



Review

Canadian Women's Heart Health Alliance

The Canadian Women's Heart Health Alliance ATLAS on the Epidemiology, Diagnosis, and Management of Cardiovascular Disease in Women—Chapter 2: Scope of the Problem

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ABSTRACT

Background: This Atlas chapter summarizes the epidemiology of cardiovascular disease (CVD) in women in Canada, discusses sex and gender disparities, and examines the intersectionality between sex and other factors that play a prominent role in CVD outcomes in women, including gender, indigenous identity, ethnic variation, disability, and socioeconomic status.

Cardiovascular disease (CVD) is the leading cause of premature death in women in Canada.¹ Beyond sex-unique CVD risk factors in women, several traditional risk factors have a greater morbidity and mortality impact in women compared to men. Rates of CVD vary substantially among provinces and within regions of Canada. This Atlas chapter aims to do the following: summarize the epidemiology of cardiovascular disease in women in Canada; discuss sex and gender

RÉSUMÉ

Contexte : Ce chapitre de l'Atlas condense l'épidémiologie des maladies cardiovasculaires (MCV) chez les femmes au Canada, aborde les disparités entre les sexes et les genres, et examine l'interrelation entre le sexe et d'autres facteurs qui jouent un rôle important dans l'émergence des MCV chez les femmes, notamment le genre, l'identité

disparities; and examine the intersectionality between sex and other disparities that play a prominent role in CVD outcomes in women, including indigenous identity, ethnic variation, disability, and socioeconomic status (SES). **Figure 1** summarizes the key concepts presented in this chapter.

Demographics

Cardiovascular wellness indicators/traditional risk factors

Most Canadian women have at least one risk factor for CVD.² Although the burden of CVD has been improving over time, outcomes for women, particularly those aged < 55 years, have stagnated.³ Women are more likely than men to die in the year following an acute myocardial infarction (MI) and to experience death, heart failure, or stroke within 5 years after acute MI.^{4,5}

Received for publication September 11, 2020. Accepted October 12, 2020.

Ethics Statement: This is a comprehensive review of the evidence of the epidemiology and management of women's cardiovascular health in Canada. No ethics review was required.

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See page 8 for disclosure information.

Methods: CVD is the leading cause of premature death in Canadian women. Coronary artery disease, including myocardial infarction, and followed by stroke, accounts for the majority of CVD-related deaths in Canadian women. The majority of emergency department visits and hospitalizations by women are due to coronary artery disease, heart failure, and stroke. The effect of traditional cardiovascular risk factors and their association with increasing cardiovascular morbidity is unique in this group.

Results: Indigenous women in Canada experience increased CVD, linked to colonization and subsequent social, economic, and political challenges. Women from particular racial and ethnic backgrounds (ie, South Asian, Afro-Caribbean, Hispanic, and Chinese North American women) have greater CVD risk factors, and CVD risk in East Asian women increases with duration of stay in Canada.

Conclusions: Canadians living in northern, rural, remote, and on-reserve residences experience greater CVD morbidity, mortality, and risk factors. An increase in CVD risk among Canadian women has been linked with a background of lower socioeconomic status, and women with disabilities have an increased risk of adverse cardiac events.

autochtone, les variations ethniques, le handicap et le statut socio-économique.

Méthodes : Les MCV sont la principale cause de décès prématuré chez les femmes canadiennes. Les maladies coronariennes, y compris l'infarctus du myocarde, suivies des accidents vasculaires cérébraux, sont à l'origine de la majorité des décès liés aux MCV chez les femmes canadiennes. La majorité des visites aux urgences et des hospitalisations des femmes sont dues à des maladies coronariennes, des insuffisances cardiaques et des accidents vasculaires cérébraux. L'effet des facteurs de risque cardiovasculaire traditionnels et leur association avec l'augmentation de la morbidité cardiovasculaire est unique dans ce groupe.

Résultats : Les femmes autochtones du Canada connaissent un accroissement des maladies cardiovasculaires, liée à la colonisation et aux défis sociaux, économiques et politiques qui en découlent. Les femmes d'origines raciales et ethniques spécifiques (par exemple les femmes sud-asiatiques, afro-caribéennes, hispaniques et chinoises d'Amérique du Nord) présentent des facteurs de risque de MCV plus importants, et le risque de MCV chez les femmes d'Asie de l'Est augmente avec la durée de leur séjour au Canada.

Conclusions : Les canadiens qui vivent dans les régions nordiques, rurales, éloignées et dans les réserves présentent une morbidité, une mortalité et des facteurs de risque de MCV plus élevés. L'augmentation du risque de MCV chez les femmes canadiennes a été associée à un statut socio-économique plus bas, et les femmes handicapées ont un risque accru de survenue d'événements cardiaques indésirables.

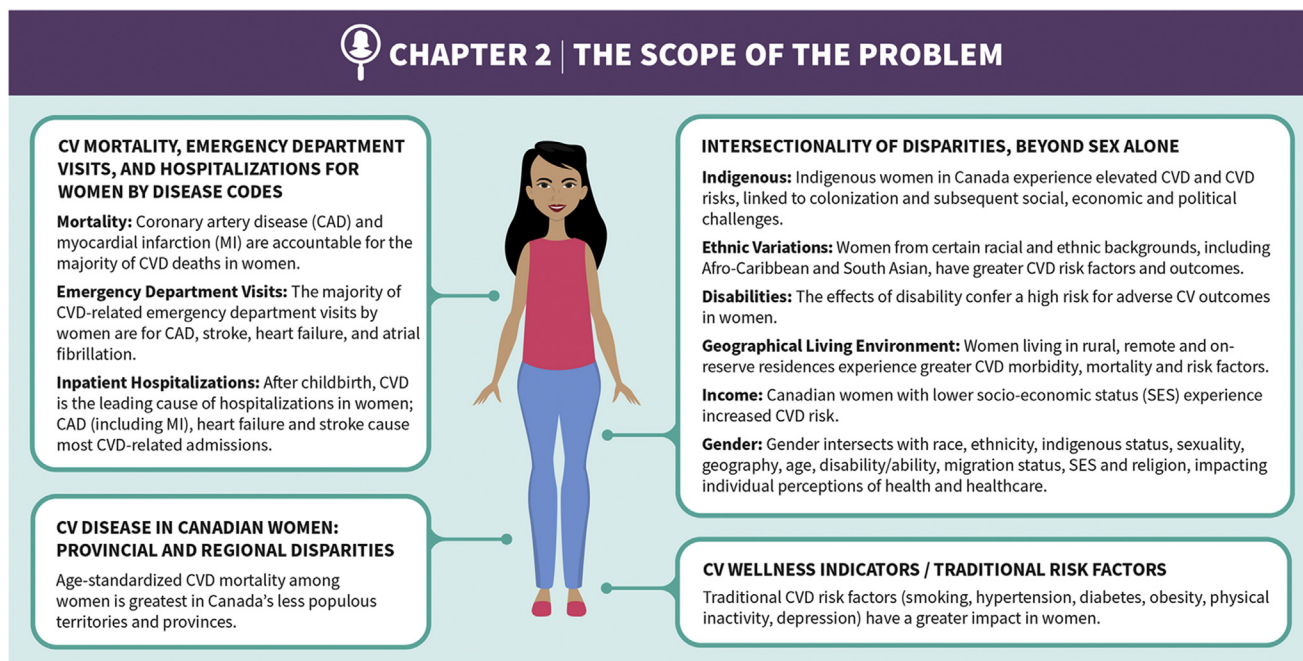
Women who experience a stroke are at higher risk of mortality, have poorer outcomes, and are less likely to return home, while also being less likely to participate in rehabilitation than men.⁶ Women who do complete rehabilitation, however, experience greater reduction in mortality and greater relative benefit compared to men.⁷

A recent publication from the **Prospective Urban Rural Epidemiological (PURE)** study examining differences in risk factors, treatments, CVD incidence, and mortality between women and men from 27 high-, middle-, and low-income countries, found that the CVD risk factor burden was lower in women, compared to men, across all economic levels and geographic regions.⁸ However, several previous studies have found that traditional CVD risk factors, including type 2 diabetes mellitus, hypertension, smoking, and dyslipidemia, pose a greater risk for complications in women.⁹ We are also beginning to understand that each of the CVD risk factors may be further exacerbated by gender factors. Diabetes in women is associated with significantly increased cardiovascular risk, MI, and stroke mortality, with a loss of the protective effect of sex hormones in younger premenopausal women lose the protective effect of sex hormone.¹⁰⁻¹² Obesity and psychosocial stress appear to have greater effect in the development of diabetes in women compared to men,¹² and women diagnosed with metabolic syndrome are at an intermediate risk of CVD mortality.^{13,14} The prevalence of obesity continues to rise in women in Canada and worldwide. The metabolic effects of obesity and physical inactivity are associated with increased CVD risk, with the latter being particularly prevalent in women aged > 70 years.^{13,15,16} The prevalence and incidence of hypertension in Canada is higher in women over the age of 60 years, compared to men.¹⁷ Hypertension in older Canadian women and those with

diabetes is not well controlled, and women treated with antihypertensive medications report higher systolic blood pressures than do men.¹⁸ Smoking is less prevalent in women than in men; however, the progressive decline of tobacco use over time has occurred less markedly in women.¹⁹ Tobacco use, the single most important modifiable risk factor for developing MI, has a 7-fold increased risk for CVD in women aged < 55 years.⁵ Current smoking and diabetes mellitus, in particular, increase the risk of obstructive coronary artery disease (CAD) in women to a greater extent than they do in men; obstructive CAD, specifically, yields a higher 30-day mortality risk for women.²⁰ Elevated levels of triglycerides and low levels of high-density lipoprotein (HDL) cholesterol are strong predictors of CVD death in women, with HDL level being a greater predictor of CVD mortality in women, compared to men, particularly in those aged > 65 years.²¹ Elevated low-density lipoprotein (LDL) cholesterol is a strong predictor of CVD risk in women aged < 65 years, but less predictive in women aged > 65 years.²² LDL particle size is important; young women with high levels of small atherogenic LDL particles appear to have a significantly greater risk for early MI.²¹ The incidence of depression is twice as high in women as it is in men.^{23,24} Depression increases a woman's risk for a cardiac event by between 50% and 70%,^{25,26} and it is directly associated with fatal cardiac events in postmenopausal women.²⁷ Women are almost twice as likely as men to experience depression after a cardiac diagnosis, and the risk of cardiac morbidity and both cardiac and all-cause mortality are increased by 2-3-fold for those with post-MI depression.²⁸⁻³⁰ Women are also twice as likely as men to be diagnosed with an anxiety-related psychiatric disorder, and the prevalence of anxiety is higher among women with congenital heart disease, compared to men.^{31,32}

CANADIAN WOMEN'S HEART HEALTH ALLIANCE ATLAS

Epidemiology, Diagnosis, and Management of Cardiovascular Diseases (CVD) in Women



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Figure 1. Summary of current state of cardiovascular disease mortality, healthcare utilization, risk factors, and other important health determinants for women in Canada.

Anxiety increases the risk of congenital heart disease by > 25% and of cardiac death by nearly 50%.³³

In summary, most Canadian women have at least one risk factor for CVD. Women experience poorer outcomes compared to men following a cardiovascular event. Traditional CVD risk factors, including smoking, hypertension, diabetes, obesity, physical inactivity, depression, and anxiety, have a greater impact on women as compared to men.

CVD Mortality, Emergency Department (ED) Visits, and Hospitalizations for Women

Mortality

The most recent (2018) absolute and age-standardized mortality rates for heart diseases and stroke in Canada for females and the total population are presented in [Table 1](#). Mortality rates vary considerably among provinces and within regions of Canada. Similar to the total population, the absolute mortality rate due to heart disease among females was highest in Prince Edward Island, followed by Alberta, Saskatchewan, and Newfoundland and Labrador. The northern territories of Nunavut and the Northwest Territories reported the lowest absolute mortality rates.³⁴ Age-standardized mortality rates for heart diseases among females in 2018 were highest in the least-populated provinces and territories of

Nunavut, Northwest Territories, Newfoundland, and Prince Edward Island, and they were lowest in the larger provinces of British Columbia, Ontario, and Quebec. Similar trends for mortality due to stroke were observed, with lowest absolute and highest age-standardized mortality rates among smaller territories and provinces.

[Table 2](#) summarizes cardiovascular-related deaths by cause for women in Canada in 2016-2017. Across the various CVD mortalities examined, the majority of diagnosed individuals resided in Ontario, followed by Quebec and British Columbia. CAD was the most common cause of CVD mortality in all provinces and territories, followed by stroke.

In summary, CAD, including MI, is accountable for the majority of CVD-related deaths among Canadian women. Age-standardized mortality among women is highest in Canada's less-populous territories and provinces.

ED visits

Data were analyzed from the Canadian Institute for Health Information National Ambulatory Care Reporting System, which included 8 provinces and territories and represented 64% of Canadian ED visits. Overall, an estimated 175,000 cardiovascular disease-related ED visits by women took place in 2016-2017. [Table 3](#) summarizes the causes for CVD-related ED visits; the majority were for CAD, stroke, and heart failure, followed closely by atrial fibrillation. The majority of

Table 1. 2018 absolute and age-standardized mortality rates for heart disease and stroke for females, and total population, by province/territory

Province/territory	Heart disease				Stroke			
	Women/girls		Total population		females		Total population	
	Mortality (%)	Age-standardized mortality rate (per 100,000)	Mortality (%)	Age-standardized mortality rate (per 100,000)	Mortality (%)	Age-standardized mortality rate (per 100,000)	Mortality (%)	Age-standardized mortality rate (per 100,000)
Prince Edward Island	20.6	114.8	21.5	153.3	7.0	39.5	5.3	39.5
Alberta	19.8	108.4	20.8	145.0	5.2	28.0	4.3	29.8
Saskatchewan	19.1	109.2	21.0	153.9	4.7	27.2	4.1	30.0
Newfoundland/ Labrador	18.9	135.0	20.3	167.8	5.9	42.7	5.1	44.2
New Brunswick	17.8	108.8	18.6	140.6	5.4	33.8	4.6	34.8
British Columbia	17.6	86.2	18.3	114.6	7.0	35.2	5.9	37.2
Ontario	17.4	89.4	18.5	118.3	5.4	28.2	4.6	29.7
Quebec	17.2	91.2	18.4	117.4	5.1	27.2	4.4	28.1
Manitoba	16.7	100.6	17.6	132.7	5.6	33.6	4.8	35.5
Nova Scotia	15.6	99.1	18.3	142.7	6.7	42.4	5.5	43.5
Northwest Territories	11.2	121.3	16.3	171.0	3.7	42.6	2.9	34.6
Nunavut	9.9	214.7	9.7	216.1	3.7	50.4	3.1	46.5
Yukon	—	—	—	—	—	—	—	—
Canada	17.6	93.4	18.7	123.6	5.6	29.8	4.8	31.4

Data from Statistics Canada.

women with heart failure, CAD, and stroke were admitted to inpatient care, while women with atrial fibrillation, arrhythmia, vascular disease, heart valve disease, and congenital heart disease were more likely to be discharged without hospital admission. For most CVD-related ED visits, the majority of women were aged ≥ 52 years, with the exception of those with congenital heart disease, with 77% aged < 52 years.

In summary, the most common CVD-related visits to EDs by women are due to CAD (including MI), stroke, and heart failure.

Inpatient hospitalizations

Cardiovascular disease is the leading cause of hospitalization among Canadian women, aside from giving birth. Table 4 presents the frequency of hospitalizations for specific cardiovascular conditions for women in Canada in 2016-2017. CAD (including MI), heart failure, and stroke caused the highest number of hospitalizations. Up to 60% of those hospitalized due to stroke and CAD, and over 40% of those hospitalized due to heart failure and heart valve disease, had comorbid hypertension. Between 30% and 40% of women hospitalized for CAD or heart failure had comorbid diabetes mellitus. Over 80% of CVD-related hospitalizations were in women aged ≥ 52 years, with the exception of congenital heart disease (16%). Greater than 65% of women (except for those who suffered a stroke, 51%) returned home after their hospitalizations, whereas others were transferred to long-term care or to another care facility, including palliative care.

A recently published Canadian age- and sex-specific analysis of hospitalizations across all provinces except Quebec demonstrated that the burden of several major cardiovascular diseases appears to be shifting to earlier in life.³ Between 2007 and 2016, women aged 20-39 years were the only cohort that did not see a significant decrease in hospitalization for CAD and vascular disease. Furthermore, younger women experienced a relative increase of 25% in stroke hospitalizations, compared to a nonsignificant relative decrease in stroke hospitalizations among men of the same age group. Despite an overall age- and sex-standardized decrease of 2.4% in heart failure hospitalizations over the decade, women aged 20-39 years experienced a 25% increase in heart failure hospitalizations (of note, an even greater increase of 56% in heart failure hospitalizations was found for men in this age bracket). These findings may be due to an increase in risk-factor burdens (eg, obesity, metabolic syndrome, type 2 diabetes mellitus) in younger women, as well as increased recognition and diagnosis of different forms of CAD in younger women (eg, spontaneous coronary artery dissection).

In summary, CVD is the leading cause of hospitalization for Canadian women. Hospitalizations for certain cardiovascular conditions are increasing among younger Canadian women (aged 20-39 years); this increase is not demonstrated in men of the same group or women in older cohorts.

Disparities beyond sex

Indigenous. Indigenous peoples of Canada include First Nations, Métis and Inuit, as recognized within the Canadian

Table 2. Total CVD-related mortality in Canadian women, by province/territory and CVD condition, 2016-2017

Province/territory	CAD (incl. MI)	Stroke	Heart failure	Vascular disease (incl. PAD)	Atrial fibrillation	Valvular heart disease	Arrhythmia	Congenital heart disease	Total
Ontario	13,205 (40)	3955 (36)	1,475 (29)	1230 (40)	1070 (37)	985 (35)	260 (20)	130 (42)	22,310 (38)
Quebec	6660 (20)	2515 (23)	1665 (32)	590 (19)	490 (17)	765 (27)	740 (56)	45 (15)	13,470 (23)
British Columbia	4245 (13)	1805 (16)	670 (13)	455 (15)	580 (20)	485 (17)	135 (10)	45 (15)	8420 (14)
Alberta	3,590 (11)	935 (8)	425 (8)	325 (10)	260 (9)	190 (7)	50 (4)	40 (13)	5815 (10)
Manitoba	1,245 (4)	500 (5)	200 (4)	115 (4)	130 (4)	95 (3)	30 (2)	35 (11)	2350 (4)
Saskatchewan	1120 (3)	380 (3)	265 (5)	110 (4)	120 (4)	65 (2)	35 (3)	5 (2)	2100 (4)
Nova Scotia	1105 (3)	430 (4)	130 (3)	105 (3)	115 (4)	80 (3)	20 (2)	—	1985 (3)
Newfoundland/Labrador	675 (2)	220 (2)	90 (2)	60 (2)	55 (2)	50 (2)	10 (1)	10 (3)	1480 (2)
New Brunswick	790 (2)	280 (3)	180 (4)	80 (3)	70 (2)	50 (2)	30 (2)	—	1170 (2)
Prince Edward Island	175 (1)	50 (0.5)	20 (0.4)	30 (1)	10 (0.3)	15 (1)	—	—	300 (1)
Northwest Territories	30 (0.1)	10 (0.1)	—	5 (0.2)	—	—	—	—	45 (0.1)
Yukon Territory	—	10 (0.1)	5 (0.1)	—	—	5 (0.2)	—	—	20 (0.03)
Nunavut	10 (0.03)	—	—	—	—	—	—	—	10 (0.02)
Canada	32,850	11,090	5125	3105	2900	2785	1310	310	59,475

Values are n (%). A value < 5 is indicated by a — and does not necessarily mean that there were zero deaths. Data from Statistics Canada, Canadian Vital Statistics Deaths Database. CAD, coronary artery disease; CVD, cardiovascular disease; incl, include; MI, myocardial infarction; PAD, peripheral artery disease.

Constitution Act.³⁵ Indigenous knowledge, voice, perspectives, and worldviews, which for centuries helped indigenous peoples thrive, have been fragmented or silenced, due to colonialism and racism, leading to disproportionately negative impacts on social determinants of health, and increased rates of chronic disease, including cardiovascular and infectious diseases.^{7,35,36} Social inequalities, resulting from socioeconomic and connectivity challenges, globalization, migration, loss of language and culture, and disconnection from the land, have greatly contributed to the health disparities experienced by indigenous adults.³⁷

From 2011 to 2014, elevated rates of CVD were reported in Canada among First Nations (16.7%), Métis (17.1%), and Inuit (17.9%) women, compared to non-indigenous women (14.4%),³⁸ with many studies identifying 2-3-fold greater experiences of heart disease and stroke among indigenous populations.^{35,39} Available research indicates that experiences of CVD among indigenous women are increasing, unlike the declining or plateauing experiences among non-indigenous women.^{35,40} Risk profiles for CVD are unique among indigenous peoples, with lower rates of hypertension,³⁶ and identified relationships between cultural connectedness and hypertension.⁴⁰ However, indigenous women experience greater rates of elevated cholesterol levels, dyslipidemia, blood glucose, diabetes mellitus, and obesity compared to non-indigenous women.^{39,40} Indigenous women also experience social, economic, and political inequality, which contributes to their elevated health risks.⁴¹ Colonial impacts of residential schools, interpersonal and lateral violence, discrimination, racism, and loss of culture influence the physical health of indigenous peoples and carry across generations, contributing to intergenerational trauma.⁴² Access to health care systems and structures for indigenous peoples in Canada is hampered by limited accountability, fragmented delivery and jurisdictional ambiguity, and insufficient medical coverage through the federal Non-Insured Health Benefit plan, and it is further challenged through displacement of indigenous peoples and a lack of access to medical professionals, particularly physicians and specialists.^{35,42} Residence location, including large proportions living in rural, remote, and northern communities (48.2%), combined with lower income levels, create economic barriers to accessing health care for many indigenous peoples, and women in particular.^{35,43,44}

In summary, indigenous women in Canada experience elevated rates of CVD and CVD risk factors. Social, economic, colonial, and political challenges contribute to this elevated experience of CVD for indigenous women.

Ethnic variations. Canada is a highly ethnically diverse country. The rates of CVD and CVD risk factors among ethnic minority groups, including South Asian, Afro-Caribbean, Hispanic, and Chinese North Americans, are higher when compared to their Caucasian counterparts.^{45,46} Moreover, poorer outcomes have been reported for women in these ethnic groups.⁴⁵ Although these ethnic groups share similar CVD risk factors, there is marked variability in the prevalence of risk factors related to ethnicity.^{1,47} SES has been reported to contribute to the disparities of CVD burden that ethnic women face.^{1,48}

Table 3. CVD-related ED visits for Canadian women, by condition, 2016-2017

Visit-related variables	CAD (incl. MI)	Stroke	Heart failure	Atrial fibrillation	Arrhythmia	Vascular disease (incl. PAD)	Heart valve disease	Congenital heart disease	Total
ED visits, n	31,910	25,672	21,969	19,110	11,025	4058	1729	260	115,733
Age ≥ 52 years	91	89	97	95	67	73	93	23	89
Discharged home	35	42	34	69	72	64	76	72	49
Admitted to inpatient care	62	57	66	31	27	34	24	25	50

Values are %, unless otherwise indicated. Includes data from 8 provinces and territories (Yukon Territory, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, and Prince Edward Island) representing 64% of Canadian ED visits. Data from Canadian Institute for Health Information, National Ambulatory Care Reporting System.

CAD, coronary artery disease; CVD, cardiovascular disease; ED, emergency department; incl, including; MI, myocardial infarction; PAD, peripheral artery disease.

South Asians are the largest visible minority in Canada and have the highest rates of atherosclerotic CVD, hypertension, and stroke compared to other non-indigenous ethnic groups, for both men and women.^{1,46,47,49} The South Asian (SA) portion of the INTERHEART Study concluded that 9 modifiable risk factors—dyslipidemia, smoking, hypertension, diabetes, abdominal obesity, psychosocial stress, reduced consumption of fruits and vegetables, moderate consumption of alcohol, and physical inactivity—accounted for 94% of the population attributable risk of MI in SA women.⁵⁰ Moreover, the risk for MI was greater at a younger age in South Asians.

SA women demonstrate metabolic abnormalities at lower body mass index and waist circumference than other groups, and SA women have higher waist-hip ratios compared to Caucasian Canadian women. These factors may contribute to the disproportionately higher prevalence of insulin resistance, metabolic syndrome, and diabetes among the SA population compared to Caucasian and Chinese groups.^{46,49,51-57} Given that lower body mass index and waist circumference cut-offs are better predictors of metabolic syndrome,^{58,59} sex- and ethnic group-specific cut-offs have been recommended in cardiovascular risk assessment.⁶⁰ Evidence indicates that SA Canadian women have lower HDL and adiponectin levels and elevated ApoB/ApoA1 ratios and lipoprotein(a) levels compared to their Caucasian counterparts.^{46,61-63} Increased high-sensitivity C-reactive protein level is associated with increased cardiovascular risk; however, its utility as a biomarker is confounded by varying levels among women, depending on ethnicity.^{64,65}

Canadian women of Afro-Caribbean ethnicity have greater prevalence rates of stroke and hypertension among ethnic groups there and have been found to have higher rates of physical inactivity and obesity compared to the overall

population.^{49,66,67} Chinese and SA women are also less likely to participate in daily physical activity.⁴⁷

Among all Canadian ethnic groups, East Asian Canadian women of predominantly Chinese descent have the lowest incidence of CVD. However, greater duration of stay in Canada is linked with increased CVD risk among these women.^{47,67} In specialized heart failure clinics in Ontario, more Chinese women had heart failure compared to non-Chinese and non-SA patients.⁶⁶

Cardiovascular risk for women can be determined using the QRISK3 algorithm, which incorporates ethnicity and improves prediction when compared to the Framingham risk engine.⁶⁸ Presently, there are no Canadian CVD guidelines or scientific statements specific to ethnicity. The American Heart Association has published a comprehensive scientific statement, including recommendations, pertaining to atherosclerotic CVD in American South Asians, and although the contemporary American risk scoring system includes sex, it does not include ethnicity.^{69,70} When implemented, guideline adherence has demonstrated success with specific programs directed toward recognition of ethnicity differences in the treatment of CVD.⁷¹

In summary, there exists an excess burden of CVD and associated risk factors, particularly diabetes, obesity, and hypertension, in the ethnically diverse Canadian population, inclusive of women. Ethnically tailored prevention strategies are required to reduce these disparities, and more robust inclusive clinical research in these groups is warranted.

Disabilities. The focus on disability puts emphasis on current health policy and addresses a persistent knowledge gap related to lack of inclusion of women with disabilities in clinical research.⁷²⁻⁷⁴ Despite the growing health and major medical

Table 4. CVD-related hospitalizations for Canadian women, by condition, 2016-2017

	CAD (incl. MI)	Heart failure	Stroke	Atrial fibrillation	Arrhythmia	Vascular disease (incl. PAD)	Heart valve disease	Congenital heart disease	Total
Hospitalizations, n	41,102	30,712	25,476	9998	9711	6807	6,126	2363	132,295
Comorbid hypertension,	58	44	60	28	35	37	46	7	49
Comorbid diabetes,	33	39	27	20	19	21	26	2	30
Age ≥ 52 years,	93	98	93	96	82	92	94	16	92
Discharged home (excl. Quebec)	66	73	51	88	80	74	66	85	68

Values are %, unless otherwise indicated. Data from Canadian Institute for Health Information, Discharge Abstract Database; Quebec Integrated Chronic Disease Surveillance system.

CAD, coronary artery disease; CVD, cardiovascular disease; excl, excluding; incl, including; MI, myocardial infarction; PAD, peripheral artery disease.

advances in Canada, a substantial number of women are living with disabilities. Disability is an umbrella term for impairments, activity limitations, and participation restrictions in both social and physical activities.^{75,76}

Approximately 23% of Canadian women aged 18 to 59 years report activity limitations associated with a long-term condition or health problem.⁷⁴ The average age of disability onset is in the early 40s, and the prevalence of disability increases with age.⁷⁷ Women with disabilities report lower levels of educational attainment, workforce participation, and annual personal income. They are more likely to be single (odds ratio 1.37) or separated/divorced/widowed (odds ratio 1.47) compared to the general population, with higher rates of obesity, physical inactivity, diabetes, and smoking.⁷⁸ Compared to women without disabilities, women with disabilities are less knowledgeable about CVD risk factors and experience significant deficiencies in CVD preventive screening (eg, family history/smoking queries).⁷⁹

Women live longer than men and are thus at higher risk of morbidity and disability over their lifespan. For example, women have 4 times the risk of men of developing osteoporosis.⁸⁰ Additionally, the prevalence of systemic autoimmune rheumatic diseases is greater in women aged > 45 years compared to men, with prevalence rates approaching or exceeding 1 in 100 for women with primary Sjögren syndrome.⁸¹ Women with autoimmune rheumatic diseases have greater cardiovascular morbidity and mortality, most likely related to inflammation and accelerated atherogenesis, and to the difficulty of distinguishing between cardiac and disability symptom presentations (eg, shoulder discomfort, shortness of breath). A significant factor influencing the time between symptom onset and access of medical care is recognition that symptoms are cardiac in origin. In Canada, women are 3 times more likely to be diagnosed with multiple sclerosis than men.⁸² Multiple sclerosis increases the risk of venous thromboembolism and peripheral vascular disease for both women and men, with a 2.5 times higher risk of myocardial infarction in women only.⁸³ A subgroup analysis by sex (n = 2 studies) included in a recent systematic review suggests that there is an increased risk of stroke in women who have multiple sclerosis (odds ratio 2.13; 95% confidence interval [CI], 1.84-2.46; $P < 0.001$).⁸⁴ Cardiovascular morbidity results are similar to those reported in a recent Canadian population-based study, although CVD mortality was reported to be higher in men (n = 515) compared to women (n = 901) with multiple sclerosis.⁸⁵

Adults with disabilities are 4 times more likely to report their health to be fair or poor compared to people with no disabilities (40% vs 10%),⁷⁸ and women with disabilities are particularly vulnerable due to having fewer resources and protective factors.⁷⁴ Adjusted for age, women with physical disabilities have 6.6 (95% CI, 5.2-8.4) times higher odds of having CAD, 5.9 (95% CI, 4.3-8.1) times higher odds of having cardiac symptoms,⁸⁶ and are less likely to receive preventive or urgent care compared to women without disabilities.^{72,75,78} Although annual electrocardiograms and cardiac screening for low-risk women without symptoms are not recommended by Choosing Wisely Canada, it is important to recognize that cardiovascular risk and symptoms may be different and more difficult to interpret in women who have disabilities. To reduce risk, the Canadian Society for Exercise

Physiology provides recommendations for adults with disabilities (eg, spinal cord injury), including those disabilities that are more prevalent in women (eg, multiple sclerosis).⁸⁷ Activities for women with multiple sclerosis are performed at a lower intensity and duration and include both aerobic activity and strength training at least twice weekly.

In summary, the cumulative effects of disability contribute to an increased disease burden and even higher risk for adverse cardiac events among women with disabilities. Limited data exist about the cardiac health care experiences of women with disabilities, and these women are at risk of not receiving the same level of available evidence-based patient-centred care.

Geographic living environment. Experiences of CVD differ across provinces and regions, as described above, but they also vary with geographic living environment. Variations exist in Canada, including from northern to southern locations, between urban and rural residence areas, and between on- and off-reserve residences. The national average for CVD mortality (123.7 per 100,000 residents) is higher for women living in more rural or remote locations compared to women living in major urban centres.⁸⁸ The health regions with the lowest CVD mortality among women in Canada in 2013 were the largest metropolitan areas of Toronto, Vancouver, and Montreal (104.2 per 100,000 residents), followed by the suburbs of these major centres (115.2 per 100,000 residents) and other large centres in Canada (Calgary, Edmonton, Ottawa, Waterloo, Durham, Halton, Simcoe Muskoka, Wellington-Dufferin-Guelph; 122.3 per 100,000 residents).⁸⁹ The health regions with the highest rates of CVD death among Canadian women were the northern, rural, and remote locations within each province, and Canada as a whole (138.6-147.6 per 100,000 residents). Experiences of CVD are striking when comparing on- and off-reserve locations. From 2003-2007, the age-standardized CVD mortality rates among on-reserve populations were 86.3 per 100,000 residents, compared to 62.9 per 100,000 for off-reserve residents.⁹⁰

Knowledge of CVD and CVD risk factors is greater among women living in urban centres.⁹⁰ Rates of CVD events are inversely related to availability of and visits to family physicians, and frequency of periodic health examinations, with health system factors accounting for 15.5% of regional variation in incidence of CVD events.⁸⁸ Canadian residents living in remote and sparsely populated areas experience fewer family physician visits, less lipid screening, poorer blood pressure control, and less use of statins compared to urban, metropolitan residents.⁸⁸

In summary, geographic disparities in CVD mortality and CVD risk factors within Canada are considerable. Canadians living in metropolitan areas experience the lowest burden of CVD, with rural and remote, northern, and on-reserve individuals experiencing the greatest burdens.

Income. Across North America, women of lower-income SES are at greater risk of health-related issues compared to women of higher SES.⁹¹ Canadian women who are socially or economically disadvantaged experience challenges in accessing health services, resources, and treatments. Paired with the challenges of engaging in risk-reducing behaviours, women with a low SES in Canada are more susceptible to CVD than

those with a high SES.⁹² Even in the context of the Canadian universal health care system, associations between SES and outcomes in acute coronary syndrome have been identified. Compared to both other income groups and men, low-income women had less access to cardiac catheterization and had higher 30-day mortality.⁹³ Given the rapidly increasing inequality gap, and the inverse gradient for SES groups, CVD rates in the Canadian population are predicted to increase significantly in the future.⁹²

Critical scholars have noted that minority women such as those from lower SES backgrounds report a general lack of awareness and misaligned beliefs/perceptions about their personalized risk for CVD.^{94,95} Gonsalves et al. report that women of low SES were excluded from the construction of social media public health messaging on CVD risk by a national campaign on women's heart health in Canada.^{96,97}

Gender

Gender is a complex social construct defined by 4 domains: gender identity, gender roles, gender relations, and institutionalized gender.⁹⁸ Many traditional psychosocial determinants of health are gendered and may therefore impact health outcomes differently for women, men, and gender-diverse individuals through various pathways.⁹⁸ The GENESIS-PRAXY (Gender and Sex Determinants of Cardiovascular Disease: From Bench to Beyond Premature Acute Coronary Syndrome) study⁹⁹ created a "gender index" to assess the role of variables that are traditionally ascribed to each sex in society. Pelletier et al.⁹⁹ demonstrated that personality traits and social roles traditionally ascribed to women were associated with adverse cardiovascular outcomes in young patients with acute coronary syndromes. More importantly, regardless of biological sex, patients with high gender scores (reporting traits and roles traditionally ascribed to women) were 4 times as likely to be readmitted to the hospital within the first year post-acute myocardial infarction. Using the GENESIS-PRAXY gender index in a cohort of patients (aged 21-92 years) undergoing cardiac catheterization, results demonstrated that health status outcomes were associated with a patient's gender-related characteristics. Patients with CAD and higher gender index scores reported significantly worse health-related quality of life at 1 year (compared to those with low gender index scores) regardless of biological sex.¹⁰⁰ In summary, gender intersects with race, ethnicity, indigenous status, sexuality, geography, age, disability/ability, migration status, socioeconomic status, and religion,¹⁰¹⁻¹⁰³ emphasizing the importance of considering gender-related characteristics to further our understanding of CVD in women, as well as the need for an intersectional approach to future clinical research studies.

Conclusions

Canadian women are at risk for CVD, the leading cause of their premature mortality and their healthcare utilization. Risk factors including smoking, hypertension, diabetes, obesity, physical inactivity, depression, and anxiety are particularly more harmful in women than in men. Cardiovascular mortality rates in women are highest in the northern, rural, and remote locations in Canada.

Indigenous women and women of SA origin are at notably greater risk of CVD and experience poorer cardiovascular outcomes, as do marginalized populations such as those with disabilities and lower SES.

Acknowledgements

The authors gratefully acknowledge Lisa Comber for her coordination of this effort. A special thanks goes to Alexa Desjarlais from the Libin Cardiovascular Institute CV & Me program, and to Manu Sandhu and Angela Poitras from the University of Ottawa Heart Institute for their graphic design of the chapter illustration. Thanks also go to the Heart & Stroke Foundation for acquiring some of the data used in this Atlas chapter. This chapter has been submitted on behalf of the Canadian Women's Heart Health Alliance (CWHHA), a pan-Canadian network of ~60 clinicians, scientists, allied health professionals, program administrators, and patient partners, whose aim is to develop and disseminate evidence-informed strategies to transform clinical practice and enhance collaborative action on women's cardiovascular health in Canada. The CWHHA is powered by the Canadian Women's Heart Health Centre at the University of Ottawa Heart Institute.

Funding Sources

Support for this work was provided by the University of Ottawa Heart Institute Foundation.

Disclosures

S.L.M. is a member of the Novo Nordisk steering committee and is a consultant of Lantheus Medical Imaging. The other authors have no conflicts of interest to disclose.

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