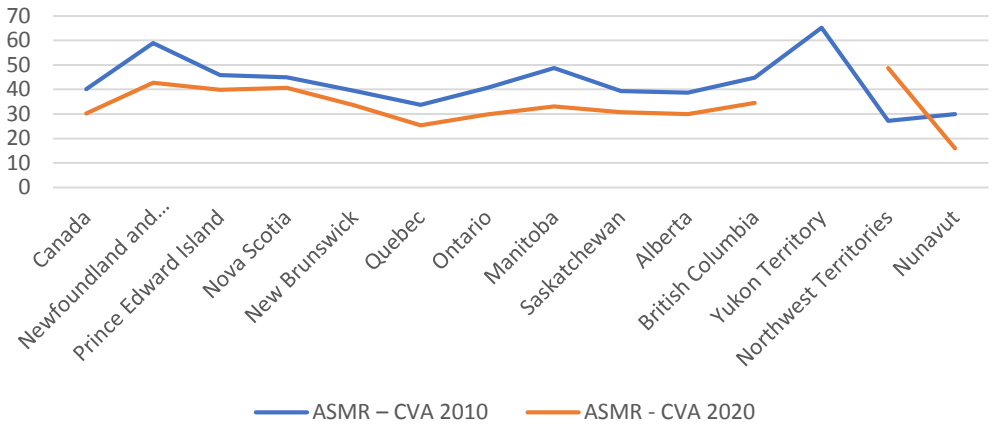


Figure 4.73
Age-standardized mortality rate per 100,000 population, stroke (major CVA), both sexes, males and females, 2010 and 2020, Canada



**Note that the following section 4.4 to 4.8, abstract, problem statement, study purpose and significance, limitations, recommendations, future consideration and conclusion are part of the defence.*

4.4 Result summary– Cardiovascular Disease Risk factors

In this study, where the trend of CVD and its correlation with selected CVD-risk factors is assessed between 2010 and 2020, findings show an improvement in the ASPR of two CVD risk factors, namely tobacco smoking, 17.5% (-17.8% change at 95% CI) between 2010-2014 and 2015-2019; and physical activities, 56.7% (+9.0% change) respectively. Unlike the recent improvement in epidemiology outlook of tobacco smoking and physical activity, an upward trajectory is noticeable in three (3) CVD risk factors including the ASPR rate of alcohol consumption which rose from 19% in 2010 to 20.2% in 2019 (+6.3% change); ASPR of diabetes rose from 7% in 2010 to 7.7% in 2019 (+10.0% change); and diet (5 times or more fruit/vegetables intake daily) which declines from ASPR 40.9% in 2010 to 30.8% in 2019 ((-24.7% change) at 95% respectively. An upward trajectory in three (3) risk factors, namely alcohol 20.2% (+6.3% change), diabetes 7.7% (+10,0% change), and diet (fruit/vegetables), 30.8% (-24.7% change) between 2010-2014 and 2015-2019 CCHS in the HIDT. See Table 4.86 and figures 4.74-4.75.

Table 4.86

The prevalence of selected CVD risk factors in Canada (aged 18+) between 2010-2014 and 2015-2019

CVD Risk factors	2010-2014 ASPR (%)	2015-2019 ASPR (%)	% Change	ASPR Risk Factors per gender, 2010-2019 (%)		ASPR of Risk Factors per Location 2019/20 (%)		Trend/trajectory CVD Risk Factors over ten years, 2010 - 2020
				M	F	Highest	Lowest	
Alcohol consumption	19.0	20.2	+6.3	24.9 (-6.7% Change)	15.7^ (+37.7% Change)	NWT 29.8 (-3.6% Change)	Manitoba 18.2 (-16.5% Change)	The increased trajectory of Alcohol consumption mostly in females with a downward trajectory in males who consume alcohol
Diabetes (excluding gestational)	7.0	7.7	+10.0	8.9^ (+12.7% Change)	6.6^ (+8.2% Change)	Newfoundland & Labrador 9.6^ (-7.9% Change)	Nunavut 5.3 (-19.7% Change)	Increasing trajectory in the rate of diabetes for both genders
Fruit/Vegetable, five or more daily	40.9	30.8	-24.7	23.4 (-30.4% Change)	37.8 (-21.1% Change)	Quebec 38.4 (-18.1% Change)	Newfoundland & Labrador 20.5 (-22.4% Change)	Decrease in 5 fruit/vegetable consumption
Tobacco smoking	21.3	17.5	-17.8	20.3 (-16.1% Change)	14.8 (-23.65% Change)	Nunavut 59.4^ (+16.24 % Change)	British Colombia 14.1 (-18,0% Change)	Improvement: Decreasing the rate of tobacco smoking
Physical activities	52.0	56.7	+9.0	60.3^ (+11.7% Change)	53.3^ (+7.0% Change)	Yukon 67.3^ (+8.9% Change)	Nunavut 47.5^ (+25.3% Change)	Improvement: Increasing the rate of physical activity.

Figure 4.74
Age-standadized prevalence (%) of a selected CVDs risk factors accross Canada between 2010-2014 and 2015-2019

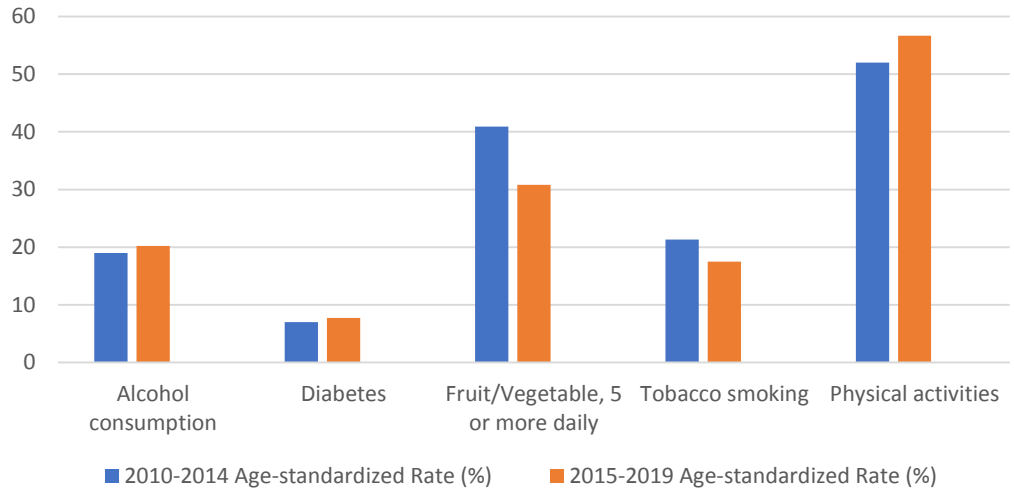
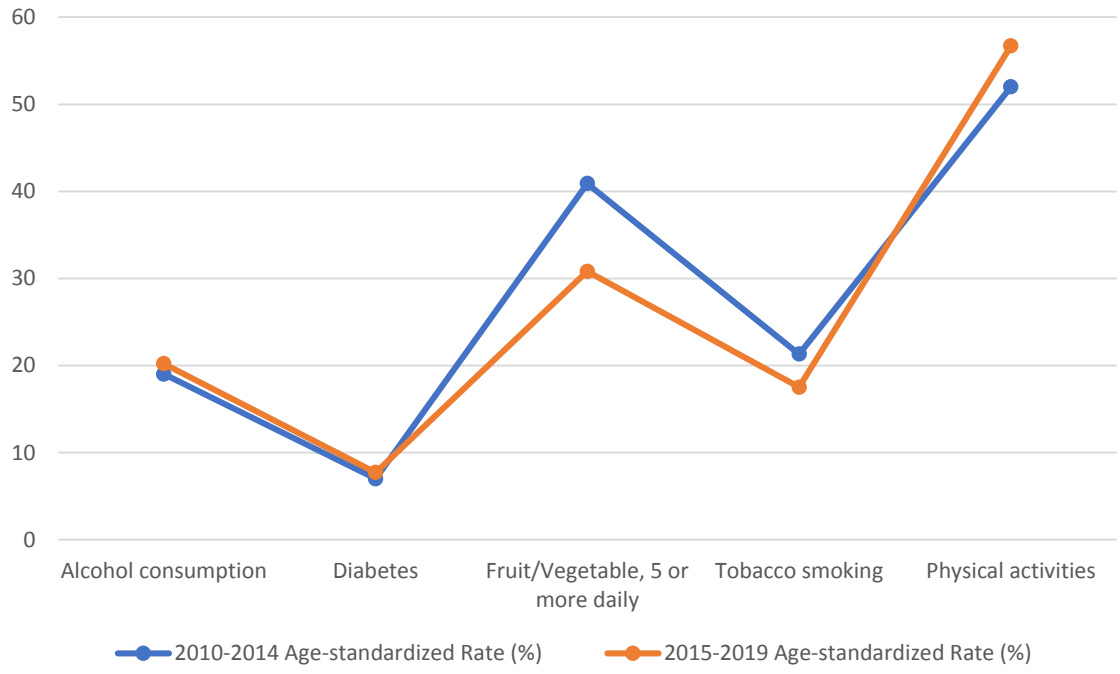


Figure 4.75
Age-standardized prevalence (%) and trend of a selected CVDs risk factors accross Canada between 2010-2014 and 2015-2019



4.5 Result Summary – Cardiovascular Disease Conditions

As of the year 2020, the age-standardized prevalence rate of hypertension/high blood pressure for persons aged 20 and older takes the lead at 23.09% at 95% CI (7,975,240 persons), followed by ischemic heart disease with 7.34% (2,633,165 persons), heart failure with 3.36% (787,605 persons), stroke/cerebrovascular accident with 2.57% (927,475 persons) and acute myocardial infarction 1.98% (712,730 persons) respectively as noted in table 4.87 and figure 4.76-4.77. Between the 2010-2011 and 2019-2020 fiscal years, evidence of improvement in the ASPR prevalence of IHD (-10.12% change) is noticeable, followed by heart failure (-6.05% change) and hypertension (-5.02% change) respectively. Unlike the promising ASPR of IHD, heart failure, and hypertension over the past decade, the ASPR of acute myocardial infarction increased by +3.13%, followed by stroke with +0.78% change between the 2010-2011 and 2019-2020 fiscal years respectively.

Table 4.87

Summary Table: Selected cardiovascular Disease, age-standardized prevalence, trend, percentage change, percent, both sexes, age 20 years and older, between 2010-2011 and 2019–2020 fiscal year

CVD	Age-standardized Prevalence Rate of selected CVDs (%)		% Change in Rate over ten between 2010-2011 and 2019-2020 fiscal year	ASPR of CVD per gender, 2019-2020 Fiscal year (%)		ASPR of CVD per Location 2019-2020 Fiscal year (%)		Trend/trajectory CVD over ten years, 2010 - 2020
	2010-2011 Fiscal Year	2019-2020 Fiscal Year		F	M	Highest	Lowest	
Acute Myocardial Infarction (AMI)	1.92 (533,980 Cases)	1.98^ (712,730 Cases)	+3.13	1.10	2.93	Newfoundland & Labrador, 2.66^ (+4.31% Change)	British Columbia, 1.61^ (+5.92% Change)	Increasing
Heart Failure (HF)	3.47 (641,210)	3.26 (787,605)	-6.05	2.71	3.86	Yukon, 4.48^ (+25.49% Change)	Nova Scotia, 2.59 (-16.72% Change)	Decreasing
Hypertension (HBP)	24.31 (6,684,300)	23.09 (7,975,240)	-5.02	21.90	24.28	Newfoundland & Labrador, 30.23 (-2.39% Change)	Quebec, 19.82 (-10.19% Change)	Decreasing
Ischemic Heart Disease (IHD)	8.20 (2,275,815)	7.37 (2,633,165)	-10.12	5.60	9.25	New Brunswick 8.57 (-9.12% Change)	Yukon 4.61^ (+20.08% Change)	Decreasing
Stroke (CVA)	2.55 (715,980)	2.57^ (927,475)	+0.78	2.36	2.81	PEI 3.02^ (+1.00% Change)	Nova Scotia 1.94 (-5.37% Change)	Increasing

Figure 4.76

Figure showing Age-standardized prevalence (%) and trend of a selected CVD accross Canada between 2010-2011 and 2019-2020 fiscal years

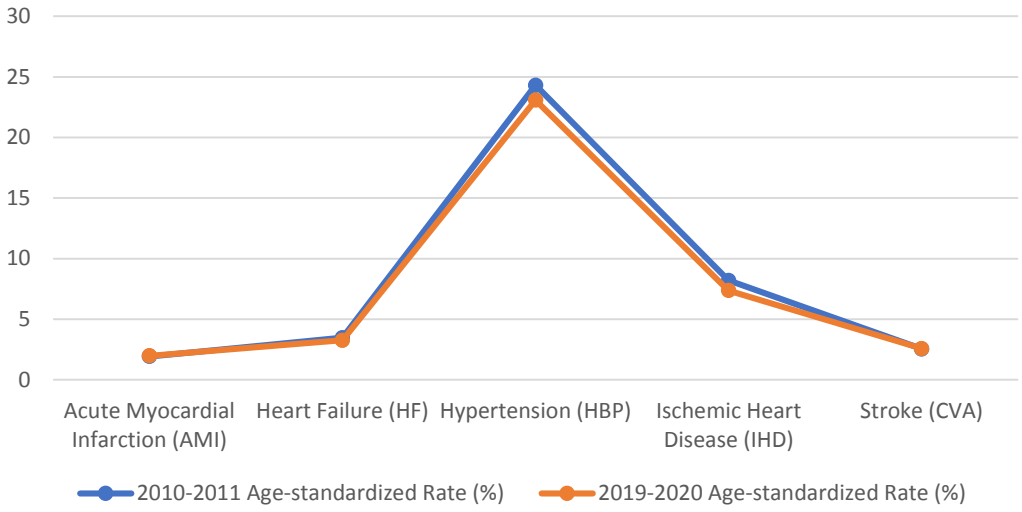


Figure 4.77

Figure showing Age-standardized prevalence (%) and trend of a selected CVD accross Canada between 2010-2011 and 2019-2020 fiscal years

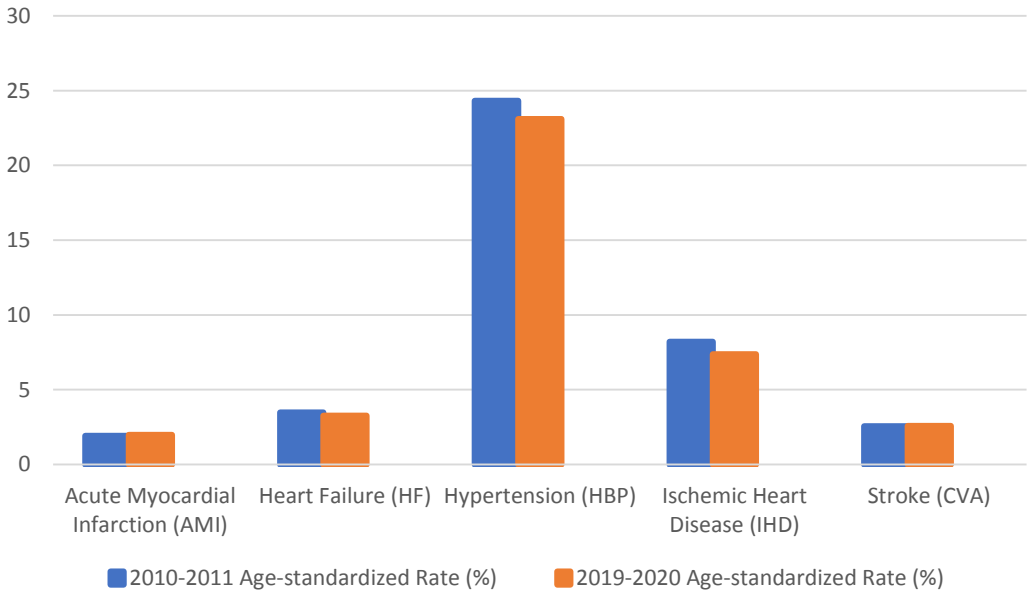


Table 4.88

Summary Table: Selected CVD, Age-standardized prevalence, percent, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal years in Canada

Year	AMI	HF	HBP	IHD	CVA
2010	1.92	3.47	24.31	8.2	2.55
2011	1.94	3.43	24.33	8.13	2.55
2012	1.96	3.39	24.22	8.04	2.55
2013	1.97	3.36	24.11	7.94	2.55
2014	1.99	3.37	24.01	7.86	2.56
2015	1.99	3.34	23.86	7.76	2.57
2016	2	3.31	23.68	7.67	2.58
2017	2	3.29	23.46	7.56	2.58
2018	1.99	3.27	23.29	7.45	2.57
2019	1.98	3.26	23.09	7.34	2.57

Figure 4.78

Summary Figure: Selected CVD, Age-standardized prevalence, percent, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal years in Canada

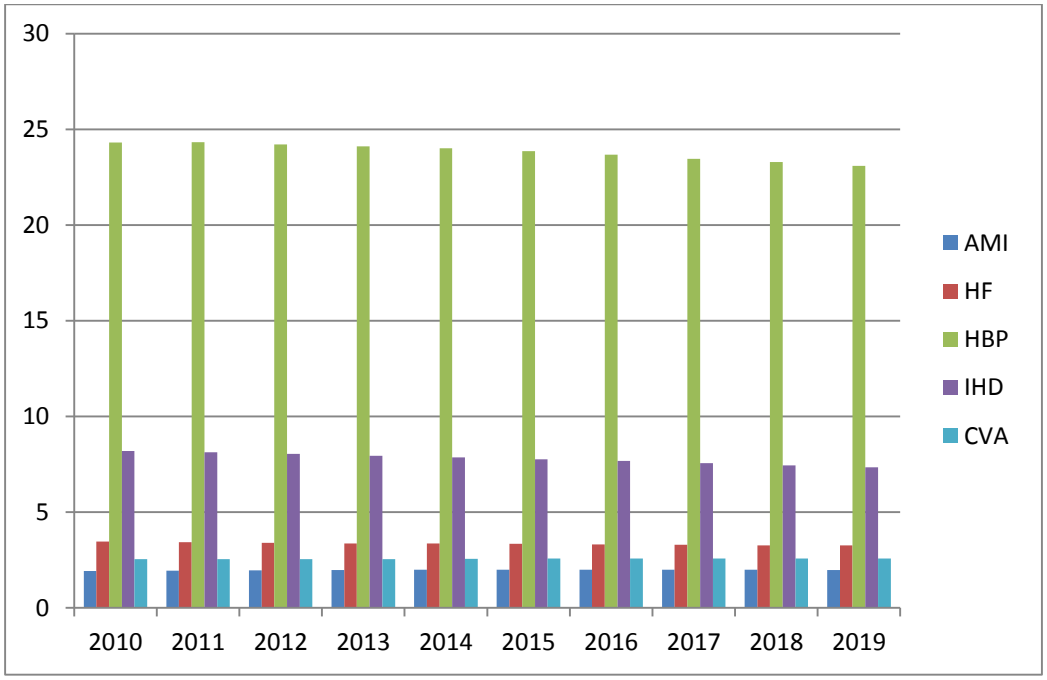


Figure 4.79

Selected CVD, Age-standardized prevalence, percent, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal years in Canada

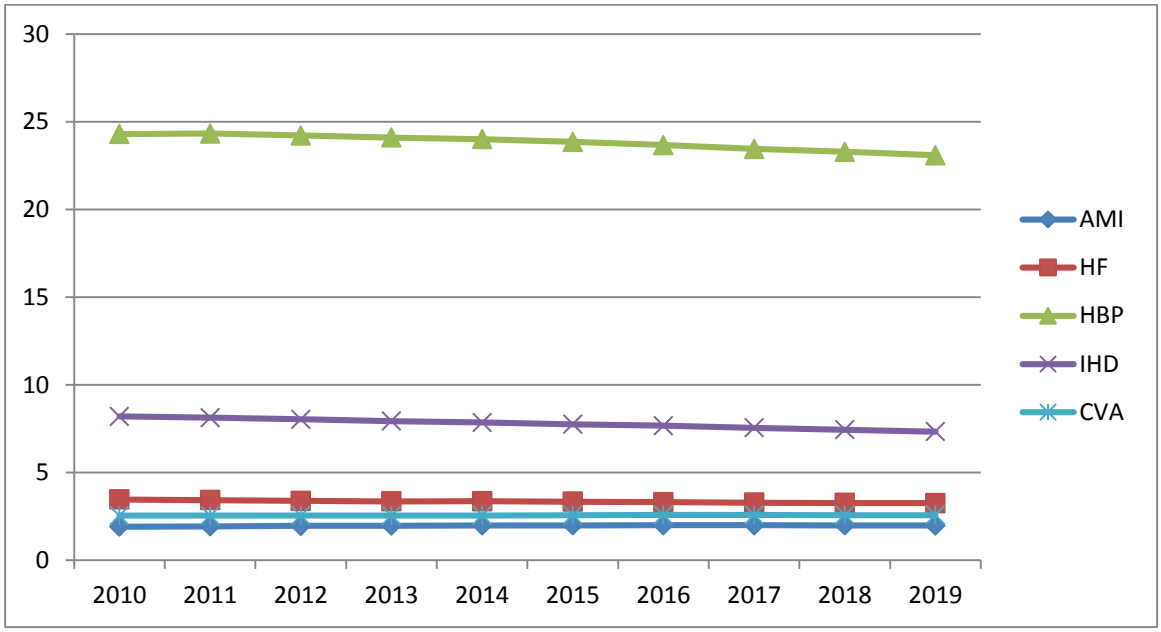


Table 4.89

Summary Table: Selected CVD, Age-standardized prevalence, cases, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal years in Canada

Year	AMI	HF	HBP	IHD	CVA
2010	533,980	641,210	6,684,300	2,275,815	715,980
2011	555,500	653,470	6,868,210	2,322,890	737,515
2012	578,655	667,195	7,028,810	2,367,875	759,480
2013	598,985	682,015	7,183,145	2,407,435	780,970
2014	619,430	700,130	7,320,515	2,444,095	805,180
2015	637,615	713,645	7,447,105	2,477,955	828,080
2016	658,970	730,750	7,580,355	2,520,910	854,550
2017	678,715	749,025	7,701,370	2,558,815	878,730
2018	697,010	767,455	7,836,655	2,593,035	902,480
2019	712,730	787,605	7,975,240	2,633,165	927,475

Figure 4.80

Selected CVD, Age-standardized prevalence, cases, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal year in Canada

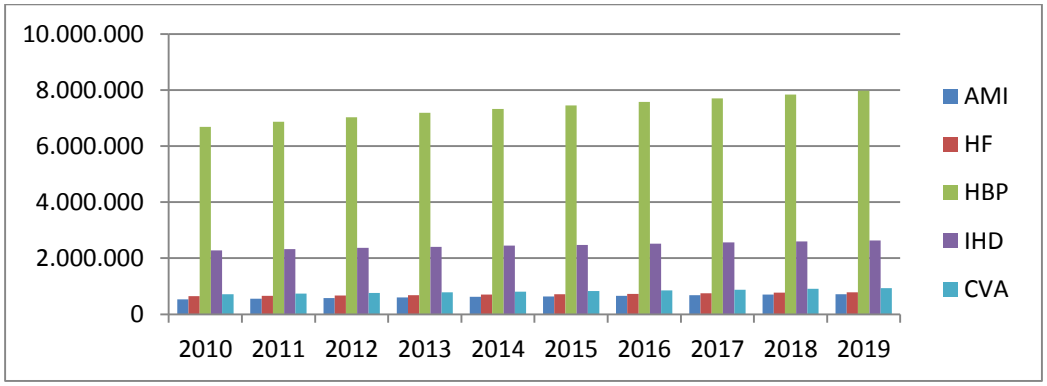
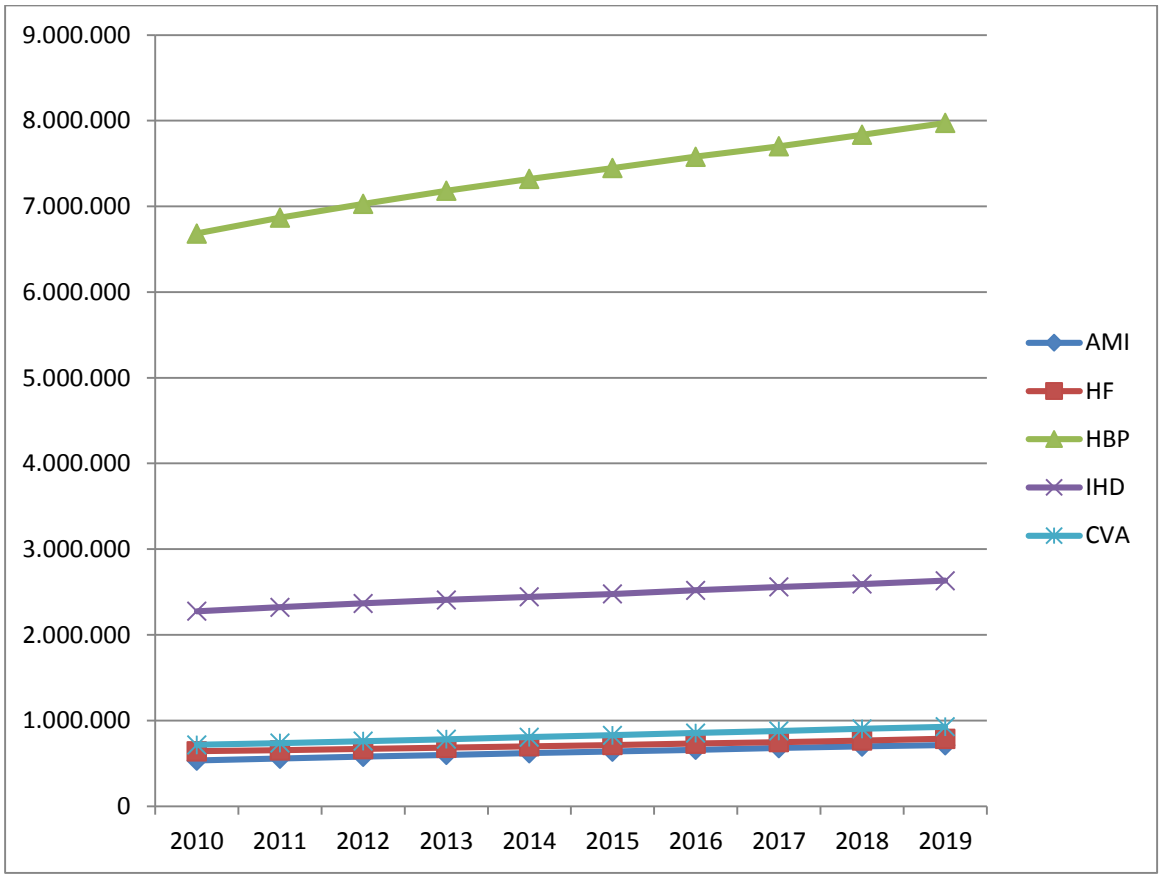


Figure 4.81

Selected CVD, Age-standardized prevalence, cases, Age 20 years and older, between 2010-2011 and 2019-2020 fiscal year in Canada

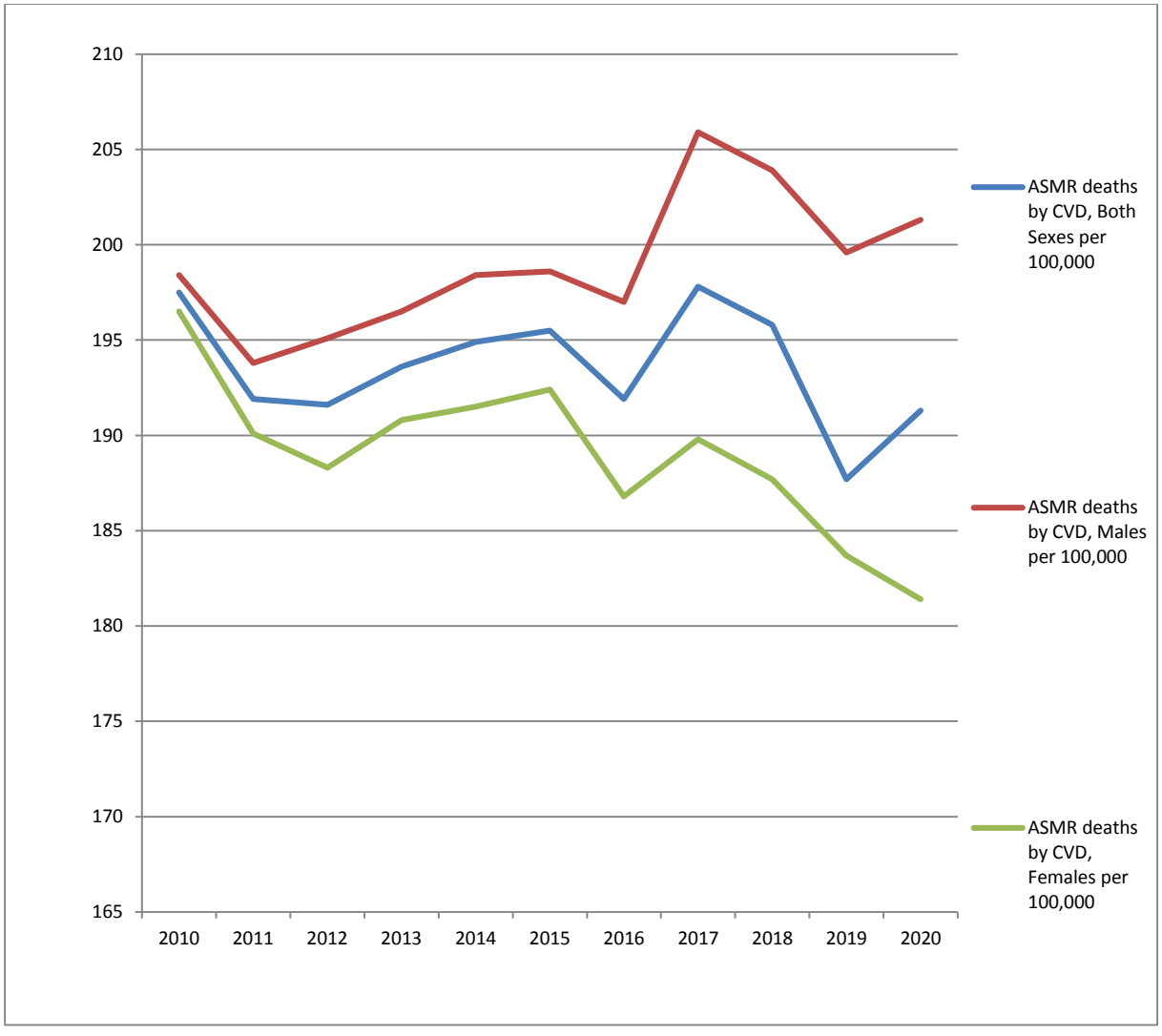


4.6 Results Summary – Cardiovascular Disease attributable Mortality

A total of 307,205 (males: 159,076; females: 148,129) deaths were recorded in Canada in 20020. Out of all causes of death, a total of 72,677 (males: 38,005; females: 34,672) deaths, which accounts for 23.66% of all deaths, were attributable to cardiovascular disease (CVD), thus making CVD the second leading cause of death next to cancer in 2020 (Statistics Canada, 2022). Comparatively, there was a decline in the number of deaths attributable to CVD in Canada between 2010 and 2020.

Figure 4.82

Age-standardized mortality (ASMR) rate per 100,000 populations, cardiovascular disease (CVD), both sex, males and females, in Canada, 2010 to 2020



In 2010, 28.07% of all deaths were attributable to CVD, which is about 2 in every seven deaths, while the rate declined to about 1 in 4 deaths in 2020. The same trajectory is noticeable in the age-standardized mortality rate (ASMR) attributable to CVD, which declined from 197.5 deaths per 100,000 populations in 2010 to 191.3 deaths per 100,000 populations in 2020 – see figure 4.82 (Statistics Canada, 2022). Of note, the noticeable improvement in the ASMR mortality rate attributable to CVD did not cut across Canada, as the Northwest Territories has the highest ASMR of 173.4 deaths per 100,000 population. In contrast, Quebec has the lowest ASMR of 107.3 deaths per 100,000 population when the ASMR mortality attributable to major CVD was 118.3 deaths per 100,000 as noted in figure 4.82. Although the age-standardized mortality rate of CVD has dropped compared to the preceding years, more than one-fifth (1/5) of deaths are attributable to CVD - 17.5 for other CVDs and 4.5 for stroke/CVA in Canada in 2020.

4.7 The percentage change in the trend of CVD, its risk factors and mortality rate in Canada between 2010 and 2020

From the figure 4.83 showing the percentage change in the trend of CVD, its risk factors and mortality rate in Canada between 2010 and 2020, there is an improvement in the rate of tobacco smoking (-17.8% change) and physical activity (+9% change) while an upward trajectory is noticeable in the rate of diabetes (+10% change), alcohol consumption (+6.3% change) and reduced consumption of fruit/vegetable (-24.7% change).

Evidence of improvement is affirmed in the ASPR of heart failure (-6.05% change), high blood pressure (-5.02% change) and ischemic heart disease (-10.12% change), unlike the ASPR of acute myocardial infarction (+3.13% change) and stroke/CVA (0.78% change). An improvement is equally noticeable in the ASMR rate of CVD-attributable mortality (-3.29% change) as noted in figure 4.83. By inference, there is a promising correlation in the epidemiology outlook of tobacco smoking, physical activities, heart failure, high blood pressure, and ischemic heart disease. Conversely, there is a correlation in the trend of diabetes, alcohol consumption, diet, acute myocardial infarction and stroke, which seems to be contributing to the burden of cardiovascular disease in Canada. A population-based conceptualized framework is imperative to mitigate the negative epidemiology outlook of the latter.

Figure 4.83
The percentage change in the trend of CVD, its risk factors and mortality rate in Canada between 2010 and 2020

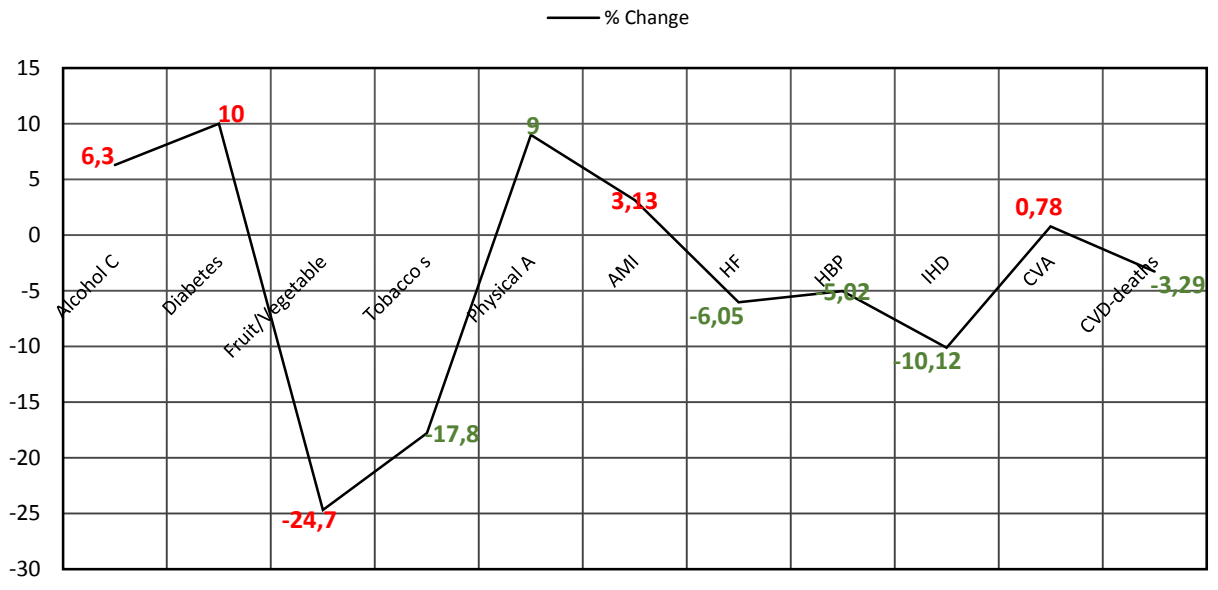
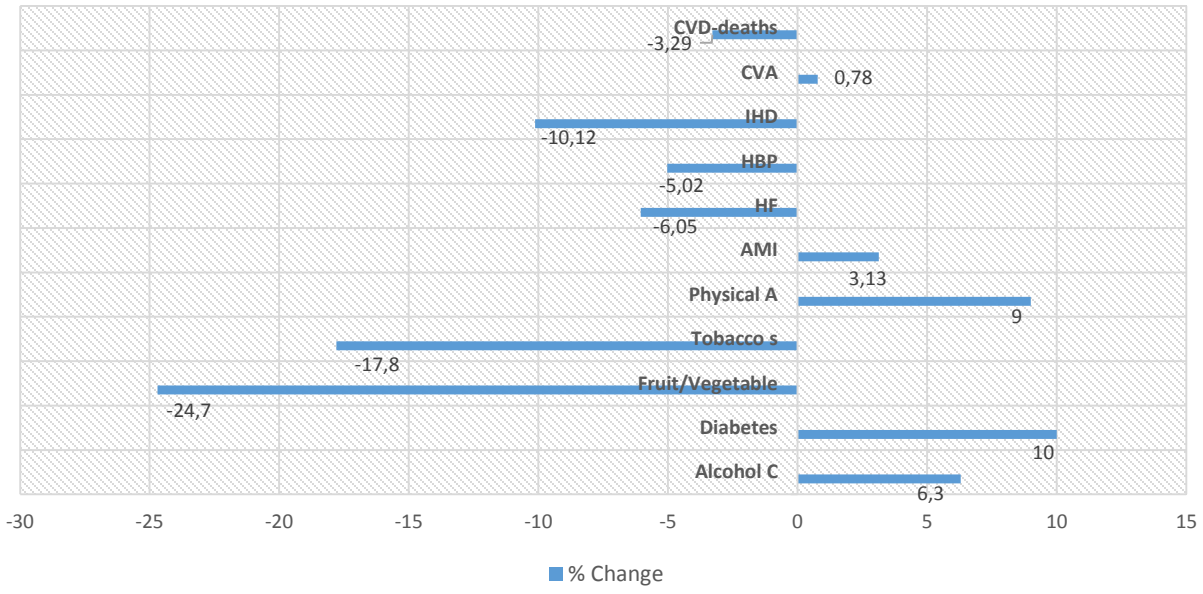


Figure 4.84
The Percentage Change in the Trend of CVD, its Risk Factors and Mortality Rate in Canada between 2010 and 2020



CHAPTER FIVE

5.0 Discussion, Limitation, Recommendations, direction for Future Research, and Conclusion

5.1 Discussion and Summary of CVD Risk Factors in Canada

The outcome of the study reveals an improvement in the age-standardized prevalence rate (ASPR) of two (2) CVD risk factors, namely tobacco smoking and physical activity, with an unfavourable trajectory, in three (3 CVD risk factors, including the rate of alcohol consumption, fruit/vegetable intake and diabetes respectively:

5.1.1 Tobacco Smoking

Between 2010 and 2019, the ASPR of tobacco smoking declined from 21.3% to 17.5% at 95% CI, with evidence of a -17.8% change. In perspective, an estimated 1 in 5 males and 1 in 7 females aged 18 and older cigarettes in Canada as of 2019. British Columbia has the lowest ASPR of tobacco smoking of 14.1% (-18% change) at 95% CI, while the territory of Nunavut has the highest ASPR of tobacco smoking of 59.4% (+16.24% change) at 95% CI. Struik et al. (2022) allude that the rate of tobacco smoking is dangerously high. The outcome of this study corroborates Struik et al. (2022) affirmation of the promising outcome of the behaviour change technique model used in the Canadian online smoking cessation programs. Harris et al. (2022) coin the importance of evidence-based smoking cessation techniques as one of the significant contributory factors to declining tobacco smoking in Canada.

5.1.2 Physical Activity

The ASPR of physical activities increased from 52% to 56.7% (+9.0% change) at 95% CI in Canada between 2010 and 2019. In 2019, an estimated 2 in 3 males and 1 in 2 females aged 18 and older engaged in physical activity in Canada. Notwithstanding the improvement in the rate of physical activities, the territory of Yukon has the highest number of populations who engage in physical activities at ASPR of 67.3% (-8.9% change) 95% CI, while the territory of Nunavut has the lowest number of populations who engages in physical activities at ASPR 47.5% (-25.33% change) 95% CI as of the year 2019. A multi-strategy intervention promotes the effective implementation and adherence to the mandatory physical activity policy, according to (Nathan et al., 2022). The policy is

well-observed in the school system with a promising outcome. An increased walkable neighbourhood, active transportation and transit infrastructure, and improved zoning and subdivision regulations incorporating reasonable access to the park have directly correlated with improved physical activities in Canada over the past decade (Frank et al., 2022).

5.1.3 Alcohol Consumption

Unlike the recent improvement in tobacco smoking and physical activity, an upward trajectory is noticeable in the ASPR rate of alcohol consumption diabetes, with a decline in the diet rate (5 times or more fruit/vegetables) between 2010 and 2019. As of 2019, the ASPR rate of alcohol consumption was 20.2% in Canada, with evidence of a +6.3% change increase since 2010. While there is evidence of improvement in the ASR prevalence of alcohol use among the males aged 18 and older with a -6.7% change, findings show a remarkable increase in the ASPR of heavy alcohol consumption in the female population aged 18 and older between 2010 and 2019 at a +37.7% change. Northwest Territories has the highest rate of alcohol consumption of 29.8% (-3.6% change), while the province of Manitoba has the lowest ASPR rate of Alcohol consumption of 18.2% (-16.5% change between 2010 and 2019, 95% CI), respectively. Although the assessed data period is pre-CoVID-19 pandemic, significant empirical evidence shows increased alcohol consumption attributable to COVID-19 and a predictor of future contemporary health issues (Baptist et al., 2022; Shield et al., 2022).

Notwithstanding the effect of the pandemic alcohol consumption rate, the increase in alcohol consumption rate is well-documented in the recent. For example, an increase in moderate-severe alcohol use disorder in selected Canadian provinces and territories, e.g. British Columbia, has been reported in recent times (Socias et al., 2023; Shield et al., 2022). An increase in illicit drug use is noticeable during the rise in Alcohol consumption attributable to the COVID-19 pandemic in Canada. Youths in British Columbia and Prince Edward Island were more likely to use more alcohol and drugs than the youths in Ontario (Shield et al., 2022).

5.1.4 Diabetes (excluding gestational)

In Canada, the ASPR prevalence of diabetes rose from 7% to 7.7% between 2010 and 2019, with more males, 8.9%, and 6.6% of females aged 18 and older currently living with diagnosed diabetes in Canada. The rise in the rate of diabetes is documented in the Bjornstad et al. (2023) study – a finding

that aligns with this study outcome in part. In 2019, the province of Newfoundland and Labrador had the highest ASPR prevalence of diabetes of 9.6% (+7.87% change), while the territory of Nunavut has the lowest ASPR rate of 5.3% with a -19.7% change AT 95% CI within the past decade. To prevent the burden or manage the complications of diabetes, education, screening, early detection and increased foot care (Patel et al., 2022).

5.1.5 Diet (Fruit/Vegetable Consumption)

Although studies have demonstrated the beneficial effect of adequate vegetable and fruit intake, the ASPR of Canadians who consume five fruits/vegetable per day declined from 40.9% to 30.8% with evidence of -24.7% change at 95% CI between 2010 and 2019 (Drapeau et al., 2022). Nearly 2 in 5 females and 1 in 4 males now consume five or more fruits/vegetables per day as of 2019. The decline in healthy diet consumption is not isolated to a region as a study affirms a growing concern of noncommunicable diseases such as CVD attributable to dietary risk factors (Qiao et al., 2022). It is expedient to raise public awareness on the impact of dietary intake on the CVD burden in Canada. The province of Quebec has the highest ASPR rate of 38.4% of the population who consume five fruits/vegetables daily. In comparison, Newfoundland and Labrador have the lowest ASPR of 20.5% at 95% CI across Canada. Undoubtedly, the cost of a healthy diet limits adequate intake in socially disadvantaged communities and those with low economic status. Increasing food insecurity and a widening number of families with low economic status raise some concerns (Hutchinson & Tarasuk, 2022). More alarming is the food insured following the COVID-19 pandemic, the dwindling food-chain supply and the climate that is experienced globally (Berry et al., 2022; Polsky & Garriguet, 2022). Although a healthy diet is associated with a healthy heart, the recent global shortage of food attributable to the factors mentioned above will plumage the trend of a healthy diet and ultimately impact the epidemiology outlook of cardiovascular disease in Canada.

5.2 Discussion and Summary of CVD burden and trend in Canada

5.2.1 Acute Myocardial Infarction: Findings highlights between 2010 and 2020

- The age-standardized incidence rate of acute myocardial infarction (AMI) reduced from 230 per 100,000 in 2010-2011 to 193 per 100,000 population in the 2019-2020 fiscal year.

- The age-standardized prevalence rate of acute myocardial infarction increased from 1.92% in 2010-2011 to 1.98% in the 2019-2020 fiscal year. Kachan et al., 2023 report shows increasing nonviable myocardium with increased mortality attributable to ST-segment-elevation myocardial infarction (STEMI) in the recent time thus corroborating the outcome of this study in part.
- The age-standardized prevalence rate of acute myocardial infarction in Canadian males is nearly triple that in females. In the 2010-2011 fiscal year, the prevalence rate of AMI was 1.92 (males – 2.84%; females – 1.1%), while the rate was 1.98 (males – 2.93; females – 1.1%) in the 2019-2020 fiscal year.
- The age-standardized prevalence rate of AMI increases with age. Between 2010 and 2020, the trajectory of AMI among Canadians aged 20 to 49 is incomparable with those 50 and older, as evidence shows an insignificant increase in the rate of AMI in Canadians aged 49 and younger, unlike Canadians aged 50 and older.
- Between 2010 and 2020, Newfoundland and Labrador continue to have the highest prevalence rate of AMI, with British Columbia maintaining the lowest rate of AMI in Canada.

5.2.2 Heart failure: Findings highlight between 2010 and 2020

- Between the 2010-2011 and 2019-2020 fiscal years, the age-standardized incidence rate of heart failure (HF) reduced from 549 per 100,000 to 512 per 100,000 populations – an indicative of -6.7% changes over a 10-year period ASR incidence of heart rate at 95% CI.
- The age-standardized prevalence rate of heart failure reduced from 3.47% % in 2010-2011 to 3.26% in 2019-2020 fiscal years - an indicative of -6.05% changes in ASR prevalence of heart rate at 95% CI. The noticeable improvement in the prevalence of heart failure is supported by Kim et al. (2022) in their study on the effect of therapeutic strategies for heart failure cardiomyopathy in correlation with diabetes.
- The age-standardized prevalence rate of heart failure in Canadian males is more than that of their female counterparts. In the 2010-2011 fiscal year, the prevalence rate of heart

failure was 3.37% (males: 4.07%; females: 2.96%), while the rate was 3.26% (males: 3.86; females: 2.71%) in the 2019-2020 fiscal year.

- Unlike the noticeable upward trajectory in the prevalence of heart failure for persons aged 40 and 64, there was a downward trend in the crude prevalence of heart failure for persons aged 65-79 (5.67%), 80+ (18.33%) and 85-89 (19.41%) in 2019-2020 fiscal year respectively. While it is unclear why an upward trend in the prevalence of heart failure is recorded for adults aged 40 and 64, what seems apparent is the decline in the prevalence rate of heart failure in older adults.
- An improvement in the trend of heart failure across Canada but British Columbia and Yukon Territory is noticeable between the 2010-2011 and 2019-2020 fiscal years.
- Although the rise in heart failure in the Yukon Territory between 2010 and 2020 may be attributable to the disproportionate social determinant of health, what seems astounding is the rise in the trend of heart failure in British Columbia, where many health indicators and risk factors are adjudged favourable comparatively. The heart failure profile in British Columbia calls for a further study to explore the effect of immigration and other potential contributory factors on the rise in heart failure in the region.
- According to Grégoire et al. (2022), heart disease and stroke were the leading cause of death. Notwithstanding the burden of heart disease, applying a confidential price discount has a promising effect on the prevalence of heart disease.

5.2.3 Hypertension: Findings highlight between 2010 and 2020

- Between the 2010-2011 and 2019-2020 fiscal years, the age-standardized incidence rate of hypertension (excluding gestational hypertension) of persons aged 20 and older reduced from 2,526 cases per 100,000 population to 1,947 cases per 100,000 population – an indicative of -22.92% changes over ten years ASR incidence of heart rate at 95% CI.
- The age-standardized prevalence rate of hypertension in Canadian males is more than their female counterparts. In the 2010-2011 fiscal year, the prevalence rate of hypertension was 24.41% (males: 24.45%; females: 24.07%), while the rate was 23.09% (males: 24.28%; females: 21.9%) in the 2019-2020 fiscal year. The improvement in the prevalence of

hyphenation is dated as far back as the year 2000, according to Campbell et al. (2023). Of note is the development and implementation of dietary policy targeted at controlling the burden of hypertension – credit to the coalition of health hand scientific bodies across the board (Campbel et al., 2023).

- The age-standardized prevalence rate of hypertension reduces from 24.07% to 23.09% (95% CI) - an indicative of -5.02% changes in ASR prevalence of hypertension at 95% CI.
- The noticeable improvement in the prevalence of hypertension over the past decade is evident for females, with a -9.02% change, unlike males, which was a -0.7% change in Canada between 2010-2011 and 2019-2020 fiscal years.
- Of note is the remarkable increased risk of developing hypertension at the age of 35 and older as only 1.44% of persons aged 20-34 and a jump in the ASR presence of hypertension for persons aged 35 and 49 estimated as 9.28%. The ASR prevalence of hypertension increased exponentially from the lower to the higher age group.
- Although the rise in heart failure in the Yukon Territory between 2010 and 2020 is evident, there is no correlation in the trend of heart failure compared with hypertension in the Yukon Territory as the Yukon Territory HBP outlook is more promising across Canada comparatively. That notwithstanding, Quebec takes the lead in terms of the most promising province for an improved ASR prevalence of hypertension.
- More work is necessary to address the record-high ASR hypertension in Manitoba. Quebec, Yukon, Nova Scotia, Ontario, and PEI are provinces and territories whose model is beneficial for a better outlook on the rate of hypertension in other provinces and territories.
- Of note, integrative mobile health, intervention, hypertension control model, and improved technical packages, particularly in primary care and education, continue to promote promising outcomes in the prevalence of hypertension in Canada (Brettler et al., 2023; Oh et al., 2022).

5.2.4 Ischemic Heart Disease: Findings highlight between 2010 and 2020

- Between 2010-2011 and 2019-2020 fiscal years, the age-standardized incidence rate of ischemic heart disease for persons aged 20 and older reduced from 737 per 100,000

population to 589 per 100,000 population – an indicative of -20% changes over a 10-year period ASR incidence of heart rate at 95% CI.

- The age-standardized prevalence rate of ischemic heart disease declined from 8.2% in 2010-2011 to 7.34% in the 2019-2020 fiscal year - an indicative of improvement in the IHD disease burden outlook with a -10.49% change over a 10-year-period. The improved treatment regimen and mobile phone technology for heart disease management, among other factors, are attributable to increased compliance, health literacy and the ultimate decline in the rate of ischemic heart disease in Canada (Indraratna et al., 2020; Savarese et al., 2022).
- The age-standardized prevalence rate of ischemic heart disease in Canadian males is more than their female counterparts in a nearly 2 to 1 ratio as of 2020. In the 2010-2011 fiscal year, the prevalence rate of ischemic heart disease was 8.20% (males: 10.20%; females: 6.41%), while the rate was 7.34% (males: 9.25%; females: 5.60%) in the 2019-2020 fiscal year.
- Although the ASR prevalence of IHD continues to decline, the trajectory is more promising for females with -12.63% change, unlike males, which had -9.31% change between the 2010-2011 and 2019-2020 fiscal years.
- The trend of ischemic heart disease in the past decade is more favourable for persons aged 65-79, closely followed by persons aged 35-49, while persons aged 80 and older and persons aged 20-34 have the least promising ASR prevalence of IHD in Canada.
- As of the fiscal year 2019-2020, New Brunswick has the highest ASR prevalence of ischemic heart disease at 8.57% (-9.12% change since 2010), followed by Ontario with 7.55% (-13.71% change since 2010) and Quebec with 7.54% (-12.22% change since 2010) while Yukon Territory has the least ASR prevalence of ischemic heart diseases. An upward trajectory is noticeable in the prevalence of ischemic heart disease in British Columbia (6.83% from 6.77%) and Yukon Territory (4.61% from 3.84%), respectively.
- It is expedient to address the potential effect of migration and surveillance dynamics, amongst others, on the burden of IHD across Canada.

- The model explored and implemented in Yukon Territory and Prince Edward Island may be reviewed to improve the rate of ischemic heart disease across Canada. This review will allow for assessing the effect of population dynamics and surveillance system/data collection on the outcome in the region.

5.2.5 Cerebrovascular Accident/Stroke: Findings highlight between 2010 and 2020

- Between the 2010-2011 and 2019-2020 fiscal years, the age-standardized incidence rate of stroke/Cerebrovascular Accident (CVA) for persons aged 20 and older reduced from 323 per 100,000 population to 280 per 100,000 population – an indicative of -13.31% changes over ten years ASR incidence of heart rate at 95% CI.
- The age-standardized prevalence rate of stroke increased with a +0.78% change from 2.55% (males: 2.81%; females: 2.32%) to 2.57% (males: 2.81%; females: 2.36%) between 2010-2011 and 2019-2020 fiscal year – an indicative of an unfavourable trend in stoke/CVA epidemiologic outlook over the past decade.
- While there were no changes in the prevalence of stroke for males between 2010 and 2020, an increase in the prevalence of stroke is noticeable for females, with a +1.72% change within the past decade comparatively.
- As of 2020, persons aged 80 and older have the highest age-standardized prevalence rate of stroke at 16.81% with a -0.83% change since 2010, followed by persons aged 65-79 (6.71%), 50-64 (2.35%), 35-49 (0.62%) while the least is persons aged 20-34 (0.13%).
- A downward trajectory in the prevalence of stroke is noticeable in the older adult population aged 65 and older. Conversely, an upward trajectory is noticeable in the prevalence of stroke in young and middle-adult Canadians aged 20- to 64.
- What is more apparent is that the most pronounced upward trajectory in the prevalence of stroke is noticeable in persons aged 50-60, with a +14.63% change between 2010 and 2020.
- Prince Edward Island has the highest ASR prevalence of stroke at 3.02% (-9.12% change since 2010), followed by Ontario at 7.55% (-13.71% change since 2010) and Quebec with 7.54% (+1% change since 2010) while Nova Scotia has the least ASR prevalence of stroke of 1.94% (-5.37% change since 2010).

- Although a decline in the prevalence of ischemic heart disease is evident in Canada between 2010 and 2020, an upward trajectory is noticeable in the prevalence of ischemic heart disease in both British Columbia (6.83% from 6.77%) and Yukon Territory (4.61% from 3.84%) respectively. To improve the prevalence of stroke across Canada, the model explored and implemented in Yukon, Ontario, Saskatchewan and Nova Scotia may be explored by other regions.
- It is imperative to develop an optimal intervention with more focus on the persons aged 20 and 64 with a more deliberate focus on persons aged 50-64 as these age groups have an upward trend in the prevalence of stroke unlike the older adults aged 65 and older with a promising stroke outlook and burden in Canada. Given that rural areas have a disproportionate rate of cerebrovascular accidents, it is imperative to reconcile the difference in the urban-rural settlement when reviewing the CVA mana agent approach (Kapral et al., 2019).

5.3 Discussion and Summary of CVD attributable Mortality in Canada

- In 2020, when the total deaths by all causes were 307,205 (males: 159,076; females: 148,129), 72,677 (males: 38,005; females: 34,672) deaths were attributable to cardiovascular disease. By proportionality, 23.66% of all deaths were attributable to cardiovascular disease (CVD). Cardiovascular disease, next to cancer, is the second leading cause of death (Statistics Canada, 2022).
- More males die from CVD per annum compared with females. In 2020, the ASMR CVD-related death for males is 201.3 deaths per 100,000 population (+1.46% change from the 2010 record), whilst the ASMR for females was 181.4 deaths per 100,000 population with -7.68% change compared with the 2010 record – an indicative of improvement in the female ASMR for CVD between 2010 and 2020.
- Although the disparity in the trajectory of the ASMR attributable to CVD for differencing gender is not assessed in this study, the healthcare utilization uptake is arguably high for women compared to men for reasons including but not limited to frequent access to the healthcare services during early adulthood and middle adulthood for both prenatal and

maternal care. The CVD screening during physical and clinical examination enhances early CVD detection and prompt treatment.

- Evidence of improvement is noticeable in the number of deaths attributable to CVD in Canada between 2010 and 2020. In 2010, about 2 in 7 deaths were attributable to CVD, a rate that declined to about 1 in 4 deaths in 2020.
- By inference, the epidemiology outlook of CVD disease burden and mortality rate reveals an improvement in the prevalence of heart diseases such as ischemic heart disease, heart failure and hypertension. Notwithstanding the increased ASPR trajectory for acute myocardial infarction (AMI) and stroke/cerebrovascular accident (CVA) over the past decade, fewer people have died from CVD as of the recent time, particularly as of the year 2020 compared with CVD profile and epidemiology outlook in Canada in the year 2010.
- Although the improvement in the ASMR for CVD-related death spans over 20 years as the CVD mortality rate was 247 deaths per 100,000 population in the year 2000, the downward trajectory of the CVD mortality rate has slowed down when the records are compared at every ten-year-interval since the year 2000 (Statista, 2023). Between 2000 and 2010, there was a -20.04% change in the age-standardized mortality rate of CVD, while a -3.29% change was recorded between 2010 and 2020, respectively. Although the actual cause of the disparity in the percentage of the CVD mortality rate is not explored in this study, assessing the migration effect, improved surveillance system, aging population, possible change in Canada's demographic outlook, cultural influence, and the intervention model explored in the past decade will provide an insight into the reduced decline in the ASMR of CVD-related deaths in the recent times.
- A direct proportional correlation between the ASMR CVD mortality rate and age exists. Persons aged 90 and older take the lead with the highest ASMR CVD mortality rate of 5,953.9 deaths per 100,000 deaths, followed by persons aged 85 to 89 (2,479 deaths per 100,000), persons aged 80 to 84 (1,258.1 deaths per 100,000) population in Canada respectively. Although there is a correlation between CVD mortality and age, except for the infants with ASMR- CVD mortality rate of 5.4 deaths per 100,000, the age group with the least ASMR CVD mortality rate is 1 to 9 at 0.3 deaths per 100,000 population.

- Increasing evidence suggests infant mortality due to CVD has a link with congenital heart defects. The assessment of Olugbuyi et al. (2022) on the impact of socioeconomic status and residence distance on infant heart disease shows a correlation between socioeconomic status and residence distance on the infant's clinical outcomes. An improved social determinant of health and access to quality prenatal care will change the epidemiology outlook of infant CVD-related mortality.
- With 118.3 deaths per 100,000 population (-95% CI) and ASMR of CVA of 30.2 deaths per 100,000 population used as a mean factor, Northwest Territory has the highest age-standardized prevalence rate of CVD-related death of 173.4 deaths per 100,000 population with Quebec having the least ASMR of 107.3 deaths per 100,000 population. The highest ASMR of CVA is in the Northwest Territories, with 48.7 deaths per 100, with the least ASMR of CVA (stroke) in 2020 being Nunavut at 15.9 deaths per 100,000 population.

5.4 Study Limitations

- With the high rate of unreported CVD and undiagnosed indicators such as hypertension and other related health conditions, the CVD data reported in CCDSS may be slightly suppressed. Encouraging health consumers for routine blood pressure check-ups is essential because most hypertension may be asymptomatic (PHAC, 2023).
- Chronic Disease Surveillance System (CCDSS) is responsible for some CVD indicators; findings show the target of diabetes surveillance before including hypertension and a few other CVD indicators. As such, the outcome may skew in part (PHAC, 2021).
- Linked healthcare, health insurance and physician billing administrative data sources are predominantly the CCDSS system's sources. Notwithstanding the robust data collected, there is limited information about Quebec City – this is why Quebec City is one of the target provinces in terms of buffing the surveillance of chronic diseases in the region by the Public Health Agency of Canada (PHAC, 2023).
- Based on the CCDSS surveillance tool, data were unavailable for some parameters assessed in Northwest Territories; for Nunavut, data were unavailable for 2019-2020. In Quebec, data cells with counts smaller than five (5) were suppressed by Quebec and substituted with

random numbers. As such, this may impact this region's estimated age-specific incidence and mortality rate (PHAC, 2021). According to the Public Health Agency of Canada (2021), "the modernization of the billing system for fee-for-service medical services by the Régie de l'assurance maladie du Québec (RAMQ) in 2016 has resulted in a decrease in the entry of diagnostic codes in the fee-for-service medical services file. Therefore, data for 2016–2017 and subsequent years should be interpreted with caution, as a slight underestimation is suspected".

- The potential impact of the data caveat is that the data extracted from the surveillance system and community health survey only represent cases reported to public health units and recorded in the specified case and contact management system (CCM).
- Although about 97% of Canadians are captured in the health insurance databases, the data counts, and characteristics are subject to varying degrees of underreporting due to factors such as disease awareness and medical care-seeking behaviours, secondary to clinical practice, expertise of practitioner, changes in laboratory testing, severity of illness, and reporting behaviours.
- The extracted data on the health issues captures persons aged 20 and older. The age-standardized prevalence and mortality attributable to cardiovascular disease increase with age; hence, data collected from persons aged 19 and older has no significant impact on the CVD epidemiology outlook in Canada.
- Racial and ethnic bias/factors on the burden of cardiovascular disease are not assessed in this study. Assessing the effect of immigration, culture, religion and ethnicity on the profile of cardiovascular disease is necessary when developing evidence-based disease management interventions.

5.5 Study Implications and Direction for Future Research

The outcome of this study has a robust clinical implication as a baseline for the development of Canada's provinces/territories population-based CVD management modality framework. While the direct correlation between social determinants of health and the trend of CVD is not assessed in this study, the noticeable divergence in the CVD burden between the provinces/territories with the highest and lowest rates of CVD burden across Canada has clinical and public health implications. Other

clinical implications and direction for future research based on the findings are underlisted in the following sections:

5.5.1 Disparity in age-standardized mortality rate between 2000-2010 and 2010-2020

Despite a continued improvement in the ASMR attributable to CVD over the past 20 years, this study affirms the tardiness in the downward trajectory of the CVD-attributable mortality between 2000-2010 and 2010-2020 fiscal year. Evidence shows that the CVD mortality rate was 247 deaths per 100,000 population in 2000. Between 2000 and 2010, there was a -20.04% change in the age-standardized mortality rate of CVD, whilst a -3.29% change was recorded between 2010 and 2020 respectively. Notwithstanding the downward ASMR trend, an increased trajectory is noticeable in the CVD-attributable mortality for males, unlike the female population.

5.5.2 The disparity in the Age-Standardized Mortality rate of CVD between Males and Females

The year 2000, the ASMR attributable to CVD was 198.4 deaths per 100,000 populations for males, at which time the rate was 196.5 deaths per 100,000. A decade later, the ASMR of CVD-related deaths declined for females from 196.5 in 2010 to 181.4 in 2020 by -a 7.68%. Unlike the noticeable improvement in the ASMR for females, the ASMR of CVD rose from 198.4 deaths per 100,000 male populations to 201.3 – indicative of +1.46% changes between 2010 and 2020 in Canada. Despite increasing evidence that shows that men tend to wait until their health issues become acute before presenting to the hospital, the increased ASMR attributable to CVD among men needs further research as the current data seems underreported. Unlike women with evidence of increased healthcare utilization uptake primarily for maternal care, where physical assessment and laboratory investigation are often carried out, the masculinity factors play an essential role in the healthcare uptake for men. Men's CV care needs more attention comparative. While it is arguable that the accuracy of the women's CVD-morality rate is higher than that of men, a comprehensive investigation of the men's CVD mortality rate will likely reveal a higher CVD outlook among men.

5.5.3 Migration effect on CVD attributable Mortality

Although the actual cause of the disparity in the CVD prevalence and mortality across ethnic groups is not explored in this study, assessing the migration effect, improved surveillance system, aging

population, effect of Canada's demographic outlook, cultural influence and the intervention model explored in the past decade will provide an insight into the decline in the ASMR and ASMR of CVD in the recent time. Findings show that the rate of CVD-attributable death among immigrants is lower compared with long-term residents in Canada's geographical location (Vyas et al., 2021). Given the increasing migration into Canada over the past decade, the CVD mortality outcome partially mirrors the effect. While this outcome may have impacted the rate of CVD-related mortality in Canada, which has improved over the past decade, it is unclear if this outcome is sustainable, hence the need to explore the migration effect on CVD burden in Canada to ascertain these findings.

5.5.4 Disparity in the prevalence of Alcohol Consumption by gender

While findings in this study show an upward trajectory in the ASPR rate of alcohol consumption, it is astounding to observe an improvement in the alcohol consumption rate by males by a -6.7% change for adult while an upward trajectory in the alcohol consumption rate among the adult females at an estimated +37.1% change between 2010-2014 and 2015-2019 respectively. One of the major CVD risk factors is alcohol consumption. If the rate of alcohol consumption among women remains unchecked, the CVD epidemiology outlook for women will have unfavourable clinical implications in the coming year. With limited awareness of CVD in women, women-heart health research is imperative for a data-driven outcome to mitigate the future public health threat of CVD among women (Norris et al., 2020). Of note, a decline in alcohol consumption would be noticeable only if an improvement is noticeable among the female population. It is beneficial to behavioural science to explore the disparity and the leading factors contributing to the increasing rate of alcohol consumption among the female population in the past decade.

5.5.5 Physical Inactivity and Social Determinants of Health

In this study, evidence of improvement is observed in the rate of physical activity, with a +9.04% change between 2010 and 2020. With the increased awareness of physical activity's importance against developing cardiovascular disease, one would have expected a more improved epidemiology outlook for this variable over the past decade. Of note, an astounding discovery in this study is the correlation between education, socioeconomic status, education and geographical location and physical inactivity. Based on the Canada Risk Factor Atlas (CRFA), between 2015 and 2018, 46.3%

of respondents aged 18 years and older who reported physical inactivity were employed. Conversely, 49.5% of respondents who reported physical inactivity were unemployed (Government of Canada, CRFA, 2023). The higher the level of education, the lower the physical inactivity. By inference, education predicts an increased physical activity as 50.1% of persons aged 18 and older who reported physical inactivity have post-secondary education.

In comparison, 54.2% of respondents are high school graduates, and 55.6% have less than high school. An increasing number of individuals living in urban settlement engages in more physical activities than those in rural areas. 55.4% of respondents to physical activities live in the rural area, while 47.3% live in the population centre. What seems apparent is the effect of inequality, disproportionate social determinants of health and access to basic social amenities as a predictor for physical activity and inactivity. Should the effect of disproportionate social determinants of health be addressed on the CVD risk factors such as but not limited to physical inactivity, the future CVD epidemiology outlook will be promising.

5.5.6 CoVID-19 and the future of Cardiovascular Disease

The outcome of this study was based on 2010-2020 data, while COVID-19 was officially declared in the year 2020. With the implementation of public health order, social distancing and the fear of contracting CoVID-19, many people around the world neglect their acute and chronic CV care physical health routine, with some coming down with depression and drug/alcohol abuse due to loneliness - this, amongst others, will potentially shape the epidemiology outlook of CVD in the coming years (Lau & McAlister, 2021). The outcome of this study serves as the baseline for a future assessment of the correlation between the effect of COVID-19 and the CVD burden in Canada.

5.6 Closing statement

Although the public health threat attributable to cardiovascular disease is alarming, some socially disadvantaged communities risk developing this disease more than others. Despite the public health threat attributable to CVD and the identified limitations in this study, this study provides a compendium of epidemiology outlook for each Canadian province and territory. The study's outcome could be integrated at all health system levels, focusing more on the provincial and territorial levels. Significantly, advocating for health equality, optimal distribution of wealth and development of

community-based health intervention will mitigate its effect. Canadian Heart Health Strategy and Action Plan on CVD shows positive outcomes. Adhering to prevention strategies is the most effective method of reducing CVD prevalence. Scaling up early detection of cardiovascular disease, improving the treatment modality, and prevention and control measures of cardiovascular disease are essential (PAHO, 2023).

Empowering the Canadian population on the importance of a healthy lifestyle and managing modifiable and non-modifiable CVD-risk factors through education and empowerment at all levels promotes a satisfactory CVD epidemiology outlook. In Canada, more focus is needed in the rural areas and within the Aboriginal communities by improving their standard of living. Creating more community-based treatment centres for older adults will reduce the burden of CVD. This intervention reduces the older adult hospitalization rate related to CVD and other chronic diseases, thus giving more room for acute care in the hospital.

5.7 Recommendations

- Improving the cardiovascular disease care model is expedient while encouraging health consumers to undergo regular check-ups, including cardiovascular screening, to ascertain a robust CVD profile outcome in Canada. It has been established that heart disease screening has a clinical benefit from the prevention and disease management standpoint (Abrahamson et al., 2022). Corroborative, regular vital signs measurement and assessment, particularly the heart rate, respiration and blood pressure, are expedient due to the asymptomatic presentation characterized by a hypertensive condition (PHAC, 2023).
- Health Kiosks such as in-store blood pressure stations benefit health system management for cardiovascular disease, among other chronic diseases (Maramba et al., 2022). Despite the number of blood pressure stations strategically situated in some pharmaceutical and grocery stores in Canada, it is arguable that only a few shoppers access the kiosk to check their blood pressure. Encouraging self-service blood pressure machines would promote early CVD detection, thus preventing the risks of heart attack, stroke, heart failure, and other chronic diseases. See Pictures 2.1 and 2.2.

- One of the easy ways to promote BP self-checks is to assign an individual or encourage store staff to inform or remind shoppers to utilize the available blood pressure station in the grocery or pharmaceutical stores where the same is provided. The CV profile assessment could be enhanced if the vital signs/blood pressure machine is situated in more public spaces such as bus terminals, schools, city halls, and gas/petrol stations, to mention a few. Connecting the kiosk to the provincial and national surveillance database for data collection is essential.
- Increasing evidence shows that health literacy is critical in how the public responds to their health status and health information. Although disparity exists in the ways health consumers' access and process health information and services with the emerging digital health technology due to the observable inequality, digital health technology has increased the health care service and information accessibility to a great extent. Exploring the benefits of digital health technology while mitigating inequality will improve the epidemiology outlook of CVD (Yao et al., 2022).
- The government of Canada will benefit from improving the implementation of digital health innovation in managing the trend of cardiovascular disease across Canada. Findings show a promising breakthrough in the relevance of digital health-based diagnostic and therapeutic management of cardiovascular disease, particularly in the area of "artificial intelligence-enabled cardiovascular diagnostic tools, techniques, and methodologies; big data and prognostic models for cardiovascular risk protection, and wearable devices in cardiovascular risk assessment, cardiovascular disease prevention, diagnosis, and management" (Vardas et al., 2022, np).
- Education plays a crucial role in heart disease prevention as a study shows that "educational interventions tailored to patients with coronary artery disease (CAD) can increase their disease-related knowledge and improve self-management behaviours" (de Melo et al., 2020, np).
- At multiple levels of public health interventions, primary care providers should explore and prioritize the relationship between the social determinants of health and the burden of cardiovascular disease (Powell-Wiley et al., 2022). Assessing the correlation between the prevalence of CVD and the socioeconomic status of a defined population in Canada provides a

robust outcome invaluable in developing a veritable cardiovascular disease prevention model in tandem with social determinants of health.

- It is believed that women's sex hormone plays a pertinent role in spontaneous coronary artery dissection; it is also believed that the response of women living with a diagnosed ischemic heart disease when they present with chest pain differs from the way men present with the same (Pacheco et al., 2022). The disparity in women's presentation and increased heart failure with perceived ejection fraction among the women could contribute to the CVD-mortality burden among the women comparatively. While an improvement is noticeable in the alcohol consumption rate among men, there is an upward trajectory in the rate of alcohol consumption among women in Canada between 2010 and 19 – this may impact the health outcome of women's heart health trend. With the disparity in the heart disease presentation between men and women coupled with the increasing alcohol consumption rate among women, it is recommended that sex-specific consideration is pertinent when conducting cardiovascular research (Chang et al., 2023).
- Canada provinces and territories with disproportionate CVD burden outcomes should consult with other provinces or territories with promising CVD epidemiology outlooks to learn from their approach where possible.
- Given that health literacy, education, and socioeconomic status have been proven as the significant markers for health status, in the coming year(s), the relationship between the social determinant and or the socioeconomic status and the burden across Canada needs to be assessed (Rudd et al., 2023).
- To develop a broad-conceptualized management approach, it is imperative to assess the effect of immigration, culture, religion and ethnicity on the profile of cardiovascular disease in each Canadian province and territory.

5.8 Conclusion

Findings in this study show a promising epidemiology outlook in a selected cardiovascular disease condition, while others require a more conceptualized approach to celebrate the achieved gains over the past decade. Evident of improved epidemiology outlook of three (3) major CVD conditions, namely ischemic heart disease, heart failure and hypertension and the rate of CVD-attributable

mortality is affirmed at a time when an improvement is noticeable in the trend of two (2) CVD risk factors namely tobacco smoking, and physical activity. Conversely, an increased trajectory in the rate of acute myocardial infarction and stroke is noticeable when a dissatisfactory trend is recorded in CVD-risk factors such as dietary intake, diabetes and alcohol consumption between 2010 and 2020, respectively. While the rate of hypertension, ischemic heart disease, heart failure, and stroke maintains their rank in the order of CVD ASPR over the past decade (2010-2020), IHD takes the lead as the most improved CVD followed by heart failure and hypertension respectively with no evidence of improvement in the epidemiology outlook of acute myocardial infarction and cerebrovascular accident comparatively. More males and older adults are more predisposed to developing CVD than the other population group. By inference, a correlation exists among a selected CVD condition, risk factors, and CVD-attributable mortality rate based on this study's 10-year CVD burden assessment. There is an improvement in the age-standardized mortality rate and age-standardized prevalence rate of cardiovascular disease in Canada between 2010 and 2020.

A significant divergence is evident between the province/territory with the lowest rate and those with the highest age-standardized prevalence and aged-standardized mortality rate of CVD. The marked divergence in the rate of CVD across Canada suggests the effect of disproportionate social determinants of health and health inequality in Canada despite Canada being among the high-income countries globally. Notwithstanding the empirical evidence showing an improved CVD burden, cardiovascular disease remains Canada's major public health threat. A disproportionate social determinant of health in selected Canadian territories and Aboriginal communities impacts the epidemiologic outlook of CVD burden in the regions. Consequently, focusing on effectively managing the inequality, health disparity and varied social determinants of health will harness the recent gains in the CVD epidemiology outlook in Canada.

While the importance of early CVD detection and its effective management cannot be overemphasized, more effort is required to be directed at reducing the prevalence of alcohol consumption, improving dietary intake with optimal fruit/vegetable intake and increasing diabetic education sequel to the outcome of this study. To harness the promising CVD-epidemiology outlook across Canada, a population-based conceptualized intervention with an improved social determinant

of health is imperative. A further study on the direct correlation between the trend of cardiovascular disease and health determinants, the effect of race, ethnicity, religion, culture, and migration is strongly recommended. This study's outcome is a baseline for future studies on population-based CVD-related subjects and data-driven indicators for developing conceptualized evidence-based CVD management and proactive models. The CoVID-19 pandemic declared in 2020, has arguably altered the global disease burden landscape. Given the timeline of the assessed CVD data (2010-2020), investigating the effect of emerging public health issues such as CoVID-19 on the epidemiology outlook of CVD burden using the outcome of this study its baseline is in Canada is beneficial.

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Appendix I

CCDSS Data procedures

The following data procedures are applied on the data submitted by the provinces and territories.

- **Age group aggregation for age-specific estimations or rates**

  Data submitted by provinces and territories by five-year age groups are aggregated using the following life course age groups: 1-19, 20-34, 35-49, 50-64, 65-79 and 80+ with a few exceptions. Data by five-year age groups are reported at the national level only.

- **Suppression**

  Estimates, rates, and rate ratios are not reported when the corresponding non-rounded counts are less than 10 or the coefficients of variation are greater than 33.3%.

- **Random rounding**

  To protect data confidentiality and avoid residual disclosure, crude estimates/rates are calculated using randomly rounded counts. All provincial/territorial and Canadian counts 10 or greater are randomly rounded either up or down to a multiple of 5. Random rounding is only used to calculate crude estimates/rates. Age-standardized estimates/rates are based on non-rounded counts.

- **Rate calculation**

  See CCDSS summary of methods.

- **Age standardization**

  Estimates or rates are age-standardized to the 2011 Canada population, using raw counts and five-year age groups, in order to adjust for differences in population age structure.

Provincial and territorial notes

More disease/condition-specific notes, including provincial/territorial specifications, are included in the CCDSS case definitions documentation.

- **Newfoundland and Labrador:** Data before 2008–2009 are excluded.
- **Northwest Territories:** Data were not available.
- **Nunavut:** Data before 2005–2006 are excluded. Data were not available for 2019–2020.

- **Quebec:** Data were not available for 1995–1996. Data cells with counts smaller than 5 were suppressed by Quebec and substituted with random numbers (1-4) by PHAC. As a result, age-specific incidence and mortality rates may be randomly over or under estimated. The modernization of the billing system for fee-for-service medical services by the Régie de l'assurance maladie du Québec (RAMQ) in 2016 has resulted in a decrease in the entry of diagnostic codes in the fee-for-service medical services file. Data for 2016–2017 and subsequent years should therefore be interpreted with caution, as a slight underestimation is suspected.
- **Saskatchewan:** Data cells with counts smaller than 5 were suppressed by Saskatchewan and substituted with random numbers (1-4) by PHAC. As a result, age-specific incidence and mortality rates may be randomly over or under estimated.
- **Yukon:** Data before 2010–2011 are excluded.

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Appendix II

Heart Disease in Canada

Appendix III

What is Heart Disease?

Source: https://www.health.gov.fj/what-is-heart-disease/

Blood is pumped around your body by your heart through veins and arteries. It delivers oxygen and essential nutrients to keep your body working. When there is something wrong with your heart or blood vessels, this is called heart (cardiovascular) disease.

Heart disease is the biggest killer in Fiji, with over 1,000 cases reported yearly.

What are the different types of Heart disease?

There are many different types of heart disease; some of the most common types in Fiji are;

- Congestive Heart Failure
- Hypertension
- Unstable Angina
- Ischaemic Heart disease (Coronary Heart disease)

Heart Failure

Congestive Heart Failure does not mean the heart has stopped working, but rather, it cannot pump enough blood to meet the body's needs. This may happen for different reasons; the heart muscle might be weaker than usual, or there may be a defect in the heart preventing the blood from flowing normally.

When the heart does not circulate blood properly, the kidneys receive less blood and filter out less fluid into the urine. This extra fluid in circulation builds up in other body areas, such as the eyes, lungs and legs. This fluid is called "congestion," which gives this heart disease its name.

Some common symptoms of heart failure include;

Shortness of breath – most commonly during activity and when resting or sleeping- may wake you up. You may experience difficulty breathing when lying flat, so you must prop your upper body up to relieve the difficulty. You often wake up feeling tired or anxious and restless.

Coughing and wheezing may produce white or pinkish mucus with a hint of blood.

Excess fluid in the body results in swelling in the feet, ankles, legs or abdomen. Your shoes may feel tighter, or you may noticeably gain weight.

Tiredness – feeling tired and finding daily activities such as shopping, walking and so on difficult to do.

Lack of Appetite – you may not feel hungry but often full or sick in your stomach.

Confusion, not thinking properly – you may not feel yourself, confused or disorientated. Your friends or family may notice this before you do.

Fast heart rate – you may notice your heart beating faster, like it is racing or throbbing.

Hypertension

Hypertension is Fiji's second most common heart disease; it is also known as high blood pressure. Blood pressure is the measure of the force of blood against your artery wall. Anyone can develop hypertension; it increases your risk of heart attack or stroke.

There are generally no warning signs or symptoms for high blood pressure, so it is important you get tested by your doctor or health professional, they will be able to measure your blood pressure.

Whilst blood pressure can go up and down throughout the day, if it remains high for a long period of time (around 3 months) then you have high blood pressure. See below for a chart that explains how your blood pressure is measured.

There are many lifestyle factors that can put you at risk of hypertension.

- If you are overweight or obese
- Drinking too much or excessive amounts of alcohol
- Eating too much salt (Sodium) in your diet
- A Lack of enough physical activity (you should be doing 30-60 minutes of moderate physical activity every day)

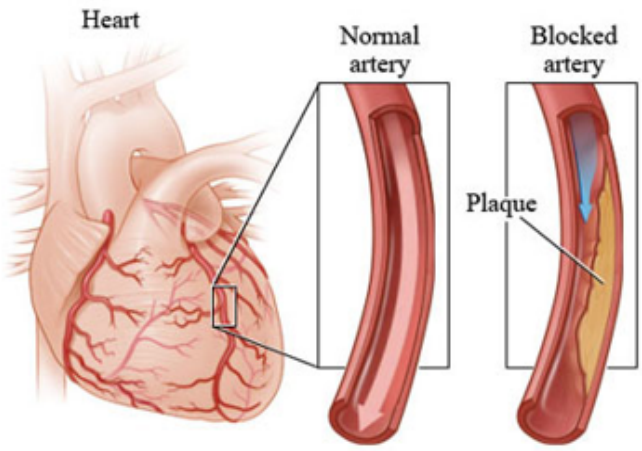
You should eliminate the risk factors above. There is also blood pressure lowering medication that you can take, but only as directed by your doctor.

If you are at risk of high blood pressure or do have high blood pressure, you should have regular health checks, at least once a year. Speak to your health worker to learn more.

Ischaemic Heart Disease

Ischaemic Heart Disease (IHD) is also known as Coronary Heart Disease and causes heart attacks by restricting blood flow to the heart. IHD is caused by a build-up of plaque along the inner walls of your heart (coronary artery), this plaque eventually thickens and hardens, obstructing the blood flow and causing a heart attack.

The signs and symptoms of IHD only become obvious once it is in an advanced state, which is why heart attacks may seem "sudden" or unexpected. This is because IHD can build up over a very long time, even decades, before symptoms are felt. Early symptoms include angina (chest pain), especially when exerted or having done exercise as well as decreased exercise tolerance (Stable IHD). Unstable IHD presents itself as chest pain or other symptoms and rapidly worsening angina.



Source: www.inrechopen.com

Angina

A common earlier symptom of IHD is Angina (chest pain) that usually occurs when exercising. You heart can't get enough oxygen to work properly because the arteries that are carrying the blood to the heart get too narrow.

Symptoms of Angina include:

- A pain or tightness in your chest that may come and go
- Sudden Difficulty breathing
- Chest pain spreading to your jaw, teeth or earlobes
- Heaviness, tingling or aching in your shoulder or arm (usually on the left side).
- Pain between your shoulder blades

If you've had any of these symptoms, talk to your local doctor or nurse immediately.

Heart Attack

A heart attack can occur when the flow of blood to a section of your heart becomes blocked, preventing the blood from moving through your heart. If the flow is not restored quickly enough, that section of your heart muscle dies.

You may experience some of the following symptoms when you are having a heart attack. Be aware that you may also not feel any pain at all.

You may feel pain in your;

- Middle of your chest (can be mild to severe) – this is the most common symptom
- Jaw
- Neck
- Shoulder

You may also get other symptoms, such as:

- Sweating
- Feeling dizzy or faint
- Vomiting
- Shortness of breath.

If you think you or someone else may be having a heart attack, call an ambulance or go to hospital immediately. Early treatment can save your life.

Am I at risk of heart disease?

An unhealthy lifestyle puts you at much greater risk of heart disease. It is the number one killer in Fiji and the world.

Your risk of heart disease increases

- As you get older
- If you smoke
- Have high blood cholesterol
- Have Diabetes
- Have high blood pressure

How do I reduce the risk of heart disease?

There are some very simple steps you can take to reduce your risk of heart disease. It all has to do with a healthy lifestyle. If you follow these steps, you are also lowering your risk of many other diseases.

- *Stop smoking*

All types and levels of smoking is very bad for your heart. Smoking increases your blood pressure and heart rate and reduces oxygen in the blood.

If you quit smoking completely, your body can repair itself and within 5 years, your risk of heart disease can drop to that of a non-smoker.

- *Reduce or cut out alcohol completely*

  If you do choose to drink, it is much better for your heart if you moderate the amount, you drink and make sure you don't drink too much.

  For adult females and adult males over the age of 65, a maximum of one drink per day is a healthy amount.

  For adult males under the age of 65, a maximum of two drinks per day is a healthy amount.

  Any more than the above levels of Alcohol is a hazard to your health.

- *Exercise for 30 minutes at least 5 days a week*

Physical activity helps you control your weight and can reduce your chances of developing other conditions that may put a

strain on your heart, such as high blood pressure, high cholesterol and diabetes.

You should aim to get at least 30 – 60 minutes of moderately intense physical activity on most days of the week. Sticking to this exercise routine will benefit your entire body, not just your heart. Even short bursts of 3 x 10-minute exercise sessions each day can benefit.

Eat a 'heart healthy' diet

A diet rich in fruits, vegetables and whole grains can help protect your heart. Beans, other low-fat sources of protein and certain types of fish also can reduce your risk of heart disease.

Bad Fats

Limiting certain fats, you eat also is important. There are different types of fat — saturated fats should be limited and trans fats should be kept out of your diet altogether.

Major sources of saturated fat include:

- Red meat
- Dairy products
- Coconut and palm oils

Sources of Trans fat include:

- Deep-fried fast foods
- Bakery products – white breads
- Packaged snack foods
- Margarines
- Breakfast Crackers

Good Fats

Rather than the above types of fats, you should include more 'healthy fats' from natural foods such as avocado, nuts, fish and olive oil. Not only are they tasty, they also help your heart by reducing the bad cholesterol.

Fruits and Vegetables

You should up your daily fruit and vegetable intake to at least 2 servings of fruit and 3 servings of vegetables a day, but the more the merrier,10 servings a day would be even better!

Lower Salt Intake

There is salt hidden in lots of foods, especially packaged and processed foods, in fact about 75% of the salt we eat is from processed food such as tinned foods and tomato sauce. Reducing salt in your diet doesn't have to be hard and by doing so, you can reduce your blood pressure which means you reduce your risk of heart disease and stroke.

Here are 4 easy ways to reduce your salt;

- Read the food labels carefully and choose the lower salt (Sodium) options
- Eat less foods that are high in salt – fatty meats, chips, processed foods
- Use natural herbs and spices to flavour your food instead of salt
- No more dipping food and meats in salt, you only need a small pinch of salt!

Maintain a Healthy Weight

Being overweight, especially if you carry lots of weight around your middle, increases your risk of heart disease. Excess weight can lead to conditions that increase your chances of heart disease such as high blood pressure, high cholesterol and diabetes.

Even a small amount of weight loss can be of benefit and reduce your risk of these diseases.

Get a Good Night's Sleep

A lack of good quality sleep can really harm your health. People who don't get enough sleep have a higher risk of obesity, high blood pressure, heart attack, diabetes and depression.

If you feel tired and want to keep sleeping when you wake up in the mornings, you are probably not getting enough sleep. Adults should aim for around 7 – 9 hours sleep each night, you should make sure you have a good routine in place and stick t it, make sure your room is dark and quiet to make sleeping easier. Getting enough sleep each night should be a priority.

A Healthy diet and daily exercise help you sleep better at night.

Get your health screened regularly

Conditions such as high cholesterol and high blood pressure can really damage your heart, but there aren't any symptoms so the only way you can know you have them is through testing. By getting regular health checks you can monitor your levels and stay in control. You can ask to be screened for Diabetes when you get a check up to ensure you get screened for;

- Blood Pressure
- Cholesterol levels
- Blood glucose levels

I want to know more about Heart Disease

You can learn more about the different types of heart disease and conditions as well as reducing your risk of heart disease on the New Zealand Heart Foundation website: www.heartfoundation.org.nz/

Appendix IV

Cardiovascular Disease Diagnosis

Cardiovascular Disease Diagnosis

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By Dr. Ananya Mandal, MD

Reviewed by April Cashin-Garbutt, MA (Editor)

Cardiovascular diseases are diagnosed using an array of laboratory tests and imaging studies. The primary part of diagnosis is medical and family histories of the patient, risk factors, physical examination and coordination of these findings with the results from tests and procedures.

Some of the common tests used to diagnose cardiovascular diseases include:

Blood Tests

Laboratory tests are used to detect the risk factors for heart diseases. These include detection of the fats, cholesterol and lipid components of blood including LDL, HDL, Triglycerides.

Blood sugar and Glycosylated hemoglobin is measured for detection of diabetes. C-reactive protein (CRP) and other protein markers like Apolipoprotein A1 and B are used to detect inflammation that may lead to heart diseases.

During a heart attack, heart muscle cells die and release proteins into the bloodstream. Blood tests can measure the amount of these proteins in the bloodstream. High levels of these proteins are a sign of a recent heart attack.

One of the markers of heart attack is the Cardiac Troponin-T. Other biomarkers include fibrinogen and PAI-1, high levels of homocysteine, elevated asymmetric dimethylarginine and elevated brain natriuretic peptide (also known as B-type) (BNP)

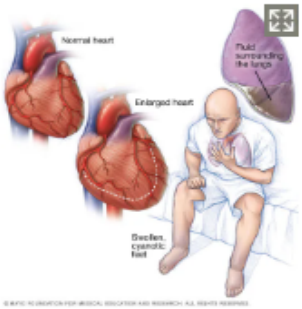
EKG/ECG (Electrocardiogram)

This is a simple and a painless test that records the heart's electrical activity. The patient is strapped to the instrument with several patches or leads placed over his or her chest, wrists and ankles. A small portable machine records the activities of the heart on a strip of graph paper.

The test shows how fast the heart is beating and its rhythm. The strength and timing of the electrical signals as they pass through the heart are also seen. An EKG/ECG can help detect a heart attack, attacks of angina, arrhythmias etc.

Symptoms

Heart failure can be ongoing (chronic), or it may start suddenly (acute).



Heart failure

Heart failure signs and symptoms may include:

- Shortness of breath with activity or when lying down
- Fatigue and weakness
- Swelling in the legs, ankles and feet
- Rapid or irregular heartbeat
- Reduced ability to exercise
- Persistent cough or wheezing with white or pink blood-tinged mucus
- Swelling of the belly area (abdomen)
- Very rapid weight gain from fluid buildup
- Nausea and lack of appetite
- Difficulty concentrating or decreased alertness
- Chest pain if heart failure is caused by a heart attack

When to see a doctor

See your doctor if you think you might be experiencing signs or symptoms of heart failure. Call 911 or emergency medical help if you have any of the following:

- Chest pain
- Fainting or severe weakness
- Rapid or irregular heartbeat associated with shortness of breath, chest pain or fainting
- Sudden, severe shortness of breath and coughing up white or pink, foamy mucus

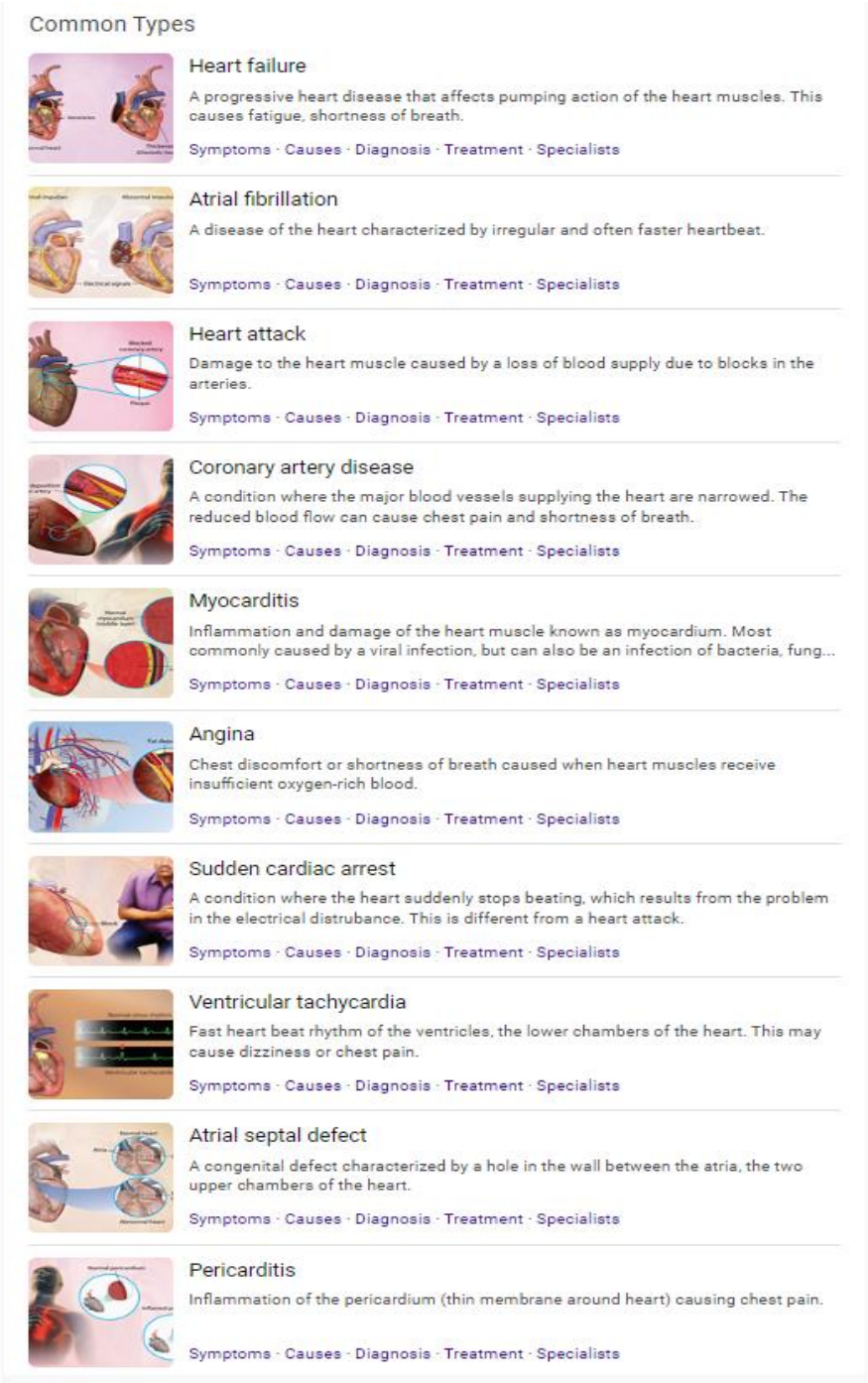
Although these signs and symptoms may be due to heart failure, there are many other possible causes, including other life-threatening heart and lung conditions. Don't try to diagnose yourself.

Emergency room doctors will try to stabilize your condition and determine if your symptoms are due to heart failure or something else.

If you have a diagnosis of heart failure and if any of the symptoms suddenly become worse or you develop a new sign or symptom, it may mean that existing heart failure is getting worse or not responding to treatment. This may also be the case if you gain 5 pounds (2.3 kilograms) or more within a few days. Contact your doctor promptly.

Appendix V

Common types of heart diseases



Source: Common types of heart diseases (Mayor, 2023)

Appendix VI

Type of heart failure, CVD risk factors, CVD Complications and Preventions

Type of heart failure	Description
Left-sided heart failure	Fluid may back up in the lungs, causing shortness of breath.
Right-sided heart failure	Fluid may back up into the abdomen, legs and feet, causing swelling.
Systolic heart failure (also called heart failure with reduced ejection fraction)	The left ventricle can't contract vigorously, indicating a pumping problem.
Heart failure with preserved ejection fraction	The left ventricle can't relax or fill fully, indicating a filling problem.

Any of the following conditions can damage or weaken your heart and can cause heart failure. Some of these can be present without your knowing it:

- **Coronary artery disease and heart attack.** Coronary artery disease is the most common form of heart disease and the most common cause of heart failure. The disease results from the buildup of fatty deposits in the arteries, which reduces blood flow and can lead to heart attack.

  A heart attack occurs suddenly when a coronary artery becomes completely blocked. Damage to your heart muscle from a heart attack may mean that your heart can no longer pump as well as it should.
- **High blood pressure.** If your blood pressure is high, your heart has to work harder than it should to circulate blood throughout your body. Over time, this extra exertion can make your heart muscle too stiff or too weak to properly pump blood.
- **Faulty heart valves.** The valves of the heart keep blood flowing in the proper direction. A damaged valve — due to a heart defect, coronary artery disease or heart infection — forces the heart to work harder, which can weaken it over time.
- **Damage to the heart muscle.** Heart muscle damage can have many causes, including certain diseases, infection, heavy alcohol use, and the toxic effect of drugs, such as cocaine or some drugs used for chemotherapy. Genetic factors also can play a role.
- **Inflammation of the heart muscle (myocarditis).** Myocarditis is most commonly caused by a virus, including the COVID-19 virus, and can lead to left-sided heart failure.
- **A heart problem that you're born with (congenital heart defect).** If your heart and its chambers or valves haven't formed correctly, the healthy parts of your heart have to work harder to pump blood, which may lead to heart failure.
- **Abnormal heart rhythms (arrhythmias).** Abnormal heart rhythms may cause your heart to beat too fast, creating extra work for your heart. A slow heartbeat also may lead to heart failure.
- **Other diseases.** Long-term diseases — such as diabetes, HIV, an overactive or underactive thyroid, or a buildup of iron or protein — also may contribute to chronic heart failure.

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Risk factors

A single risk factor may be enough to cause heart failure, but a combination of factors also increases your risk.

Risk factors for heart failure include:

- **Coronary artery disease.** Narrowed arteries may limit your heart's supply of oxygen-rich blood, resulting in weakened heart muscle.
- **Heart attack.** A heart attack is a form of coronary artery disease that occurs suddenly. Damage to your heart muscle from a heart attack may mean your heart can no longer pump as well as it should.
- **Heart valve disease.** Having a heart valve that doesn't work properly raises the risk of heart failure.
- **High blood pressure.** Your heart works harder than it has to if your blood pressure is high.
- **Irregular heartbeats.** These abnormal rhythms, especially if they are very frequent and fast, can weaken the heart muscle and cause heart failure.
- **Congenital heart disease.** Some people who develop heart failure were born with problems that affect the structure or function of their heart.
- **Diabetes.** Having diabetes increases your risk of high blood pressure and coronary artery disease. Don't stop taking any medications on your own. Ask your doctor whether you should make changes.
- **Some diabetes medications.** The diabetes drugs rosiglitazone (Avandia) and pioglitazone (Actos) have been found to increase the risk of heart failure in some people. Don't stop taking these medications on your own, though. If you're taking them, ask your doctor if you need to make any changes.
- **Certain other medications.** Some medications may lead to heart failure or heart problems. They include nonsteroidal anti-inflammatory drugs (NSAIDs); certain anesthesia medications; and certain medications used to treat high blood pressure, cancer, blood conditions, irregular or abnormal heartbeats, nervous system diseases, mental health conditions, lung and urinary problems, inflammatory diseases, and infections.
- **Alcohol use.** Drinking too much alcohol can weaken the heart muscle and lead to heart failure.
- **Sleep apnea.** The inability to breathe properly while you sleep results in low blood-oxygen levels and an increased risk of irregular heartbeats. Both of these problems can weaken the heart.
- **Smoking or using tobacco.** If you smoke, quit. Using tobacco increases your risk of heart disease and heart failure.
- **Obesity.** People who have obesity have a higher risk of developing heart failure.
- **Viruses.** Certain viral infections can cause damage to the heart muscle.

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Complications

Complications of heart failure depend on the severity of heart disease, your overall health and other factors such as your age. Possible complications can include:

- **Kidney damage or failure.** Heart failure can reduce the blood flow to your kidneys, which can eventually cause kidney failure if left untreated. Kidney damage from heart failure can require dialysis for treatment.
- **Heart valve problems.** The valves of the heart, which keep blood flowing in the right direction, may not work properly if your heart is enlarged or if the pressure in your heart is very high due to heart failure.
- **Heart rhythm problems.** Heart rhythm problems may lead to or increase your risk of heart failure.
- **Liver damage.** Heart failure can cause fluid buildup that puts too much pressure on the liver. This fluid backup can lead to scarring, which makes it more difficult for your liver to work properly.

Prevention

The key to preventing heart failure is to reduce your risk factors. You can control or eliminate many of the risk factors for heart disease by making healthy lifestyle changes and by taking the medications prescribed by your doctor.

Lifestyle changes you can make to help prevent heart failure include:

- Not smoking
- Controlling certain conditions, such as high blood pressure and diabetes
- Staying physically active
- Eating healthy foods
- Maintaining a healthy weight
- Reducing and managing stress

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Appendix VII

Canadian Risk Factor Atlas (CRFA)

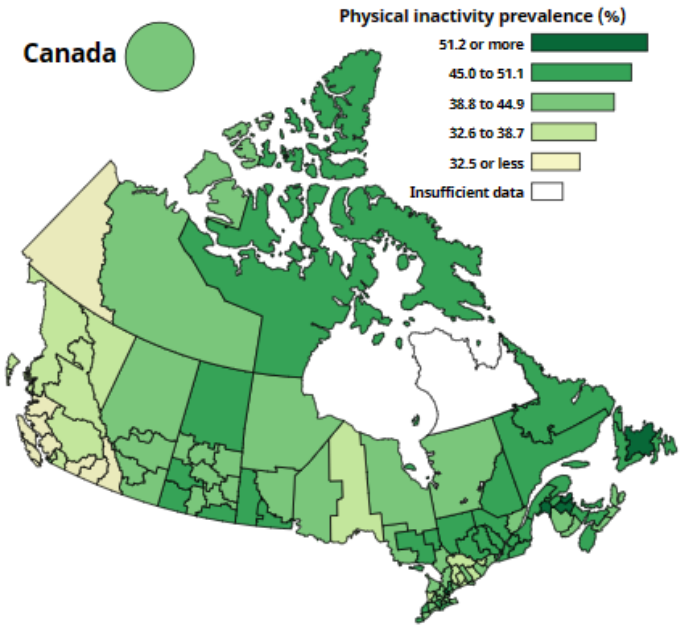
Canadian Risk Factor Atlas (CRFA)

The Canadian Risk Factor Atlas (CRFA) is an interactive database that shows prevalence maps of key chronic disease and mental health risk factors for various geographic breakdowns: provinces and territories, health regions and census metropolitan areas/large census agglomerations plus the three territorial capitals.

Based on user selections of risk factor, age group (youth, adults), sex and geographic breakdown, an interactive map is created. The CRFA compares the estimates of the selected risk factor for the selected geographic breakdown with the corresponding national average. For each risk factor, estimates are also broken down by socioeconomic status (income, education, employment) and by population centres or rural areas of residence (when applicable).

Navigate the map by hovering your mouse over each area. Click an area to lock it and zoom in and click the same area again to zoom out.

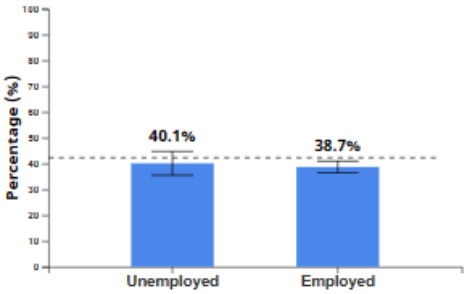
Physical inactivity : Prevalence (%) of not meeting physical activity guidelines, among Canadian adults aged 18+ years, by health regions, both sexes, age-standardized rates, 2015-2018



Map (.png) Map Data Graph Data

The **physical inactivity** age-standardized rate for **adults of both sexes** in **Nord-du-Québec, Que.** is **39.6%**. This is **not significantly different from the** national average of **42.3%**.

Prevalence of **physical inactivity** in **adults of both sexes** located in **Nord-du-Québec** by Employment



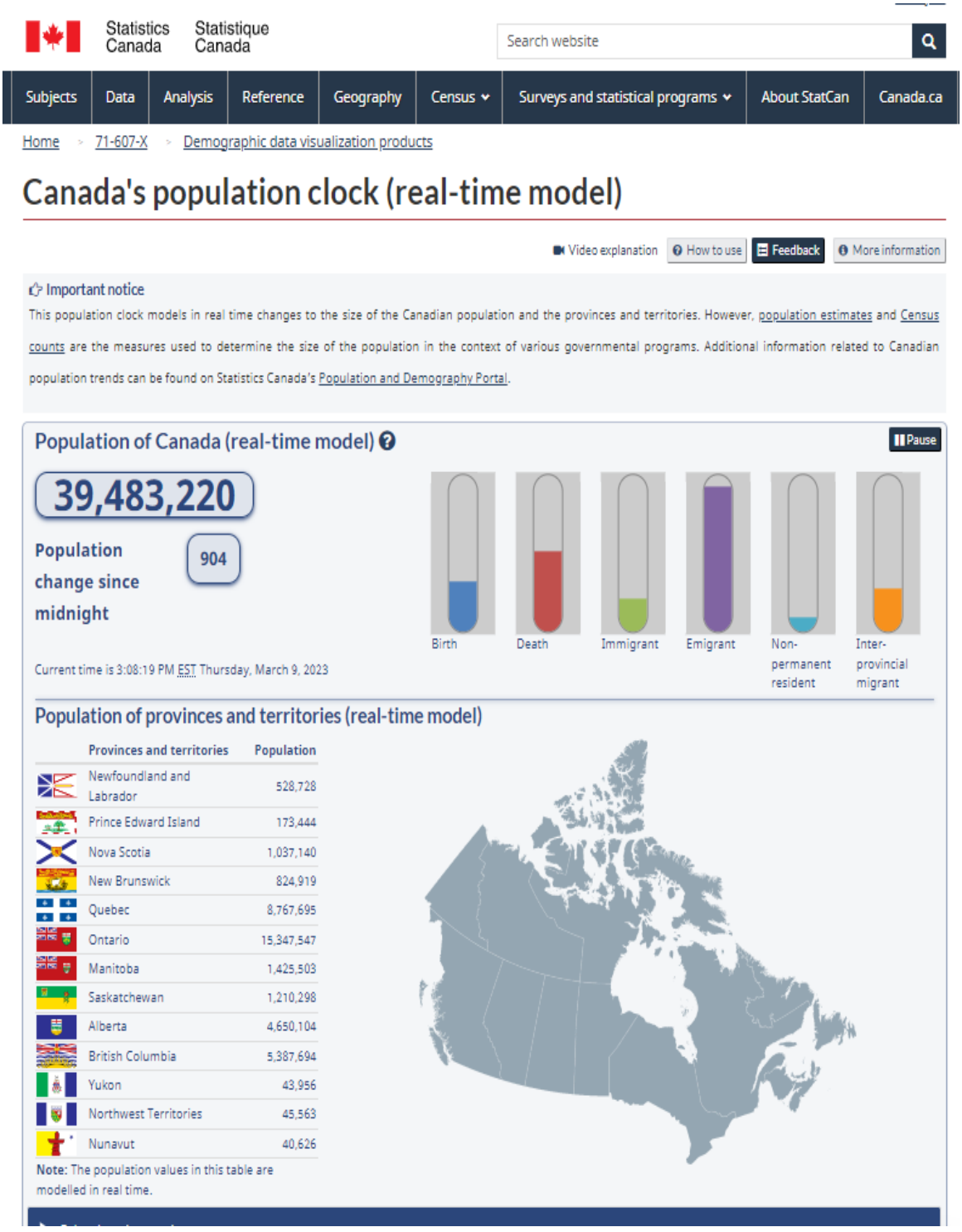
Graph Notes:

- Population limited to respondents aged 18-75 years old. Employment classification is based on working status in the week prior to the survey interview. Employment categories 3 4 exclude those that reported being retired.
- The dotted line represents the national average of Physical inactivity prevalence (%)

▶ Table: Prevalence (%) of not meeting physical activity guidelines, age-standardized rates, among Canadian adults aged 18+ years, by health regions, both sexes, 2015-2018

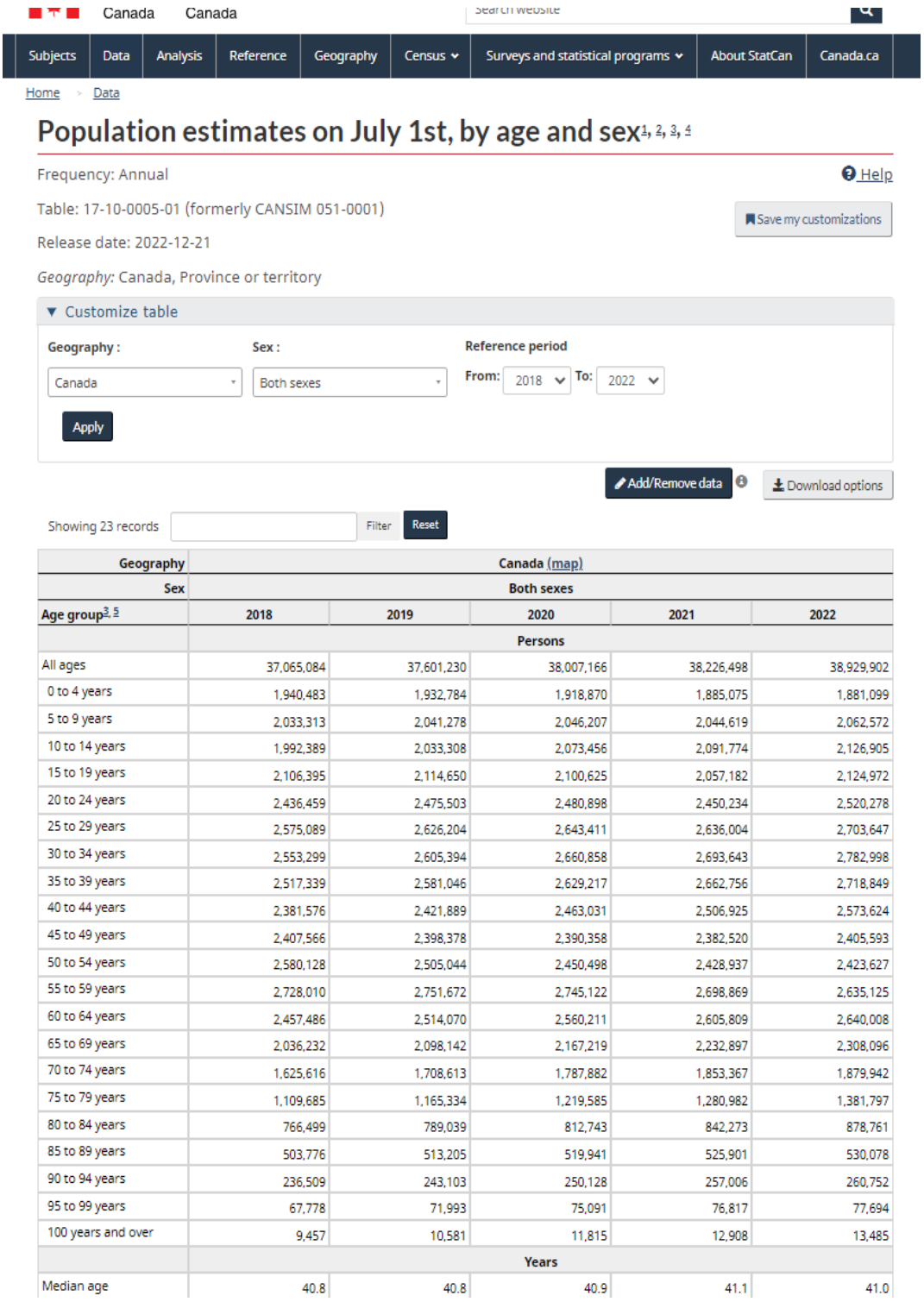
Appendix VIII

Canada's population clock (real-time model)



Appendix IX

Population estimates on July 1st, by age and sex



Canada Canada

Subjects | Data | Analysis | Reference | Geography | Census | Surveys and statistical programs | About StatCan | Canada.ca

Home > Data

Population estimates on July 1st, by age and sex[1, 2, 3, 4]

Frequency: Annual

Help

Table: 17-10-0005-01 (formerly CANSIM 051-0001)

Save my customizations

Release date: 2022-12-21

Geography: Canada, Province or territory

▼ Customize table

Geography : Canada

Sex : Both sexes

Reference period From: 2018 To: 2022

Apply

Add/Remove data | Download options

Showing 23 records | Filter | Reset

Geography	Canada (map)				
Sex	Both sexes				
Age group[3, 5]	2018	2019	2020	2021	2022
	Persons				
All ages	37,065,084	37,601,230	38,007,166	38,226,498	38,929,902
0 to 4 years	1,940,483	1,932,784	1,918,870	1,885,075	1,881,099
5 to 9 years	2,033,313	2,041,278	2,046,207	2,044,619	2,062,572
10 to 14 years	1,992,389	2,033,308	2,073,456	2,091,774	2,126,905
15 to 19 years	2,106,395	2,114,650	2,100,625	2,057,182	2,124,972
20 to 24 years	2,436,459	2,475,503	2,480,898	2,450,234	2,520,278
25 to 29 years	2,575,089	2,626,204	2,643,411	2,636,004	2,703,647
30 to 34 years	2,553,299	2,605,394	2,660,858	2,693,643	2,782,998
35 to 39 years	2,517,339	2,581,046	2,629,217	2,662,756	2,718,849
40 to 44 years	2,381,576	2,421,889	2,463,031	2,506,925	2,573,624
45 to 49 years	2,407,566	2,398,378	2,390,358	2,382,520	2,405,593
50 to 54 years	2,580,128	2,505,044	2,450,498	2,428,937	2,423,627
55 to 59 years	2,728,010	2,751,672	2,745,122	2,698,869	2,635,125
60 to 64 years	2,457,486	2,514,070	2,560,211	2,605,809	2,640,008
65 to 69 years	2,036,232	2,098,142	2,167,219	2,232,897	2,308,096
70 to 74 years	1,625,616	1,708,613	1,787,882	1,853,367	1,879,942
75 to 79 years	1,109,685	1,165,334	1,219,585	1,280,982	1,381,797
80 to 84 years	766,499	789,039	812,743	842,273	878,761
85 to 89 years	503,776	513,205	519,941	525,901	530,078
90 to 94 years	236,509	243,103	250,128	257,006	260,752
95 to 99 years	67,778	71,993	75,091	76,817	77,694
100 years and over	9,457	10,581	11,815	12,908	13,485
	Years				
Median age	40.8	40.8	40.9	41.1	41.0

Appendix X

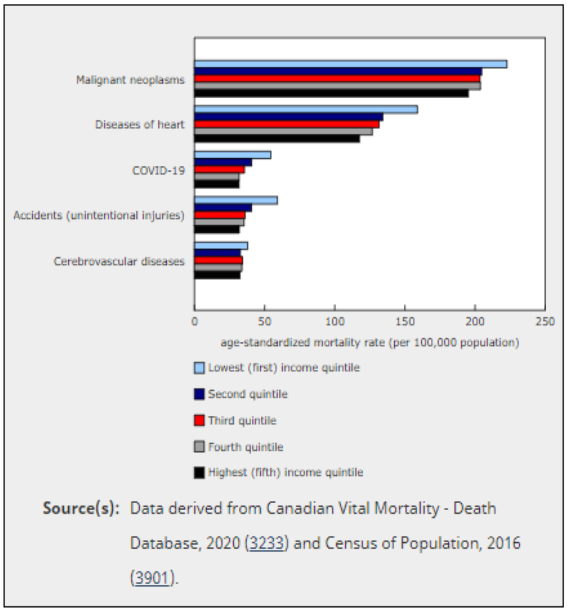
Resident population of Canada in 2022, by gender and age group

Appendix XI

Age-standardized mortality rate by neighbourhood income quintile

Chart 1
Age-standardized mortality rate for selected causes of death by neighbourhood income quintile (Canada excluding territories), 2020

Back to main article | Interactive | Image | CSV (1 KB)



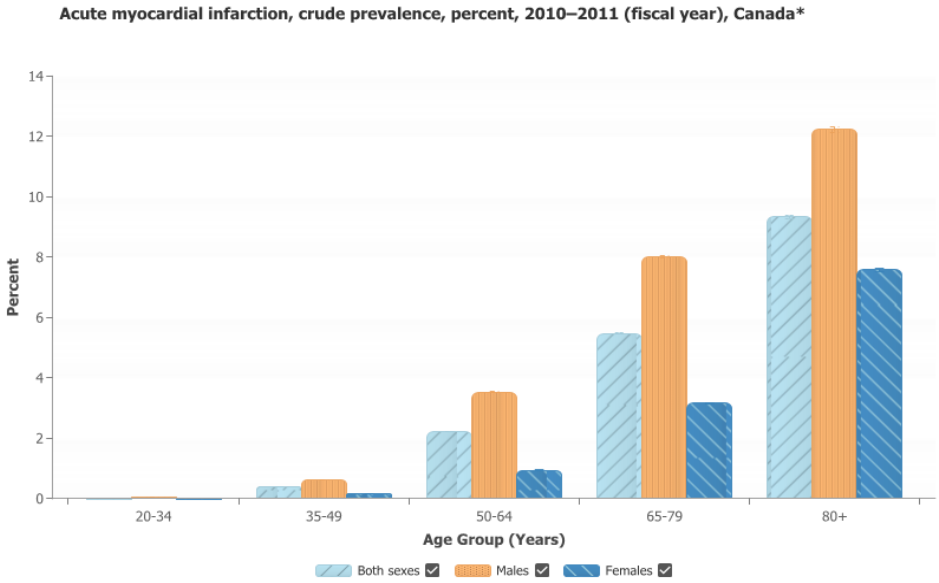
Source(s): Data derived from Canadian Vital Mortality - Death Database, 2020 (3233) and Census of Population, 2016 (3901).

Age-standardized mortality rate for selected causes of death by neighbourhood income quintile (Canada excluding territories), 2020, age-standardized mortality rate (per 100,000 population)

	Lowest (first) income quintile	Second quintile	Third quintile	Fourth quintile	Highest (fifth) income quintile
Malignant neoplasms	222.7	204.7	203.5	203.8	195.2
Diseases of heart	158.9	134.2	131.6	126.7	117.5
COVID-19	54.4	40.7	35.6	31.8	31.7
Accidents (unintentional injuries)	59.1	40.6	36.1	35.3	31.9
Cerebrovascular diseases	37.9	32.7	34.2	33.8	32.4

Appendix XII

Selected visual display for CVD trend



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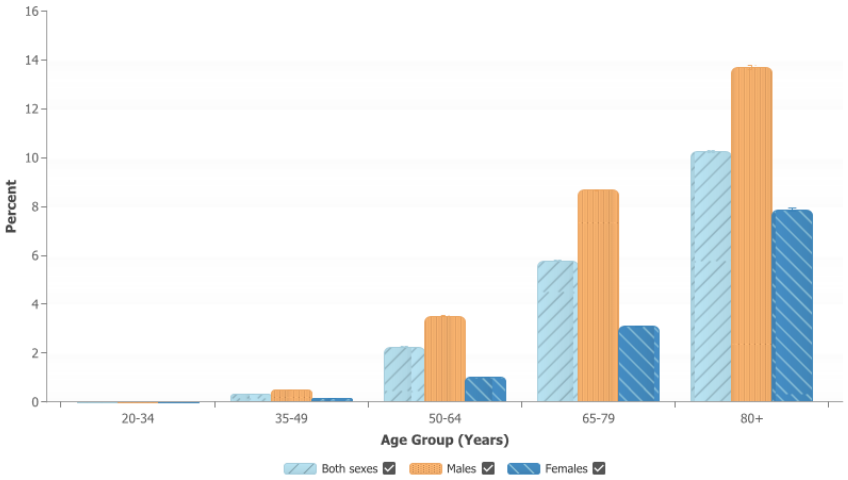
email: infobase@phac-aspc.gc.ca

Canadian Chronic Disease Surveillance System data files provided by provinces and territories, as of August 2022. For more information on data interpretation see notes below.

*Nunavut data are excluded before 2005–2006.
*Nunavut data were not submitted for 2019–2020.
*Newfoundland and Labrador data are excluded before 2008–2009.
*Yukon data are excluded before 2010–2011.
*Northwest Territories data were not available.

Acute myocardial infarction, crude prevalence, percent, 2019–2020 (fiscal year), Canada*



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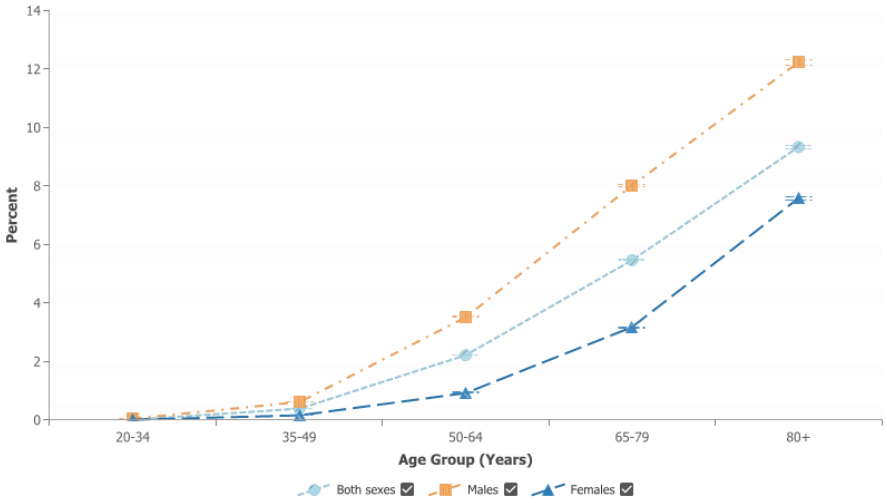

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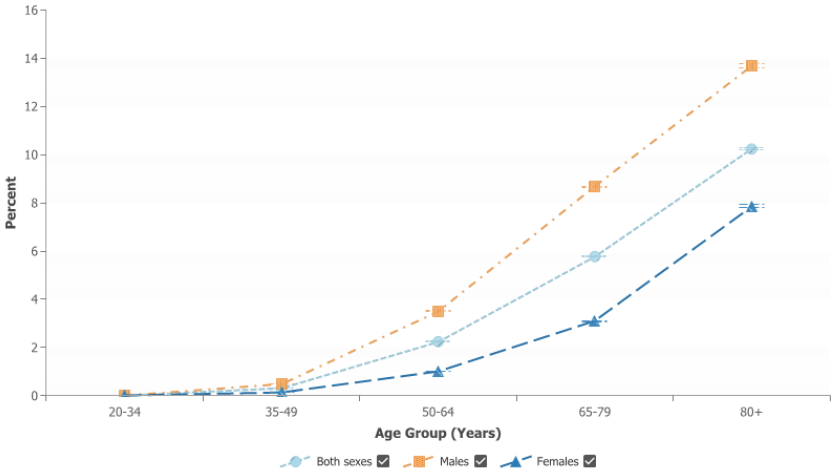

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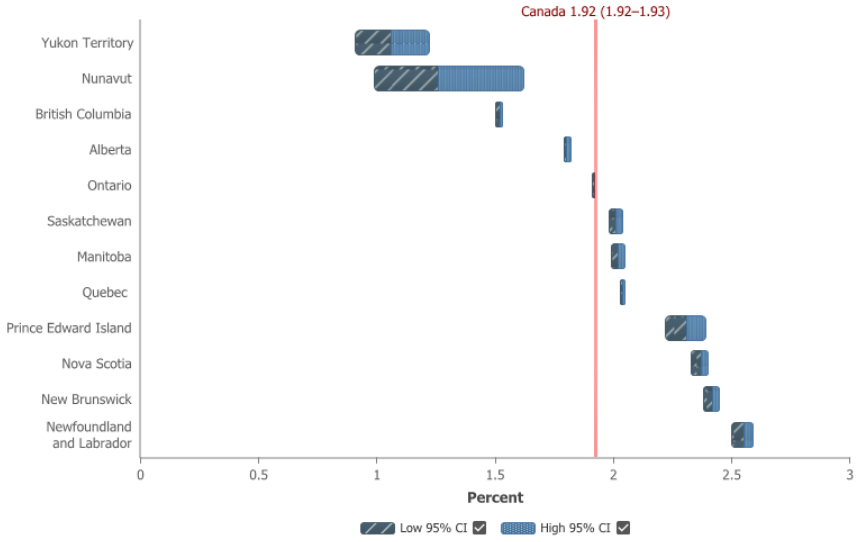
Acute myocardial infarction, age-standardized prevalence, percent, both sexes, age 20 years and older, 2010–2011 (fiscal year)*



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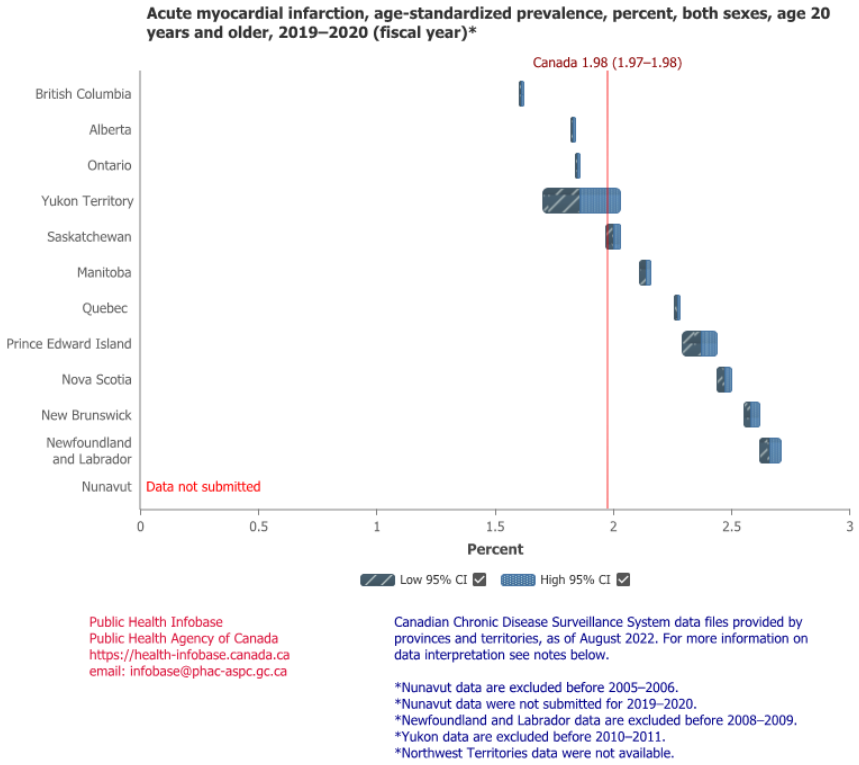
Acute myocardial infarction, age-standardized prevalence, percent, both sexes, age 20 years and older, 2019–2020 (fiscal year)*
Canada 1.98 (1.97–1.98)
British Columbia
Alberta
Ontario
Yukon Territory
Saskatchewan
Manitoba
Quebec
Prince Edward Island
Nova Scotia
New Brunswick
Newfoundland and Labrador
Nunavut
Data not submitted
0
0.5
1
1.5
2
2.5
3
Percent
Low 95% CI
High 95% CI
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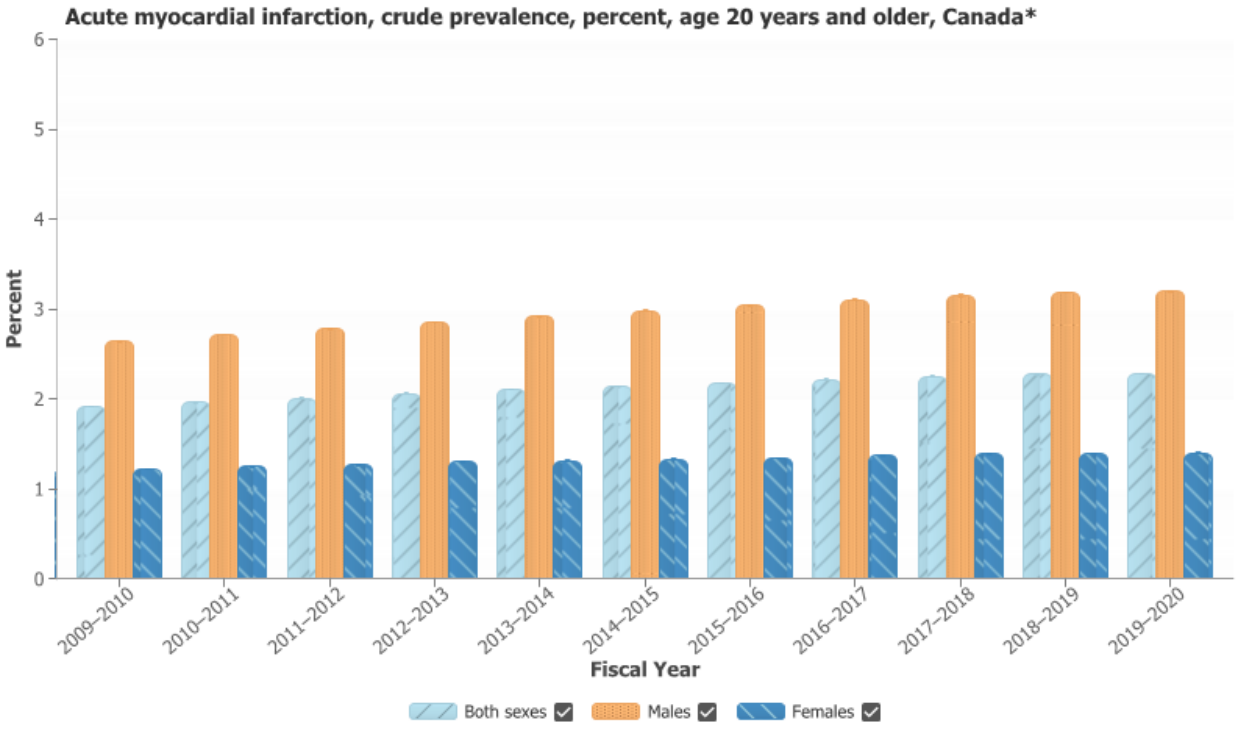

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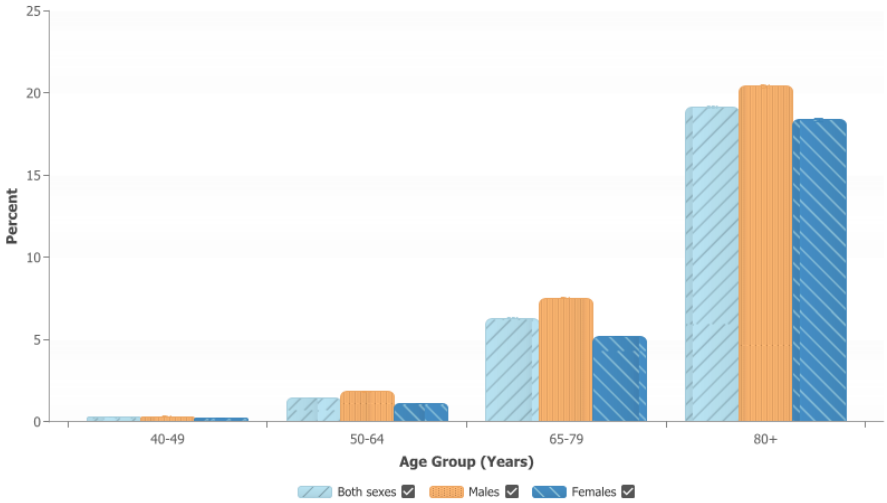
Heart failure, crude prevalence, percent, 2010–2011 (fiscal year), Canada*



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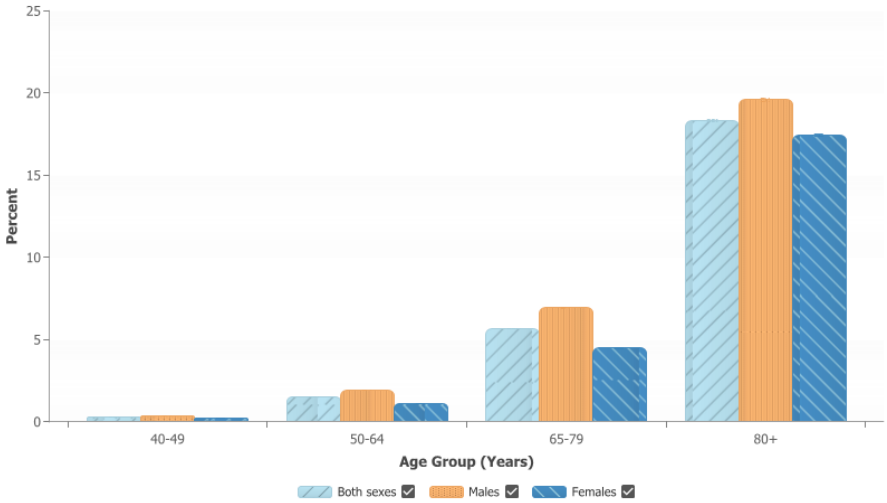

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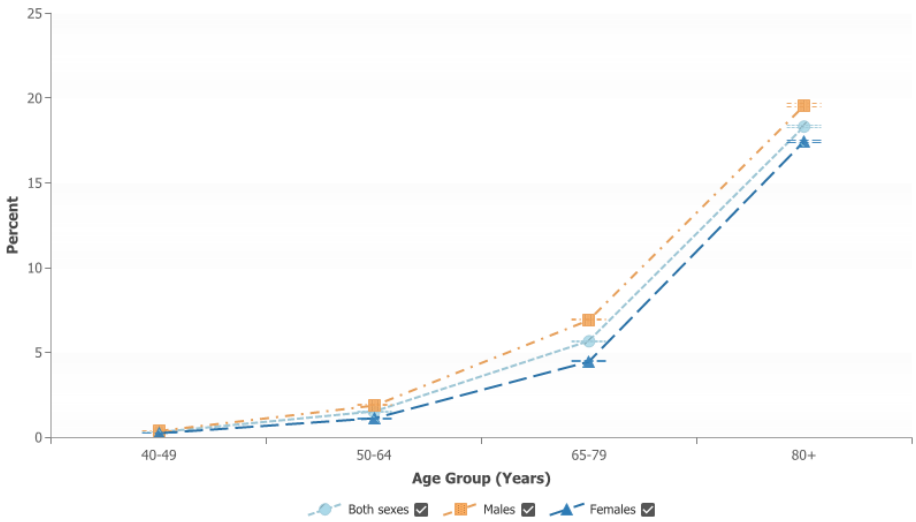

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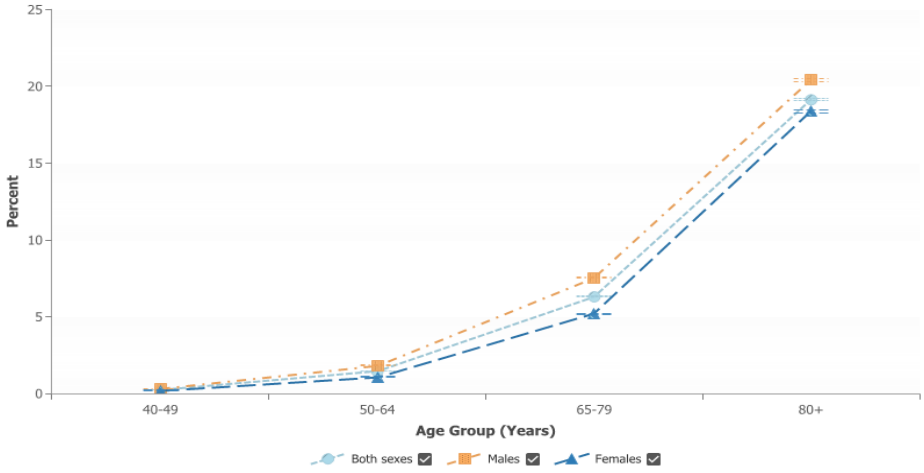

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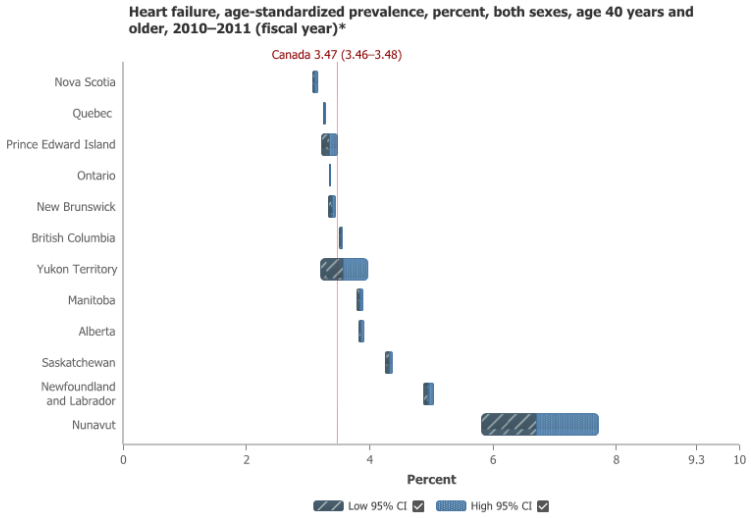
Heart failure, age-standardized prevalence, percent, both sexes, age 40 years and older, 2010–2011 (fiscal year)*
Canada 3.47 (3.46–3.48)
Nova Scotia
Quebec
Prince Edward Island
Ontario
New Brunswick
British Columbia
Yukon Territory
Manitoba
Alberta
Saskatchewan
Newfoundland and Labrador
Nunavut
0
2
4
6
8
9.3
10
Percent
Low 95% CI
High 95% CI
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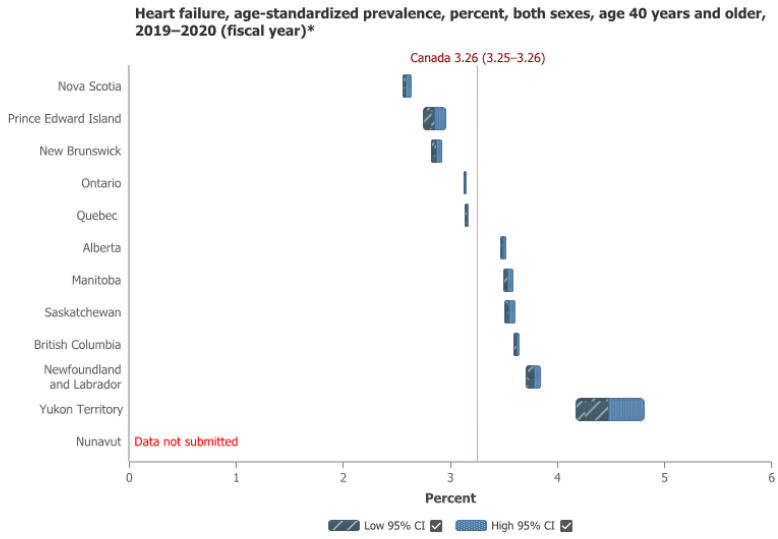
Heart failure, age-standardized prevalence, percent, both sexes, age 40 years and older, 2019–2020 (fiscal year)*
Canada 3.26 (3.25–3.26)
Nova Scotia
Prince Edward Island
New Brunswick
Ontario
Quebec
Alberta
Manitoba
Saskatchewan
British Columbia
Newfoundland and Labrador
Yukon Territory
Nunavut
Data not submitted
0
1
2
3
4
5
6
Percent
Low 95% CI
High 95% CI
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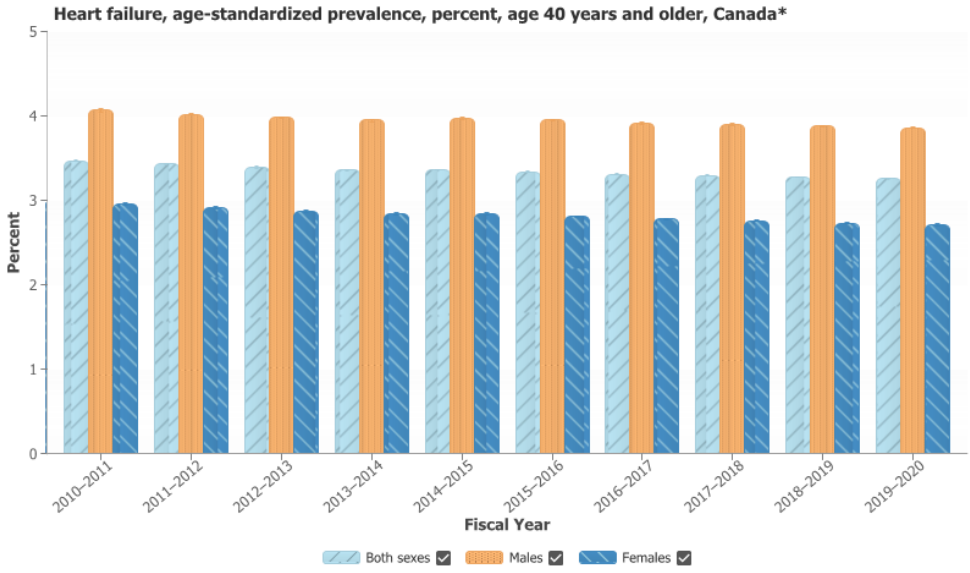

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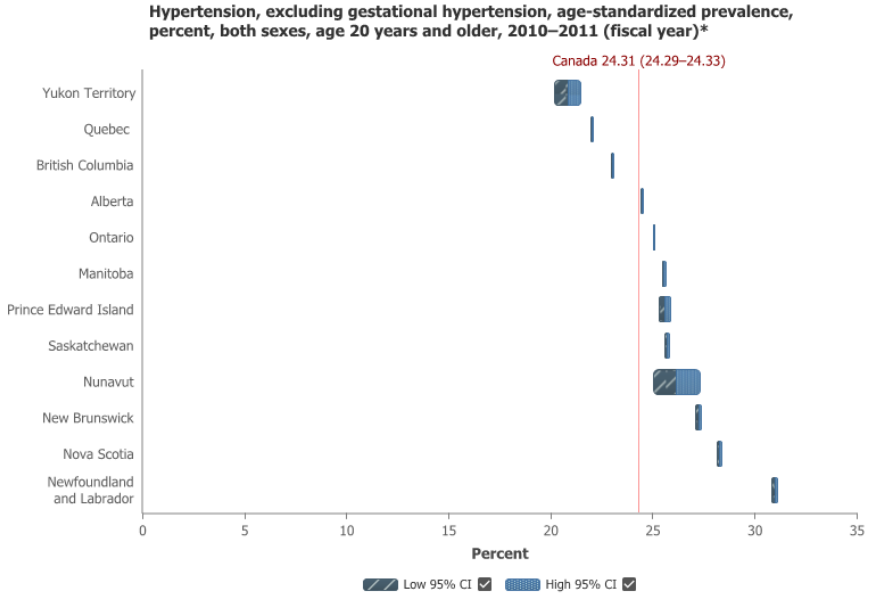

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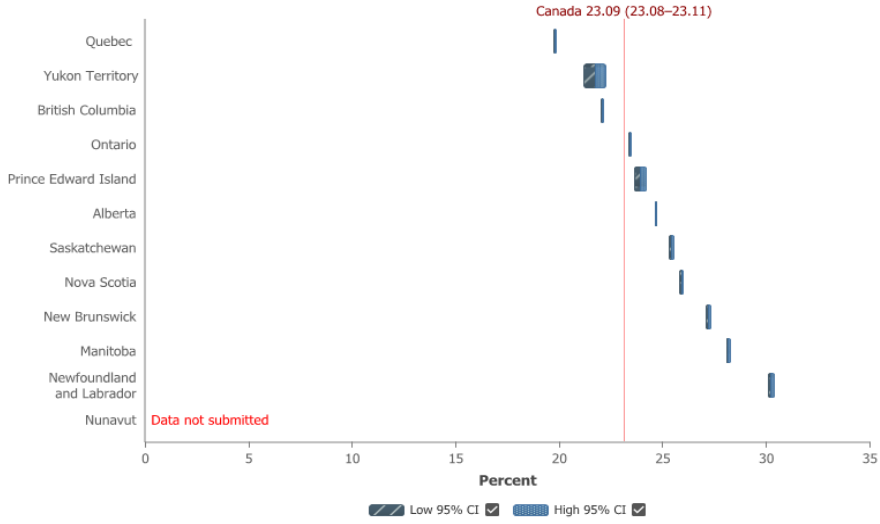

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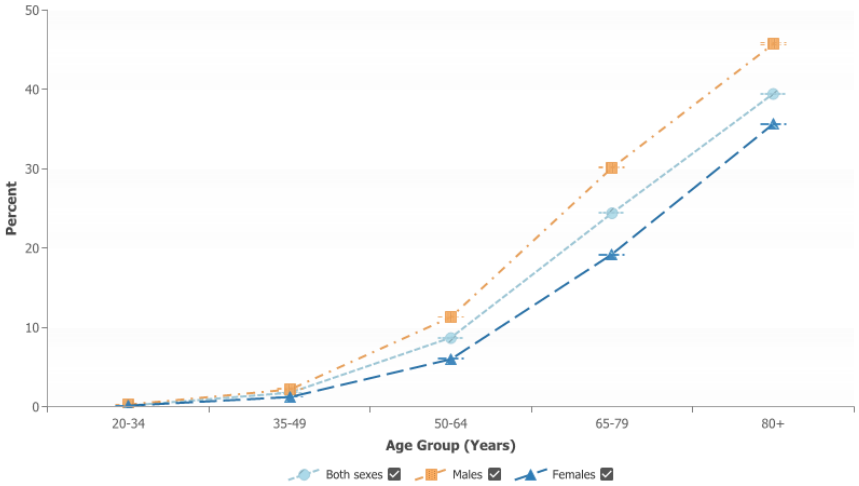
Ischemic heart disease, crude prevalence, percent, 2010–2011 (fiscal year), Canada*



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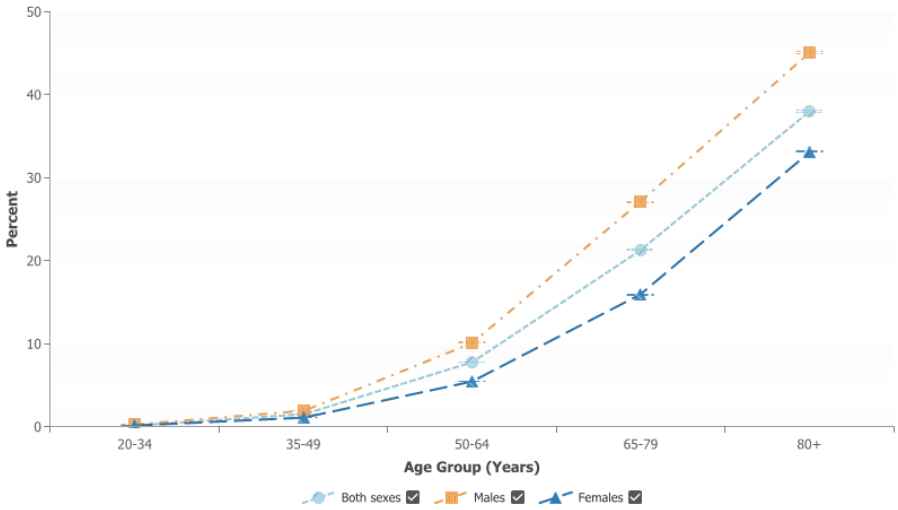

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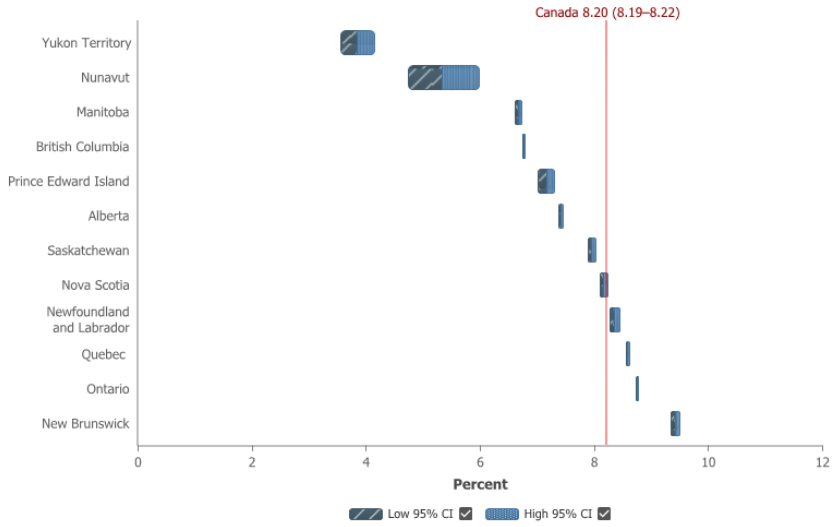

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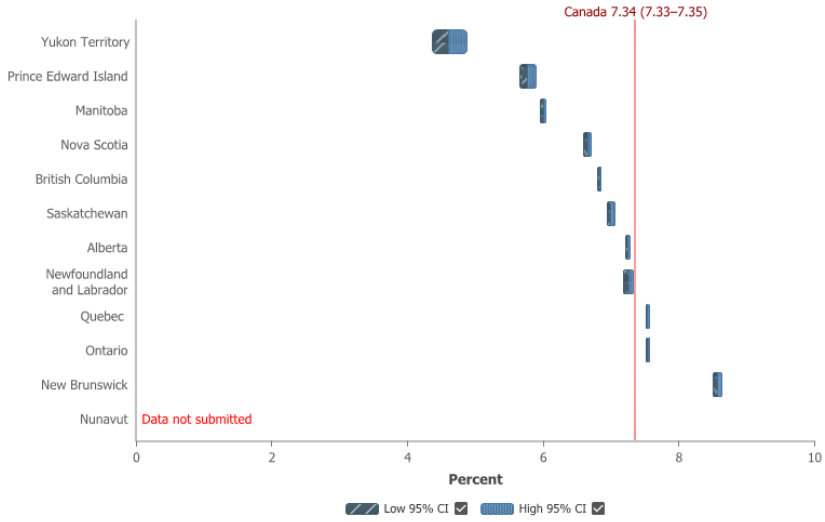

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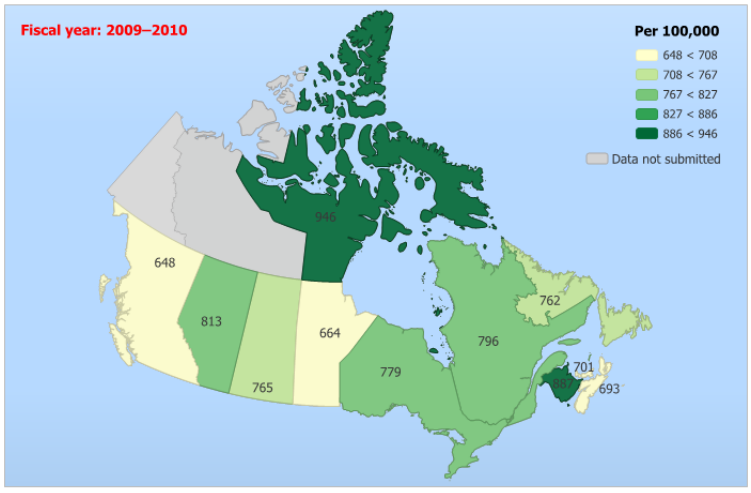
Ischemic heart disease, age-standardized incidence rate, per 100,000, both sexes, age 20 years and older, 2009–2010 (fiscal year)*



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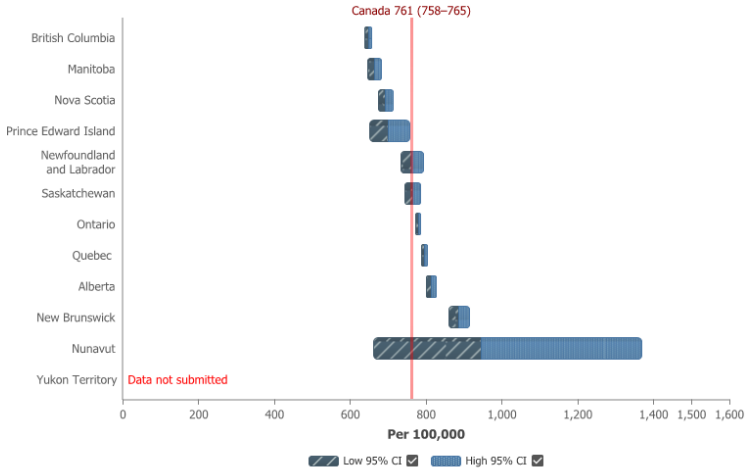

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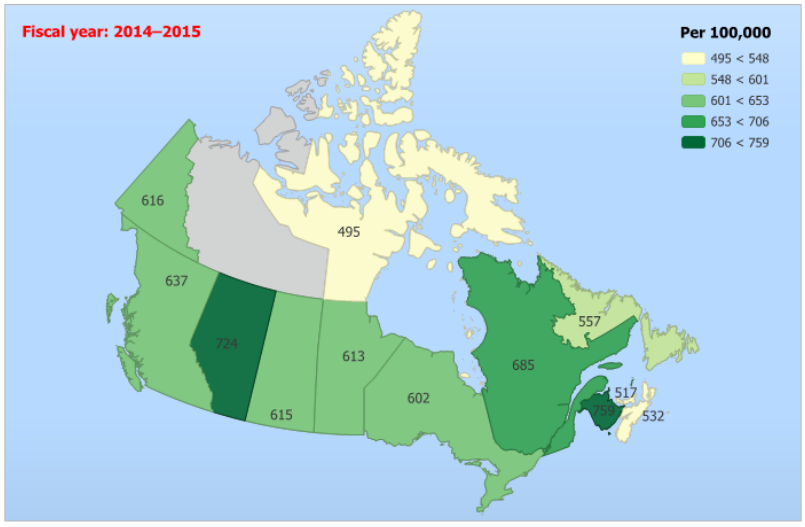

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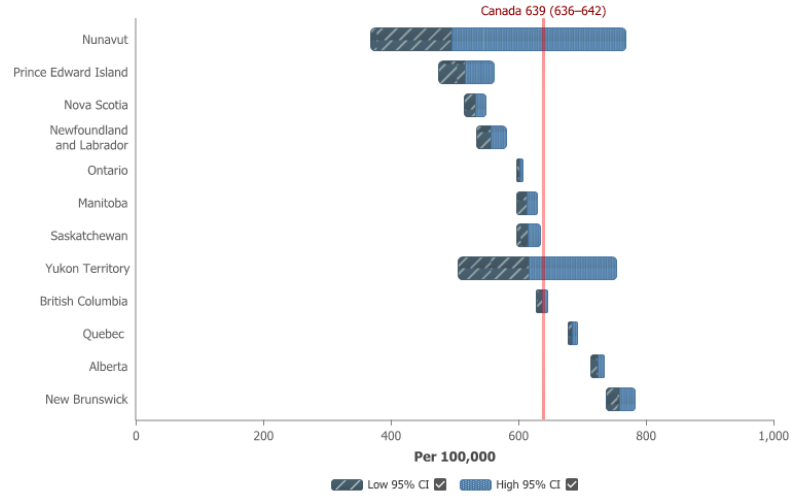

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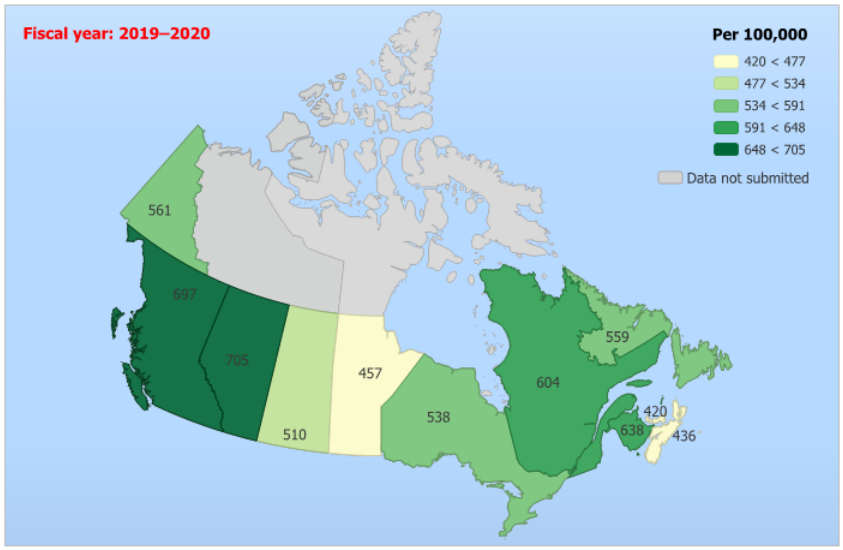

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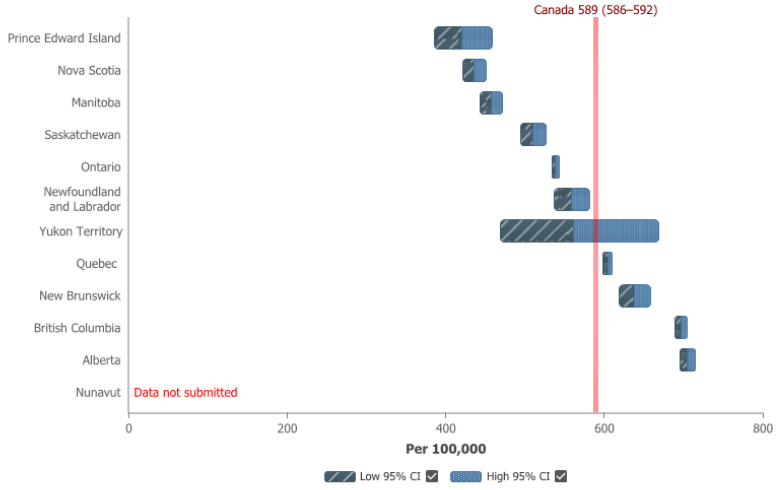

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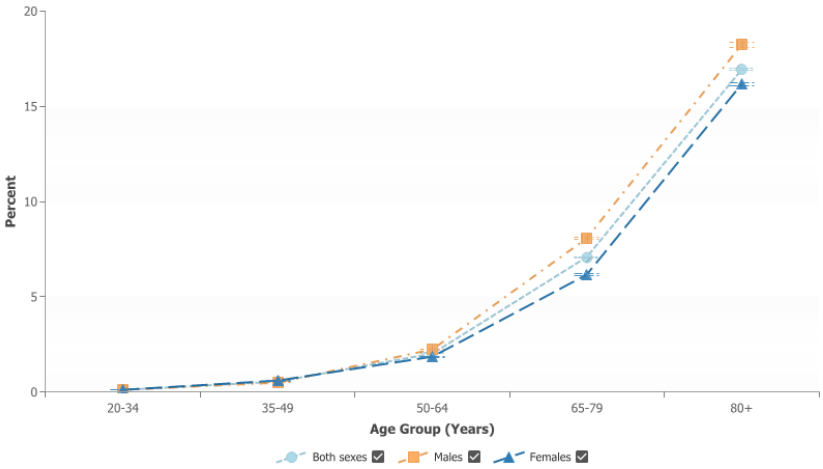

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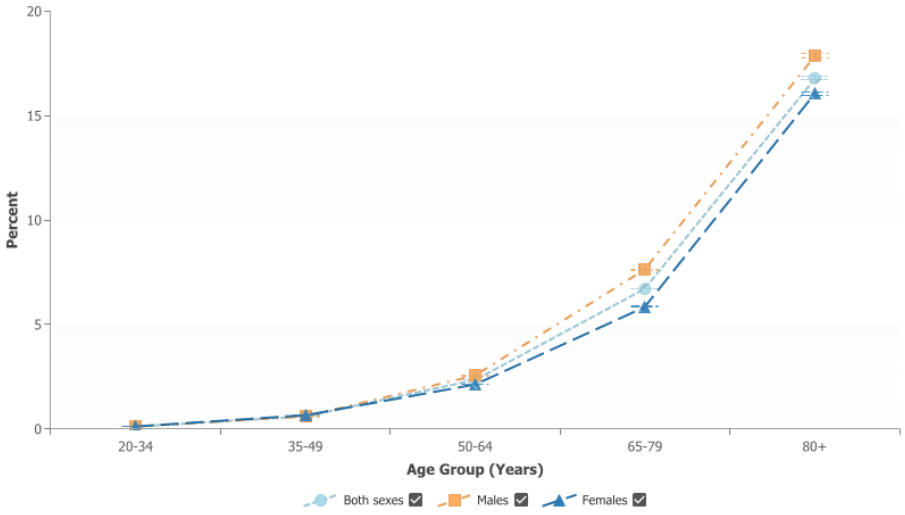

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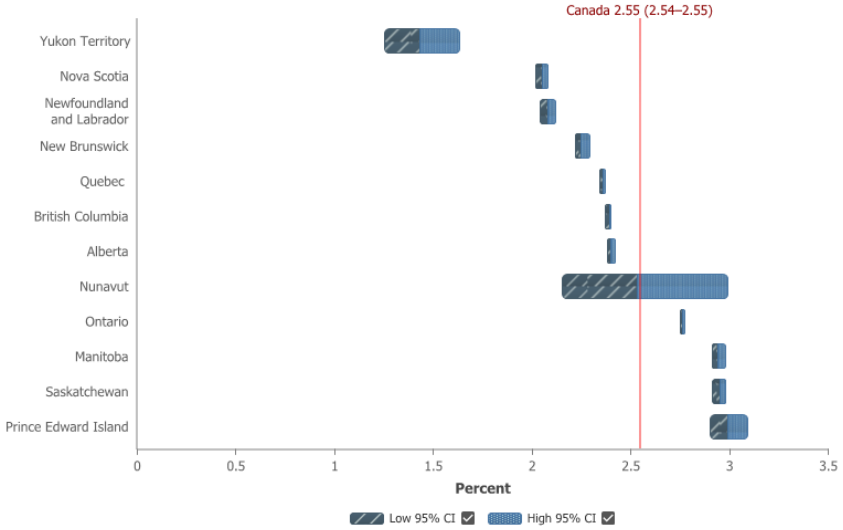

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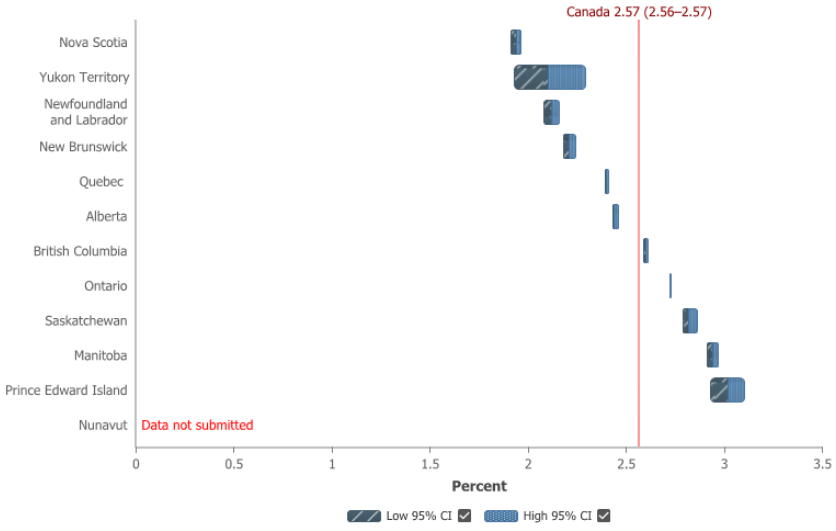
*Northwest Territories data were not available.

Stroke, age-standardized prevalence, percent, both sexes, age 20 years and older, 2019–2020 (fiscal year)*



Public Health Infobase
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Canadian Chronic Disease Surveillance System data files provided by provinces and territories, as of August 2022. For more information on data interpretation see notes below.

*Nunavut data are excluded before 2005–2006.
*Nunavut data were not submitted for 2019–2020.
*Newfoundland and Labrador data are excluded before 2008–2009.
*Yukon data are excluded before 2010–2011.
*Northwest Territories data were not available.

Appendix XIII

Age-standardized mortality rate per 100,000 population, heart disease and stroke, 2010-2020

Geography, places of residence	Age-standardized mortality rate per 100,000 population, heart disease (CVD), 2010-2020, Canada										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canada	143.0	135.6	136.4	134.8	133.3	130.5	126.0	128.6	126.5	120.7	118.3
Newfoundland and Labrador	190.7	180.5	178.0	182.8	178.1	197.5	174.9	163.3	169.4	153.8	158.1
Prince Edward Island	179.2	177.2	156.7	167.6	191.9	164.0	144.3	153.3	159.2	145.5	128.2
Nova Scotia	154.9	147.3	144.8	156.0	145.3	146.1	138.0	147.0	144.1	140.3	136.9
New Brunswick	154.4	150.3	148.2	148.2	146.5	141.3	141.0	148.9	142.5	127.0	114.9
Québec	136.1	124.8	126.0	120.2	119.8	119.9	111.3	117.6	120.2	112.4	107.3
Ontario	138.4	131.7	131.5	130.7	129.9	124.7	122.2	123.5	122.1	117.6	118.2
Manitoba	160.7	159.1	162.1	158.3	163.0	158.5	154.6	159.7	133.3	143.6	137.1
Saskatchewan	172.0	162.8	167.0	164.4	161.4	162.8	152.9	150.7	155.3	137.0	137.9
Alberta	167.5	163.5	165.6	166.2	160.7	154.3	153.6	149.4	147.7	145.1	138.8
British Columbia	16.3	15.1	14.6	15.3	14.7	16.1	14.4	15.9	14.9	12.4	10.3
Yukon	205.0	187.0	153.3	144.4	118.2	108.4	74.1	..	..	..	.
Northwest Territories	183.4	171.0	160.9	182.0	136.9	168.8	143.4	258.2	184.2	118.4	173.4
Nunavut	171.5	122.7	177.9	214.8	142.6	150.2	259.5	217.0	220.5	246.6	134.9

Source: Statistics Canada, 2022

Geography, places of residence	Age-standardized mortality rate per 100,000 population, Stroke (CVA), 2010-2020, Canada										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canada	40.1	37.6	36.9	36.1	35.4	34.9	33.1	33.4	31.6	30.9	30.2
Newfoundland and Labrador	59.0	52.0	49.0	54.6	51.9	55.0	46.7	41.5	44.8	43.5	42.7
Prince Edward Island	45.9	51.5	40.3	38.7	42.4	39.5	32.8	43.5	40.4	48.3	39.9
Nova Scotia	45.0	44.6	45.3	41.8	42.4	43.7	41.2	39.8	44.0	40.5	40.6
New Brunswick	39.5	39.6	43.3	40.0	40.2	42.3	33.5	38.2	35.2	35.1	33.6
Québec	33.7	31.4	30.3	31.8	31.2	31.1	28.6	30.0	28.2	27.4	25.3
Ontario	40.7	36.6	35.9	34.5	34.5	32.9	32.3	31.3	30.1	29.5	29.8
Manitoba	48.7	43.8	45.8	44.6	46.9	42.5	42.3	44.3	35.7	40.4	33.1
Saskatchewan	39.4	44.6	41.5	39.3	37.4	37.0	35.6	36.4	30.3	28.1	30.7
Alberta	38.7	38.8	37.8	36.2	34.9	36.3	33.1	31.8	30.1	30.6	29.9
British Columbia	30.3	30.7	28.6	30.4	29.7	32.0	31.5	31.2	29.0	28.5	25.0

Source: Statistics Canada, 2022

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Yukon	65.2	79.6	41.8	34.0	29.4	20.3	48.5	..	..	..	.
Northwest Territories	27.2	75.0	71.0	34.9	45.3	41.9	86.1	51.9	36.8	29.8	48.7
Nunavut	29.9	85.8	35.0	35.2	16.3	75.7	19.5	74.4	46.5	54.6	15.

Geography, places of residence	Age-standardized mortality rate per 100,000 population, heart disease (CVD), both sexes, males and females, 2010 and 2020, Canada					
	2010			2020		
	Both Sexes	Males	Females	Both sexes	Males	Females
Canada	143.0	186.1	109.2	118.3	153.5	88.9
Newfoundland and Labrador	190.7	243.6	146.3	158.1	200.9	122.5
Prince Edward Island	179.2	268.1	115.4	128.2	168.9	92.1
Nova Scotia	154.9	215.0	111.1	136.9	186.8	97.4
New Brunswick	154.4	205.5	116.0	114.9	149.8	88.0
Québec	136.1	172.6	107.6	107.3	135.5	83.0
Ontario	138.4	181.3	105.2	118.2	154.1	88.3
Manitoba	160.7	215.2	117.5	137.1	183.5	99.3
Saskatchewan	172.0	227.7	127.0	137.9	185.2	99.2
Alberta	167.5	216.2	127.2	138.8	177.1	106.6
British Columbia	130.8	168.0	100.4	108.9	142.5	80.4
Yukon	205.0	250.5	161.3			
Northwest Territories	183.4	181.2	184.0	173.4	266.7	64.8
Nunavut	171.5	210.3	103.5	134.9	237.2	24.0

Geography, places of residence	Age-standardized mortality rate per 100,000 population, stroke (CVA), both sexes, males and females, 2010 and 2020, Canada					
	2010			2020		
	Both Sexes	Males	Females	Both sexes	Males	Females
Canada	40.1	42.2	37.9	30.2	32.1	28.3
Newfoundland and Labrador	59.0	66.2	51.3	42.7	47.1	39.5
Prince Edward Island	45.9	44.6	46.6	39.9	41.9	38.0
Nova Scotia	45.0	45.9	43.0	40.6	43.4	39.2
New Brunswick	39.5	35.6	41.4	33.6	36.9	30.9

Québec	33.7	35.3	32.1	25.3	25.5	24.6
Ontario	40.7	43.6	38.0	29.8	32.7	27.4
Manitoba	48.7	51.1	45.6	33.1	36.0	30.0
Saskatchewan	39.4	39.3	38.3	30.7	35.6	26.7
Alberta	38.7	40.2	36.2	29.9	30.5	29.0
British Columbia	44.8	46.6	42.8	34.5	36.0	32.9
Yukon	65.2	67.7	58.1			
Northwest Territories	27.2	37.8	16.2	48.7	71.9	21.1
Nunavut	29.9	24.3	36.4	15.9	6.5	25.7

Source: Statistics Canada, 2022

	Deaths and age-specific mortality rates, by selected grouped causes, 2010 to 2020, Canada										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total # of deaths	240,075	243,511	246,596	252,338	258,821	264,333	267,213	278,298	285,675	285,270	307,205
Total # deaths Male	120,638	122,251	124,235	126,973	130,761	133,441	135,772	142,135	145,758	146,324	159,076
Total # deaths Females	119,437	121,260	122,361	125,365	128,060	130,892	131,441	136,163	139,917	138,946	148,129
ASMR of all deaths	706.0	693.3	693.7	686.2	682.6	677.0	664.4	679.6	678.2	657.1	690.4
Total major CVD related deaths	67,383	66,179	66,598	68,064	69,260	70,036	69,576	72,203	72,483	71,954	72,677
CVD-related deaths -Male	33,590	33,146	33,602	34,257	34,957	35,284	35,424	37,305	37,495	37,241	38,005
CVD-related deaths -Female	33,793	33,033	32,996	33,807	34,303	34,752	34,152	34,898	34,988	34,713	34,672
Age-standardized mortality rate (ASMR) of CVD-related deaths	197.5	191.9	191.6	193.6	194.9	195.5	191.9	197.8	195.8	191.6	191.3
ASMR CVD-related - Male	198.4	193.8	195.1	196.5	198.4	198.6	197.0	205.9	203.9	199.6	201.3
ASMR CVD-related - Female	196.5	190.1	188.3	190.8	191.5	192.4	186.8	189.8	187.7	183.7	181.4

****Results summary for defence**

As of 2020, an improvement in the ASPR of two (2) CVD risk factors, namely tobacco smoking, 17.5% (-17.8% change) and physical activities, 56.7% (+9.0% change) at 95% CI, between 2010-2014 and 2015-2019 fiscal years is noticeable. Unlike the improved tobacco smoking and physical activities ASPR, an upward trajectory in three (3) risk factors, namely alcohol 20.2% (+6.3% change), diabetes 7.7% (+10,0% change), and diet (fruit/vegetables), 30.8% (-24.7% change) at 95% CI between 2010-2014 and 2015-2019 is noticeable in this study. As of the year 2020, hypertension/high blood pressure (HBP) has the highest prevalence of 23.09% with a count of 7,975,240 persons living with hypertension followed by ischemic heart disease (IHD) with 7.34% (2,633,165 persons), heart failure (HF) with 3.36% (787,605 persons), stroke/cerebrovascular accident (CVA) with 2.57% (927,475 persons) and acute myocardial infarction (AMI) with ASPR prevalence 1.98% (712,730 persons) respectively in Canada.

Between the 2010-2011 and 2019-2020 fiscal years, evidence of improvement in the ASPR prevalence of IHD (-10.12% change), followed by heart failure (-6.05% change) and hypertension (-5.02% change) at 95% CI were noticeable respectively. Unlike the promising IHD, HF, and HBP epidemiologic outlook, the ASPR prevalence rate of acute myocardial infarction increased with a +3.13% change, followed by stroke with a +0.78% change between 2010-2011 and 2019-2020 fiscal years, respectively (PHAC, 2023). While there is no shift in the prevalence rate order of hypertension, ischemic heart disease, heart failure, and stroke between the 2010-2011 and 2019-2020 fiscal years, IHD (-10.12% change at 95% CI) takes the lead as the most improved CVD followed by heart failure (-6.05% change) and hypertension (-5.02% change) comparatively. There is no improvement in the rate of AMI and CVA as of 2020.

A decline in CVD related mortality in Canada between 2010 (28.07%) and 2020 (23.66%) - In 2010, about 2 in every 7 deaths, while the rate declined to about 1 in 4 in 2020. The same trajectory is evident in the ASMR attributable to CVD, which declined from 197.5 deaths per 100,000 populations in 2010 to 191.3 deaths per 100,000 populations in 2020. Although the age-standardized mortality rate of CVD has dropped comparatively, more than one-fifth (1/5) of deaths are attributable to CVD (17.5% for other CVDs and 4.5% for stroke/CVA at 95% CI) in Canada in the year 2020.