CJC Open 6 (2024) 205–219

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 7: Sex, Gender, and the Social Determinants of Health

Colleen M. Norris, PhD, GNP, MSc, BScN, FAHA, FCAHS,[a] Kerri-Anne Mullen, PhD, MSc,[b] Heather J.A. Foulds, PhD,[c] Shahin Jaffer, MD, MHSc, FRCPC,[d] Kara Nerenberg, MD, MSc,[e] Martha Gulati, MD, MS, FACC, FAHA, FASPC, FESC,[f] Nazli Parast, BScN, MN, CDE,[b] Nicole Tegg, RN, BScN, MN,[a] Christine A. Gonsalves, PhD,[g] Jasmine Grewal, MD,[d] Donna Hart, BA, RSW,[h] Anna L.E. Levinsson, PhD,[i] and Sharon L. Mulvagh, MD, FRCPC, FACC, FASE, FAHA[j,k]

[a] *Faculty of Nursing, University of Alberta, Edmonton, Alberta, Canada;* [b] *Division of Prevention and Rehabilitation, University of Ottawa Heart Institute, Ottawa, Ontario, Canada;* [c] *College of Kinesiology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada;* [d] *Department of Medicine/Community Internal Medicine, University of British Columbia, Vancouver, British Columbia, Canada;* [e] *Department of Medicine, University of Calgary, Calgary, Alberta, Canada;* [f] *Barbra Streisand Women's Heart Centre, Cedars-Sinai Smidt Heart Institute, Los Angeles, California, USA;* [g] *School of Human Kinetics, Laurentian University, Sudbury, Ontario, Canada;* [h] *Canadian Women's Heart Health Alliance, Ottawa, Ontario, Canada;* [i] *Faculty of Medicine, Université de Montréal, Montreal, Quebec, Canada;* [j] *Division of Cardiology, Dalhousie University, Halifax, Nova Scotia, Canada;* [k] *Department of Cardiovascular Medicine, Mayo Clinic, Rochester, Minnesota, USA*

ABSTRACT

Women vs men have major differences in terms of risk-factor profiles, social and environmental factors, clinical presentation, diagnosis, and treatment of cardiovascular disease. Women are more likely than men to experience health issues that are complex and multifactorial, often relating to disparities in access to care, risk-factor prevalence, sex-based biological differences, gender-related factors, and sociocultural factors. Furthermore, awareness of the intersectional nature and relationship of sociocultural determinants of health, including sex and gender factors, that influence access to care and health outcomes for women with cardiovascular disease remains elusive. This review summarizes literature that reports on under-recognized sex- and gender-related risk factors that intersect with psychosocial, economic, and cultural factors in the diagnosis, treatment, and outcomes of women's cardiovascular health.

RÉSUMÉ

Les profils de facteurs de risque, les facteurs sociaux et environnementaux, le tableau clinique, le diagnostic et le traitement des maladies cardiovasculaires montrent des différences importantes entre les femmes et les hommes. Il est plus probable que les femmes expérimentent des problèmes de santé complexes et multifactoriels, qui sont souvent en relation avec les disparités dans l'accès aux soins, la prévalence des facteurs de risque, les différences biologiques entre les sexes, les facteurs liés au genre et les facteurs socioculturels. De plus, la sensibilisation à la nature et à la relation intersectionnelles des déterminants socioculturels de santé, notamment les facteurs liés au sexe et au genre, qui influencent l'accès aux soins et les résultats cliniques des femmes atteintes d'une maladie cardiovasculaire demeure insaisissable. La présente revue résume la littérature qui porte sur les facteurs de risque liés au sexe et au genre peu reconnus qui se recoupent aux facteurs psychosociaux, économiques et culturels dans le diagnostic, le traitement et les résultats cliniques en lien avec la santé cardiovasculaire des femmes.

Women are more likely than men to be subjected to the impacts of health-related disparities that arise from sociocultural, socioeconomic, and political factors—that is, forces that are "above the skin."[1,2] Although progress had been made in reducing cardiovascular disease (CVD) in women, significant disparities remain in disease burden among subgroups of

Received for publication June 7, 2023. Accepted July 31, 2023.

Corresponding author: Dr Colleen M. Norris, University of Alberta, 5-246 Edmonton Clinic Health Academy, 11405 - 87 Ave NW, Edmonton, Alberta T6G 1C9. Tel.: (780) 492-0784.
E-mail: cnorris@ualberta.ca

See page 215 for disclosure information.

https://doi.org/10.1016/j.cjco.2023.07.013

women, particularly those who are socially disadvantaged due to race, ethnicity, income, and/or education.[3] The causes of these disparities are complex and multifactorial and often are associated with access to care, risk-factor prevalence, sex-based biological differences, gender-related factors, and sociocultural factors. Crenshaw developed a framework termed "intersectionality," which reflects how social identities, such as race, age, ethnicity, gender, sexual orientation, socioeconomic status, and other factors of advantage and disadvantage, merge in an overlapping fashion, impacting one's experiences in society.[4] The intersectionality of socioeconomic status, sex and/or gender, and ethnicity and/or race plays a prominent role in CVD treatment and all health outcomes in women, and the weathering hypothesis indicates that exposure to social and economic disadvantage results in poor health outcomes.[5,6] The purpose of this Canadian Women's Heart Health Alliance (CWHHA) Atlas chapter is to review the intersectional nature and relationship of sociocultural determinants of health (SDOH), including sex and gender factors, that influence awareness, access to care, and cardiovascular health outcomes. Key messages of this chapter are summarized in Figure 1.

Disparities in Cardiovascular Health Care Across Canadian Communities

Access and delivery of care

Access to healthcare can be impacted by several factors, including geography, resources, social acceptability, and structural biases.[7] One such bias has been the long-standing view of CVD as a mens' disease, which has been manifested as a lack of awareness of CVD risk in women and continues to be reflected in research, in health policies and programs, and importantly, at a clinical level.[8] Chapter 5 of this Atlas reviewed in detail sex differences in the presentation of cardiac symptoms.[9] Despite the fact that 9 of every 10 women report chest pain with documented ischemia, and even when women recognize and articulate their symptoms as being "heart-related," they are more likely than men to be dismissed by medical professionals, resulting in delays in workup and diagnosis, and playing a role in the poorer outcomes experienced by women with acute coronary syndromes (ACSs), particularly younger women.[10-12]

In Canadian emergency departments (EDs), the Canadian Triage and Acuity Scale (CTAS) determines the severity of presenting problems and organizes patients into a 5-level triage system (from 1 = resuscitation to 5 = nonurgent), which corresponds to speed of access to care. The CTAS implementation guideline contains an acknowledgment that chest pain is one of the most difficult presenting symptoms for ED staff.[13] Depending on how they are described by the patient, chest pain and other accompanying symptoms may fall under 1 of 3 CTAS triage levels—emergent (level 2), urgent (level 3), and less urgent (level 4). In addition to assessing the type and severity of symptoms, the health provider assigning triage is recommended to take into account perceived risk factors (eg, age, sex, history, and comorbidity) when assessing the level of intervention needed, which can be somewhat subjective.[13] Depending on the level assigned, patients could be seen by a physician in < 15 minutes in the case of suspected acute myocardial infarction (AMI), or > 1 hour if a cardiac-related event is not suspected. The CTAS guidelines recommend using "treatment guidelines, care maps, and critical pathways" in the triage of clinical symptoms, such as chest pain, that can fall under one or more CTAS levels. Although the American Heart Association and the American College of Cardiology published a joint Guideline for the Evaluation and Diagnosis of Chest Pain in 2021 highlighting sex differences in AMI presentation and diagnosis,[14] a recent cross-sectional survey identified an absence of sex-specific protocols for AMI diagnosis in Canadian EDs, leading to ongoing subjective assessment and potential persistent biases.[15] Chapter 3—Patient Perspectives—of this CWHHA Atlas identifies that women who were experiencing heart-related health issues and who presented at an ED or to primary care felt "misunderstood, misinterpreted, misdiagnosed, and mistreated."[16] They described being "stopped at the gate" when presenting to an ED with symptoms that may differ from those traditionally associated with ACS in men. Fundamentally, this access problem is national in scope.

Not all women have benefited equally in observed reductions in CVD mortality, and the suggestion has been made that the development of new strategies, such as specialized women's heart programs (WHPs), are crucial in addressing current sex- and gender-based disparities identified for CVD conditions.[17] Aggarwal and Mulvagh describe approximately 50 known WHP centres in North America, and a handful throughout the rest of the world.[18] They comment that, although WHPs were originally interpreted as a fads or marketing ploys, the need for them actually has intensified, with very recent growing evidence of increasing CVD morbidity and mortality for women across the lifespan.[18] Over the past decade, several Canadian clinician-scientists have introduced WHPs to Canada; these are often developed through sponsorship from charitable foundations, philanthropic organizations, or industry. Beyond routine heart disease prevention, diagnosis, treatment, and education, WHPs help to address heart conditions and risks that exclusively or disproportionately affect women across the lifespan.[19] These include risk factors such as adverse pregnancy outcomes, peripartum cardiomyopathy, polycystic ovary syndrome (PCOS), menopause, and menopausal hormone therapy concerns, as well as CVD conditions such as coronary microvascular dysfunction, and spontaneous coronary artery dissection.[19,20] A recent prospective study examining the effect of WHP specialized care in Vancouver, British Columbia, Canada in 154 women with nonobstructive coronary artery disease (ischemia with no obstructive coronary arteries or myocardial infarction with nonobstructive coronary arteries) observed significant improvements in diagnosis, risk-factor management, angina control, quality of life, and depression, and decreases in ED visits and angina-related hospitalizations at 1-year follow up.[21]

In 2022, Canada had 6 WHPs, one in both Nova Scotia and British Columbia, and 2 in both Quebec and Ontario, in various stages of development. Table 1 summarizes these Canadian centres, which all aim to provide women-specific programs and include both inpatient and outpatient initiatives that focus on aspects of prevention, pathophysiology, and treatment of CVDs in women. Important to note is that

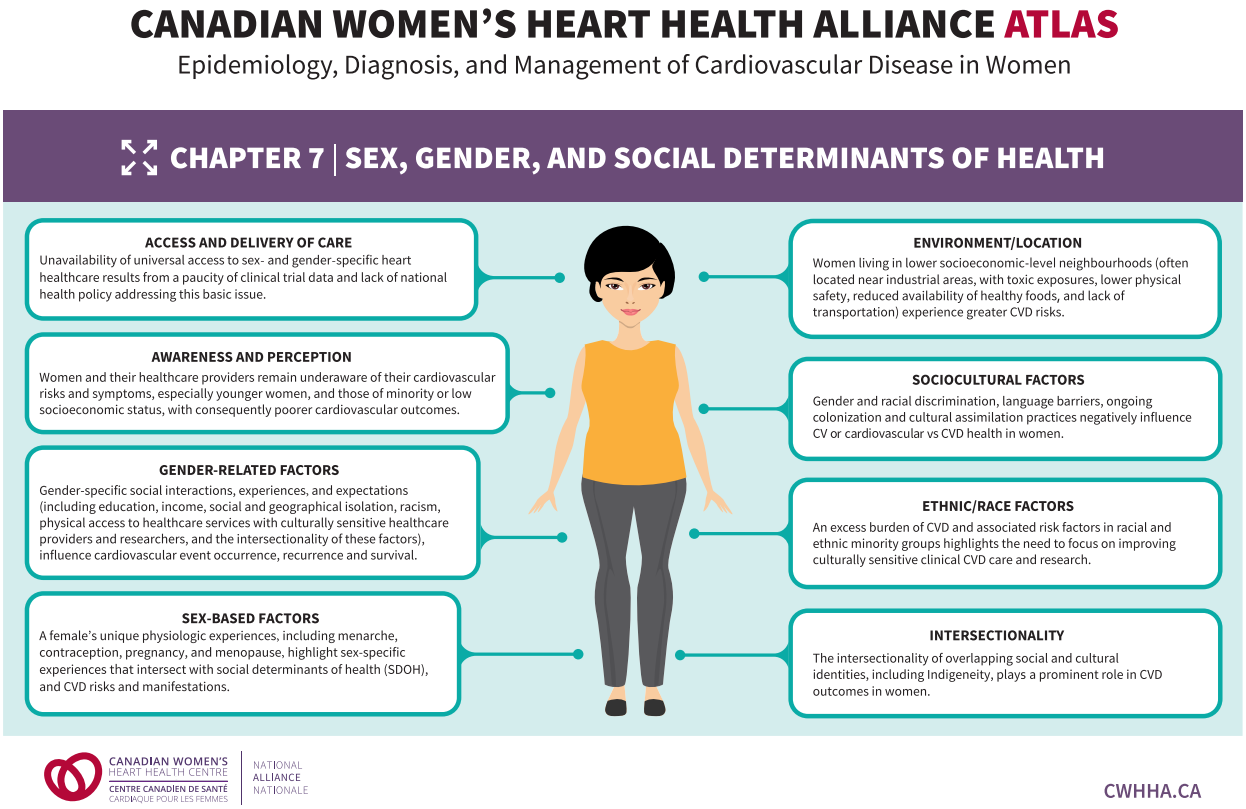

Figure 1. Summary of how sex and gender interact with the social determinants of health to influence awareness, access to care, and cardiovascular health outcomes. CVD, cardiovascular disease.

WHPs have been established in only 4 of Canada's 13 provinces and territories. Women who live outside of Halifax, Montreal, Ottawa, Toronto, or Vancouver have no local opportunities to access female-specific heart healthcare. More importantly, because of limited resources and the urban-centred locations, these WHPs are not universal, accessible, or portable, even within the provinces they serve. At the time of this publication, no dedicated clinical programs for women's heart health were available in the Prairie provinces (Manitoba, Saskatchewan, Alberta), 3 of the Maritimes provinces (New Brunswick, Newfoundland, Prince Edward Island), or the 3 territories (the Yukon, the Northwest Territories, and Nunavut). Of note, in 2019, the Libin Cardiovascular Institute in Calgary, Alberta introduced a formal program in women's cardiovascular health called CV & Me, which focuses on research, education, and awareness. In partnership with several community organizations and foundations, CV & Me includes outreach to the Calgary community to raise awareness about women's CVD—the risks, symptoms, and recovery (https://libin.ucalgary.ca/research/research-initiatives/cv-me).

Achieving equity in women's health is a considerable challenge, as myriad factors contribute to perpetuating inequities. Although broad mandates have moved women's health forward, presently, female-specific cardiovascular health policies and Canada-wide female-specific cardiovascular protocols and models of care are lacking. The relative lack of evidence driving clinical decisions in women's heart health, compounded by the low levels of awareness among the public, clinicians, and all government levels about the unique aspects of CVD in women led Coutinho to propose that improving access to quality care requires healthcare institutions in Canada to bring women's heart health issues into their strategic planning and priority arenas, including the inclusion of multidisciplinary WHPs.[22]

Awareness and perception

National advocacy campaigns and the establishment of grassroots events such as Wear Red Canada day have functioned to promote education and awareness of cardiovascular health in women. Unfortunately, knowledge gaps remain in regard to linking risk factors to CVD, among both the general public and healthcare providers, as well as persistent attitudes and beliefs that contribute to ongoing CVD-related disparities affecting women.[23-25]

CVD in women. In a 2014 cross-sectional survey of 1654 randomly selected women from 10 Canadian provinces, respondents demonstrated limited awareness and knowledge of cardiovascular risk and disease.[23] Only 43% of participants named chest pain as a symptom of heart disease, and fewer recognized shortness of breath or difficulty breathing while exercising (38%), or pain radiating to the shoulder, neck, and arm (29%), as symptoms. Women over the age of 55 years, and those with higher education and income levels, had better awareness of clinical and lifestyle-related CVD risk factors than younger women, less-educated women, and less-affluent women.[23] Among the women at greatest risk of CVD events

Table 1. Summary of 6 current specialized "women's heart programs" in Canada in 2023

Centre and /or program name, date established	Description	Location
Women's Cardiovascular Health Initiative, 1991	A comprehensive assessment and lifestyle program for women with existing or potential heart problems with a unique focus on cardiac rehabilitation for women. The program is affiliated with the University of Toronto and reports actively training healthcare professionals	Toronto, Ontario
Women's Heart Health Clinic, 2009	Two programs: one at BC Women's Hospital and the other at VGH covering the full scope of women's heart health services. A cardiologist from VGH provides cardiac care and a nurse practitioner provides clinical and prevention services. The focus of the nurse practitioner clinic is to reduce risk and provide lifestyle coaching, and the focus at VGH is on diagnostics and therapeutics.	Vancouver, British Columbia
Women's Healthy Heart Initiative, 2009	Nurse-led collaborative heart disease prevention clinic for women, providing patient-centred care and treatment focused on decreasing modifiable heart disease risk factors through healthy lifestyle: improving nutrition and increasing physical activity to lower women's cholesterol and blood pressure; achieving weight loss; and avoiding diabetes	Montreal, Quebec
Canadian Women's Heart Health Centre, 2012	Programs include the following: an outpatient women's heart health clinic specializing in spontaneous coronary artery dissection, postpartum risk assessment, unexplained chest pain, and MINOCA; an evidence-based peer support program (Women@Heart); an outpatient primary prevention program (CardioPrevent) for high-risk postpartum women; clinical and research fellowships in women's cardiovascular health. Is the convening body for both the Canadian Women's Heart Health Alliance and the Canadian Women's Heart Health Summit	Ottawa, Ontario
The Maritime Heart Centre Women's Heart Health Clinic, 2017	Multidisciplinary, specialized outpatient cardiac clinic designed for the assessment and care of women with a history of heart disease, and/or major risk factors for heart disease	Halifax, Nova Scotia
Cardio F, le Centre hospitalier de l'Université de Montréal, 2021	A multidisciplinary approach to clinical care, including care in cardiac disease in women, cardio-obstetrics, and neurovascular conditions in women. Also dedicated to teaching, knowledge translation, clinical research, and innovation related to women's cardiovascular health	Montreal, Quebec

MINOCA, myocardial infarction with nonobstructive coronary arteries; VGH, Vancouver General Hospital.

(ie, those with existing CVD or CVD risk factors), the majority (60%) perceived themselves to be at low or moderate risk.[23] Over half of women surveyed (55%) reported that CVD prevention was discussed routinely with their healthcare providers, and this was more common among women aged > 55 years. Women also commonly sought cardiovascular health information via health-promoting organizations, the Internet, and mass media.[23] Alarmingly, a 2021 report from the US noted that awareness of the fact that heart disease is the leading cause of death among women declined from 2009 to 2019, particularly among Hispanic women, non-Hispanic Black women, and younger women.[26] Women of minority racial and ethnic backgrounds who are at greater risk for CVD are frequently unaware of this and may perceive contradictory cardiovascular health messages in the mass media, with a resultant impact on the likelihood to engage in risk-reducing behaviours.[27-30]

Given that over 50% of women who present with an AMI are misdiagnosed, lack of awareness among healthcare providers of the female-specific clinical presentation of heart conditions remains an issue. In the **V**ariation **i**n **R**ecovery: Role of **G**ender on **O**utcomes of Young AMI Patients (VIRGO) study of young AMI patients, Lichtman et al., reported that women were more likely to be told that their symptoms were not cardiovascular related.[10] McSweeney et al. reported that although the level of awareness about the prevalence of ischemic heart disease among women has increased in recent years, many healthcare providers still view ischemic heart disease as being primarily a mens' disease or one that affects older women after menopause.[31] A survey of over 500 randomly selected physicians (60% primary care; 20% cardiology; 20% obstetrics and gynecology) from across Canada assessed the knowledge, beliefs, and practices of providers, as related to women's cardiovascular health.[24] Only 26% of the primary care physicians and cardiologists and 14% of the obstetrician/gynecologists who were surveyed felt effective at helping female patients understand their risk of heart disease. Less than one quarter of physicians felt effective at helping women control or prevent modifiable risk factors (eg, obesity, smoking, physical activity, low-density lipoprotein (LDL) cholesterol, blood pressure), and even fewer (13%) felt effective at helping women prevent an AMI. Aside from chest pain, many physicians (ranging from 18% to 52%) were unaware of common symptoms of AMI (eg, unusual fatigue; back, jaw, or arm pain) reported by women. Even fewer (ranging from 17% to 79%) were aware of common prodromal AMI symptoms in women (eg, fatigue, shortness of breath).

Sex-specific CVD risk factors. Chapter 4 of the CWHHA Atlas reviewed risk factors that can impact a woman's cardiovascular health across the lifespan, including pregnancy-related conditions (eg, hypertensive disorders of pregnancy), autoimmune conditions, and menopause.[20] Gaps remain in the overall perception of individual CVD risk in women who have experienced an adverse pregnancy

condition. In a cross-sectional survey of young women in the US (n = 714; mean age, 35 years; 74% White), most participants could identify hypertensive disorder of pregnancy (HDP; > 75%) and gestational diabetes mellitus (> 76%) as CVD risk factors, but few recognized preterm birth (< 16%) or delivery of a low-birth-weight infant (< 11%) as being associated with increased CVD risk.[32] Only 22.5% of participants who experienced an adverse pregnancy condition reported speaking with a healthcare professional about CVD. A recent scoping review (12 studies; 2 Canadian) found the level of knowledge of increased CVD risk following an HDP to be low among both women (n = 402) and providers (n = 1215).[33] Significant gaps are present in the identification, communication between providers, and follow-up of women following an HDP. Women report receiving no or insufficient information from their healthcare provider about risks after an HDP, and women who are aware of related risks seek this information through their own research.

PCOS is a sex-specific condition that affects 1.4 million to 2.2 million Canadian women (8%-13%) of reproductive age.[34] Women with PCOS have an increased prevalence of CVD risk factors (eg, dyslipidemia, insulin resistance, hypertension, obesity, and metabolic syndrome) and are twice as likely as those without to experience a future cardiovascular event.[35] A main theme identified in a recent qualitative study of Canadian women with PCOS (72% White and/or Caucasian; 56% married and/or with a live-in partner) was the need for greater education and awareness of the condition among primary care physicians and the need for the medical community to prioritize women's health, in general.[36] Given the number of young women who are living with the condition, we may be able to prevent or delay the onset of CVD in a large population of women by providing comprehensive care to women with PCOS.[35]

A 2019 systematic review (6 studies; 4 countries; n = 478; 83% female) found that most (range, 73% to 97%) individuals with rheumatoid arthritis (RA) were unaware of an increased risk of developing CVD in relation to their RA. Most troubling is that awareness was lowest among those who had the greatest number of traditional CVD risk factors *in addition* to their RA.[37] Similar observations have been seen in CVD risk awareness among systemic lupus erythematosus patients. However, patients who received counselling from a physician were more than twice as likely to recognize systemic lupus erythematosus as a CVD risk factor, and over 3 times as likely to identify themselves as being at risk of CVD, compared to patients who did not receive physician counselling.[38]

Many women are unaware that the risk of CVD increases after menopause, owing to a variety of factors, including changes in endogenous sex hormones, body composition, lipid profiles, and vascular health.[39] Premature ovarian insufficiency and early menopause, in particular, are independent risk factors for heart disease and overall CVD. Assessment of CVD risk factors at crucial stages in a woman's life, including at the peripartum and menopausal transition periods, and understanding a woman's history of traditional and sex-specific or predominant risk factors, provide important opportunities to monitor a woman's health, personalize care, and implement early intervention strategies to reduce her overall CVD risk.

Sex differences in guideline-based care

Women are less likely to receive guideline-based cardiovascular care than men.[25] For example, women are less likely than men to receive statin therapy or guideline-recommended dosing, despite their effectiveness at preventing both primary and secondary CVD. This disparity is due to the fact that women are offered statins at lower rates by their healthcare providers, and are more likely than men to refuse or discontinue statins.[40] Women are less likely than men to link high cholesterol levels to future cardiovascular risk (75.4% vs 82.1%; $P < 0.001$) and less likely than men to believe that statins are effective (68.0% vs 73.2%; $P < 0.001$) or safe (47.9% vs 55.2%; $P < 0.001$).[40] A qualitative Canadian study interviewing family physicians (n = 17) and patients (n = 14) identified several barriers to statin use, including the following: concerns about side effects; misconceptions about effectiveness or need; lack of acceptance of indication; difficulties with risk stratification of patients; and the questionability of the benefits of treatment among specific patient groups.[41]

A Canadian population-based cohort study examining > 23,000 ACS cases found that women were an absolute 14.3% less likely to receive coronary catheterization than men (51.8% vs 66.1%).[42] Among those who underwent revascularization, women were more likely to have recurrent ACS or die, compared to men (13.1% vs 10.6%; hazard ratio 1.24; 95% confidence interval [CI] 1.16−1.33). Even though, in general, improvements in door-to-balloon time have been observed, Udell and Fonarow found that women with ACS were less likely to receive cardiac catheterization within 90 minutes (the guideline-driven international standard), compared to men.[43] Lack of provider education, as well as innate biases, may be contributing to these disparities in quality of care.[31]

Most cardiovascular society guidelines do not include information on sex-specific or sex-predominant risk factors, or sex-based recommendations for prevention, diagnosis, and treatment of CVD.[44,45] This omission is, in part, due to the historic underrepresentation of women in clinical trials, whose data inform the content of these guidelines. DeFilippis and Van Spall propose that "given emerging data supporting differences in pathophysiology, prevention, treatment, and outcomes, we should aspire as a cardiovascular community to move toward sex-specific guidelines, particularly for cardiovascular prevention and risk-factor assessment" and "at a minimum, future guidelines should highlight knowledge gaps and/or sex differences that have been demonstrated."[44]

Medical education

A study evaluating the inclusion of sex and gender in medical curricula identified that, despite the growing evidence base, physicians and physician-scientists presently are not receiving the education necessary to understand the relationships between sex and gender and their influence on health outcomes.[46] A 2011 survey of 44 medical schools in Canada

and the US found that 70% of schools had no formal sex- and/or gender-based curriculum.[47] More recent data are limited; however, a 2021 content analysis of the course descriptions of 16 Canadian medical schools points to an ongoing scarcity of women's health content in medical school curricula.[48] This scarcity, along with the lack of sex-specific guidelines, contributes to ongoing biases and disparities in access and quality of care for women. Recognizing that medical schools must incorporate this information into didactics throughout an integrated curriculum, the Training and Education Working Group of the CWHHA undertook the planning, development, and dissemination of a Canadian Women's Heart Health e-Course and Toolkit.[49] Nine educational modules have been created, targeting trainees and all healthcare professionals within cardiology, general internal medicine, and emergency medicine. Users can access each module for individual learning, or faculty can download the tools (PowerPoints, speaking notes, and resource listings) to present at their institutions, at www.cwhha.ca.

Multinational calls to action have been published that are aimed at improving health equity for women.[2,25,50,51] Recommended actions to improve knowledge and awareness include implementation of the following: culturally sensitive and appropriate awareness campaigns to improve knowledge of the general public; better communication and interdisciplinary collaboration among healthcare providers caring for women; reporting of sex and gender-specific diagnostic criteria and treatment recommendations in clinical practice guidelines; incorporation of sex-specific content into clinical education, including the emphasis of sex-specific or predominant cardiovascular risk factors; and sex- and gender-focused research, from basic science to population health.

Sex and Gender Factors and Their Relationship With SDOH

Each human cell has 46 chromosomes, or 23 pairs of chromosomes. The 23rd pair of chromosomes, called sex chromosomes, are labelled either X or Y. Males have 1 X and 1 Y sex chromosome, whereas females have 2 X chromosomes. As young females are growing, a mechanism called inactivation randomly turns off 1 of their 2 X chromosomes, enabling traits from both X chromosomes to be expressed in the female body. As not every cell turns off the same X chromosome, different cells can express X-chromosome genes differently from one another. This cellular mosaicism renders females more genetically diverse than males and, in the context of women's heart health, leads to increased biological diversity among females.[52]

For the purposes of understanding women's heart health, *sex* is defined as a *biological* construct labelled as *female* or *male*. Sex encompasses factors such as hormones, genes, anatomy, and physiology and affects the propensity for, and trajectories, prevalence, and treatment of health conditions and diseases. Differences are present in drug absorption, body composition, metabolism, diseases, and conditions, according to sex. *Gender* is a *social construct*, described by social scientists and based upon personal gender identity as a woman or man, and as Gender Fluid, Cis Gender, Gender Queer, or Two Spirit. Gender is linked to power, and economic and social status; it is culturally specific and temporal, and is very distinct from sex. Gender has a number of dimensions, 4 of which have been identified to begin exploring the association of gender with health and health outcomes.[53] These dimensions include gender identity, gender roles, gender relations, and institutionalized gender.

Both sex and gender influence our risk of developing certain diseases, how well we respond to medical treatments, how often we seek care, as well as how providers respond to patients, their risk factors, and their presenting symptoms. Although clearly distinguishing between sex and gender is important, we also need to understand the dynamic relationship between these and other SDOH, as they all contribute to varied experiences and outcomes.[54]

Sex and gender factors associated with the control of power and resources and unequal living conditions underpin the SDOH, disproportionately disadvantaging women worldwide.[55] Addressing the SDOH is recognized as the most significant opportunity to improve CVD outcomes.[56] Although the binary understanding of gender in a patriarchal system places women at a disadvantage, gender-stereotypical behaviours for women often are protective of health, contributing to longer life expectancy among women.[55] CVD prevalence is higher among disadvantaged populations, independent of age, race, and ethnicity.[57] Populations with greater financial strain, lower educational attainment, reduced access to medical care, and greater social isolation experience greater risks of CVD.[57-62] The increased CVD risks and experiences among individuals who face greater barriers owing to SDOH are independent of age, race, and ethnicity.[57] Although many CVD risk factors are well established among the general population, many studies have focused on men, and the impacts of gender have begun to emerge only recently. The following sections detail how sex and gender intersect with the SDOH to impact CVD experiences and outcomes.

Sex-based factors

Although age has been long recognized to attenuate many protective estrogen-related vascular responses, increasing evidence indicates that the female vascular system may be programmed for more severe functional alterations compared with the male vasculature, due to widely varying hormonal influences during puberty, pregnancy, the peripartum period, and menopause.[63] In her editorial on improving the cardiovascular health of women, Gulati notes that the medical community continues to define women's health by focusing on the "bikini boundaries."[64] The term "bikini medicine" refers to the mistaken belief that women's health differs from men's in only the areas that a bikini covers (ie, breasts and reproductive organs).

Unfortunately, numerous gaps remain in our understanding of the role of female sex physiology and hormones in the context of CVD risk and treatment, and specifically, in addressing how the life stages intersect to influence CVD risk and outcomes. These gaps include, but are not limited to, the following: optimal contraceptive methods after occurrence of a cardiac event in younger women; optimal perinatal care of women with CVD; the pathophysiology of adverse pregnancy outcomes (eg, gestational hypertension, gestational diabetes, placenta

dysfunction, maternal vascular abnormalities); the mechanism of the reported untoward effects of menopausal hormone therapy, particularly in women with known CVD; and the physiological factors predisposing women to frailty in old age.

At all stages of life, sex interacts with the SDOH to impact cardiovascular health. Early age at menarche (the beginning stage of female reproduction) is a risk factor for cardiometabolic disease incidence, adverse CVD outcomes, and earlier mortality.[59,60] Early-life adverse exposures, poor nutrition, obesity, and early exposure to endocrine disrupter chemicals have been linked to earlier age at menarche in girls.[65,66] The exact mechanism linking early-life adversity with pubertal development and cardiometabolic risk in women is not clear, but mental health, stress, hyperandrogenism, insulin resistance, and systemic inflammation are all thought to potentially play a role.

Pregnancy has been nicknamed "nature's stress test," and women who experience an adverse condition during pregnancy (eg, gestational hypertension, gestational diabetes, premature delivery, placental abruption) are at much greater risk of developing premature CVD postpartum.[20] Furthermore, for many women, pregnancy can delay completion of postsecondary education and impact employment, which can in turn impact financial security and socioeconomic status, thereby impacting future health status. With improvements in the survival incidence of individuals with congenital heart disease, along with more women becoming pregnant at older ages, a growing number of women with acquired CVD have experienced pregnancy.[67] In response, the field of cardio-obstetrics has grown in Canada in recent years to help manage and improve pregnancy outcomes in women with CVD.

Estrogen is thought to be protective against CVD and its risk factors in premenopausal women, whereas postmenopausal decreases in estrogen levels are associated with hypertension and vascular injury. Menopause, generally, is recognized increasingly as a marker of CVD later in life. Early and premature menopause, in particular, are associated with increased CVD risk,[20] and also with several SDOH. The Canadian Longitudinal Study on Aging (CLSA) found, in its cross-sectional analysis of $>$ 7700 women aged 40 years and older, that single women, women with a high school to some college education, and women with lower household income were at increased risk of earlier age of natural menopause.[68] Women with existing CVD are also at higher risk of early menopause compared to women without existing CVD; however, whether CVD is a risk factor or outcome of an earlier age of menopause remains unclear.

Gender-based factors

Health behaviours. Gender is increasingly recognized as a pivotal determinant of health and outcomes, and gender factors, independent of sex, have been associated with poor CVD outcomes.[69] Gender identity, roles, relations, and institutionalization can have protective or harmful effects on health in numerous ways, including differences in use of healthcare services, systemic biases, risk exposures, and health behaviours.[70] For example, gender interacts with sex to influence the early adoption of health behaviours, such as physical activity. Physical inactivity and sedentary behaviours begin early in life, and both are risk factors for CVD across the lifespan. Generally, girls lag behind boys in terms of minutes of physical activity per day starting as early as preschool, and this trend continues into adulthood.[71] Boys are more often encouraged from the start of life to develop physical strength and gross motor skills, whereas girls have a greater emphasis placed on developing emotional and verbal skills.[72] This disparity is in part due to societal norms and perceptions of innate sex-specific physical characteristics and abilities. Later in life, self-efficacy, social support, and motivation impact physical activity participation among women differently than they do among men, and other psychosocial factors, such as perceived competency, perceived barriers and risks, subjective societal norms, and body image also play a role.[71]

Life experiences and trauma. Trauma experienced early in life, particularly physical and sexual abuse, are potent indicators of later life CVD.[73] In Canada, 12.5% of women and 4% of men report having experienced sexual abuse before the age of 15 years.[74] Just under half of women in Canada (44%) report having experienced intimate partner violence (IPV), including psychological and physical abuse.[74] IPV is associated with socioeconomic status later in life, and it is more common among Indigenous women, LGBTQ (for lesbian, gay, bisexual, transgender, queer/questioning) women, LGBTQ men, women with disabilities, and young women. Gender appears to impact how gender-related violence is experienced; women are more likely than men to report an emotional impact (92% vs 86%) and symptoms consistent with post-traumatic stress disorder (13% vs 4%) following IPV, and women's experiences of IPV have been shown to increase CVD risk factors, including cardiomyopathy, obesity, and dyslipidemia.[74] A 2020 survey conducted in 10 Canadian provinces found that 10% of women have experienced workplace discrimination based on gender, gender identity, or sexual orientation, compared with $<$ 4% of men.[75] Nearly half of LGBTQ respondents (47%) experienced discrimination at work. One quarter of women have experienced targeted sexual behaviours, specifically in the workplace, most often coming from a man.

Gender roles. Although social norms, gender roles, and demographics have been shifting such that more women are in the workforce and more men have taken on caregiving responsibilities, women remain more likely to be the primary caregiver for both children and elderly family members. In 2022, over half of unpaid caregivers in Canada (52%) were women, and women spent more hours per week on unpaid caregiving activities than did men (10 hours vs 6 hours).[76] Caregivers spend little time prioritizing their own health needs (eg, nutrition, physical activity, their own healthcare visits). Women are more likely than men to feel tired (62% vs 48%), anxious (50% vs 37%), overwhelmed (45% vs 27%), and depressed (20% vs 15%) due to their caregiving responsibilities.[76] A narrative review by Bouchard et al. reported that caregivers with elevated stress levels have a 2-fold increased risk of developing coronary artery disease (95% CI, 1.16-3.20) and hypertension (95% CI, 1.17-4.49), and a 2.6-fold increased risk of CVD-related mortality (95% CI, 1.50-4.65), compared with caregivers reporting little to no stress.[77] In a recent editorial, Parry emphasizes, given the

economic contributions of unpaid caregivers, along with the significant psychological and physical health burden placed upon them, an urgent need is to prioritize the health of unpaid caregivers in Canada.[78]

Sexual identity. Disparities exist among sexual-minority individuals (particularly lesbian, bisexual, transgender, and gender diverse women) when it comes to cardiovascular healthcare access, use, experiences, and outcomes.[79] People who are transgender and gender diverse experience significant stressors and unique disparities in relation to factors specific to these identities that further impact cardiovascular health across the lifespan.[80] Higher rates of other CVD risk factors (eg, smoking, obesity) and a higher prevalence of metabolic disease and CVD are observed in sexual-minority women, in particular.[81] Furthermore, race, socioeconomic status, sex, sexual orientation, and gender identity intersect to impact one's health.[82] Evaluation is needed of the mechanisms that link SDOH and clinical determinants with the cardiovascular health of LGBTQ adults, as well as integration of the content on LGBTQ health into healthcare professional training and continuing education.[79,80]

Gaps in gender-related research. Gender-related factors are not routinely collected in health research. An analysis conducted by the sex and gender champion on the Canadian Cardiovascular Guidelines Committee (C.M.N.) of the 175 randomized clinical trials, included in the ST elevation myocardial infarction guideline development, demonstrated that these trials neither collected nor measured gender-related factors.[83] Moreover, the **Gend**er and **S**ex Determ**i**nant**s** of Cardiovascular Disease: From **B**ench to Beyond—**Pr**emature **A**cute Coronary **Sy**ndrome (GENESIS-PRAXY) investigators (using the methodology now outlined in the Canadian Institutes of Health Research (CIHR) Institute of Gender and Health training module on Sex and Gender in the Analysis of Data from Human Participants) demonstrated that, regardless of sex, participants who reported roles and characteristics traditionally ascribed to women were 4.5 times as likely to experience a second cardiac event within the first year after their acute heart event.[69] A validation study using the Canadian GENESIS Gender Index in a cohort of patients of any age undergoing catheterization for ACS demonstrated similar results.[83] GENESIS helped inform ongoing work in the CIHR/GENDER-NET Plus funded project GOING-FWD (**G**ender **O**utcomes **In**ternational **G**roup: To **F**urther **W**ell-Being **D**evelopment; C.M.N., co-principal investigator). GOING-FWD is applying a multidimensional gender-based framework across multiple chronic disease cohorts, in 5 countries, to measure and understand sex- and gender-related determinants of health outcomes that contribute to both patients' well-being and health system sustainability.[84] A comprehensive framework of sex and gender variables has been developed, based on prior experience with gender measurement in CVD, including the creation of sex and gender variable collection templates with operationalized variables. This work aims to elucidate underlying psychosocial factors associated with outcomes following heart events. Guidance from the GOING-FWD project on the incorporation of gender into prospective and retrospective clinical studies has recently become available to access online at the CIHR Institute of Gender and Health website, at https://cihr-irsc.gc.ca/e/52608.html ("Methods for Prospectively and Retrospectively Incorporating Gender-Related Variables in Clinical Research").[85,86]

Environment and location

Neighbourhood location, availability of healthy food, high walkability, transit availability, increased physical activity resources, and access to socioeconomic resources are associated with reduction in CVD risk.[56,60,87,88] In Ontario, residents living in higher-income neighbourhoods experience a lower incidence of major CVD events than those in lower-income neighbourhoods.[61] Although not studied with sex- or gender-specific reporting in Canada, in the US, women who live in more-disadvantaged neighbourhoods experience higher risks for CVD, even after adjustment for socioeconomic differences.[62] Different from the experiences of men, greater levels of disadvantage, violence, and disorder increase risks of CVD among women,[62] whereas enhanced neighbourhood safety, social cohesion, and aesthetic quality are associated with reduced CVD risks.[88,89] Neighbourhoods where the particulate matter level associated with air pollution is elevated, such as neighbourhoods located in close proximity to agriculture, manufacturing, major roadways, and urban environments, increase CVD risk.[58] Women appear to be more reactive than men to environmental air pollutants, with a heightened risk of CVD.[58,90]

Geographic location can present barriers to healthcare access and CVD services.[60] More than 12% of women and girls overall, and nearly 27% of Indigenous women and girls in Canada, live in low-access, remote, or very remote communities.[91] Chapter 2 of this Atlas reported that age-standardized mortality rates for heart disease and stroke among women are highest in Canada's least populated and more rural provinces and territories.[92] Compared to women in urban areas, women living in rural and remote locations in Canada have poorer health outcomes, lower educational attainment and employment rates, and lower incomes, and are more likely to experience intimate partner or other gender-based violence and are less likely to engage in healthy behaviours.[91]

Overall, contributions of neighbourhood factors to development of CVD are greater for women (6.47% of 30-year risk) than they are for men (0.74% of 30-year risk).[93] Neighbourhood analysis and redesign represent important potential avenues for improving cardiovascular health at a population level.[87] Proactive efforts to improve the built environment and to expand and improve upon virtual care options may reduce CVD burdens through better neighbourhood designs and access to resources and services.[60]

Education and income

Poverty and low educational attainment are key contributing factors to observed health disparities between women and men.[81] Although lower socioeconomic status is associated with increased risk of CVD in both women and men, the association is greater in women.[94] The 2021 Canada Census data showed that poverty rates are similar among cisgender women and men (7.9% vs 8.2%, respectively).[95] However, the poverty rate for 1-parent families led by a woman is >5

times higher than it is for 2-parent families (31.3% vs 6.0%). Furthermore, transgender men (12.9%) and women (12.0%) are more likely to experience poverty than their cisgender counterparts, and over 20% of nonbinary people live in poverty in Canada. The poverty rate for Indigenous people (excluding First Nations people living on reserve) fell from 23.8% in 2015 to 11.8% in 2020; however, Indigenous people remain more likely than non-Indigenous people in Canada to experience poverty.[95]

Lower education more significantly increases women's risk of ischemic heart disease and CVD, compared to that among men.[94] The impacts of lower educational attainments on health outcomes are further compounded by lower levels of health literacy, which is the ability to obtain and comprehend knowledge and information in order to maintain or improve health.[60,96]

In Canada, the frequency of hospitalization for CVD is greatest among residents with lower socioeconomic means.[62] The impacts of socioeconomic status can alter CVD risk estimates, including the Framingham risk score, with overestimates of risks among individuals of higher socioeconomic means, and underestimates of risks among those with lower socioeconomic status.[60,97]

Socioeconomic status interacts with race and ethnicity. Anand et al. developed a social disadvantage index, which combines social and economic exposures into a single continuous measure.[98] This index was applied to a randomly selected group of 1227 Canadian men and women of South Asian, Chinese, Indigenous, and European ancestry. Social disadvantage was higher among older people, women, and non-White ethnic groups; increased social disadvantage was associated with an increased burden of some cardiovascular risk factors, and was independently associated with CVD. Further evaluation of additional measures of socioeconomic position, including interconnections with race and/or ethnicity, has been performed; structural racism and lack of diversity among cardiology clinicians and within clinical trials were contributing factors to adverse outcomes among women of racial and ethnic minorities.[99]

Sociocultural factors

Gendered socialization within traditional Western culture historically has led to distinctive expectations specific to men and women, with men socialized to be financially responsible for households and women to be emotionally responsible.[72] Rigid social roles and expectations associated with specific sexes increases the risks of CVD, with particularly high risks among women with poor-quality marriages, in situations with domestic violence, and facing high-intensity expectations as primary caregivers.[72]

Experiences of discrimination and harassment are well known to erode cardiovascular health, and they are connected to blood pressure and cardiovascular reactivity.[60,72] Within the healthcare system, implicit biases of clinicians may affect healthcare delivery to racialized populations via stereotypical assumptions on the part of clinicians, lower-quality communication and interactions between clinicians and racialized populations, and patients' fear of stereotyping.[72] Cultural factors influencing health outcomes also include language barriers, and discrimination due to a patient's perceived ability to speak English.[60] Access to medical care, including approachability, acceptability, availability, accommodation, and appropriateness affect CVD experiences.[60] Barriers to healthcare access include patients' beliefs, literacy, culture, and language.[60] Experiences of discrimination and racism also influence engagement in health behaviours, such as physical activity.[100]

Targeted and linguistically tailored, culturally specific and sensitive health education, preventive care, and treatment options delivered to specific racial and/or ethnic groups who are at greater risk may improve health knowledge and healthcare access and reduce health disparities.[101] Expansion of accessibility, maintenance of antiracist healthcare systems, increases in cultural competency training of the healthcare community, and inclusion of true representation of people of diverse backgrounds representative of Canada within healthcare systems are needed to support health outcomes for the increasingly diverse population in Canada.[99,102,103]

Race and ethnicity factors

Non-Indigenous ethnic minority women. An excess burden of CVD and its associated risk factors, particularly diabetes, obesity, and hypertension, exist in ethnic-minority groups, including South Asian (SA), Black, Hispanic, and Chinese North Americans, compared to the burden for those of European descent. CVD prognosis and outcomes are also worse in women of non-European and/or non-White origin .[92,104,105] SAs are the largest visible minority in Canada, followed by Chinese and Black Canadians, respectively.[106] This group has the highest rates of atherosclerotic CVD, hypertension, and stroke, compared to the rate among other non-Indigenous ethnic groups, for both men and women.[105,107]

SA women demonstrate metabolic abnormalities at a lower body mass index (BMI) and waist circumference than other groups, and SA women have higher waist-to-hip ratios, compared to women of European descent in Canada. These factors may contribute to the disproportionately higher prevalence of insulin resistance, metabolic syndrome, and diabetes among the SA population, compared to that among European-descent and Chinese groups, despite lower BMIs.[105,108] This high-risk phenotype, or "thin-fat" syndrome in SAs of larger-sized adipocytes and hepatic ectopic fat distribution, is felt to account partly for the increased cardiovascular risk in this population.[109] A study of familial hypercholesterolemia in American women demonstrated that women were less likely than men to receive statin and high-intensity statin therapy, and less likely to reach LDL cholesterol targets.[110] In addition, Asian and Black women were less likely to achieve LDL cholesterol levels less than 2.6 mmol/L, or even a 50% reduction from baseline levels, compared to White subjects.[110]

Cut points for obesity in relation to the distribution of glucose-, lipid-, and blood pressure-related risk factors for CVD are much lower for SA, Chinese, and Indigenous people than the values used for Europeans.[111] Given that lower BMI and waist circumference cutoffs are better predictors of type 2 diabetes and metabolic syndrome risk, sex- and ethnic group-specific cutoffs have been recommended in cardiovascular risk assessment by the World Health Organization (WHO),[112] the National Institute for Health and Care Excellence (NICE),[113] and the International Diabetes Federation.[114]

Table 2. Traditional and contemporary body mass index (BMI) and waist circumference cutoffs by ethnicity and sex

		BMI, kg/m^2			Waist circumference cutoffs, cm (inches)	
Classification	Ethnicity	Traditional WHO and NICE guidelines	Newly proposed, Caleyachetty et al.,[116] 2021	Risk of developing CVD risk factors	Bodicoat et al.[115]; Zhu et al.[117]; Zimmet et al.[114]	
Underweight		≤ 18.5	≤ 18.5	Increased		
Normal weight	South Asian	18.5–22.9	18.5–19.2	Low		
	Middle Eastern	18.5–22.9	18.5–22.1			
	Chinese	18.5–22.9	18.5–22.2			
	Black	18.5–22.9	18.5–23.4			
	White	18.5–24.9	18.5–24.9			
Overweight	South Asian	23.0–27.4	19.2–23.9	Increased		
	Middle Eastern	23.0–27.4	22.2–26.5			
	Chinese	23.0–27.4	22.2–26.9			
	Black	23.0–27.4	23.5–28.0			
	White	25.0–29.9	25.0–29.9			
Obese	South Asian	≥ 27.5	≥ 24.0	High	Women	≥ 77 (30)
					Men	≥ 90 (35)
	Middle Eastern		≥ 26.6		Women	≥ 80 (31)
					Men	≥ 94 (37)
	Chinese		≥ 27.0		Women	≥ 80 (31)
					Men	≥ 90 (35)
	Black		≥ 28.1		Women	≥ 94 (37)
					Men	≥ 99 (39)
	White	≥ 30.0	≥ 30.0		Women	≥ 88 (35)
					Men	≥ 102 (40)

CVD, cardiovascular disease; NICE, National Institute for Health and Care Excellence; WHO, World Health Organization.

More recently, large population-based cohort studies in the United Kingdom and US have recommended even lower targets for non-White ethnic groups, given their increased cardiovascular risk (Table 2).[115-117]

Black Canadian women have greater prevalence rates of stroke and hypertension compared to other ethnic groups, and they experience higher rates of physical inactivity and obesity, compared to those in the overall population.[108,118] Among all Canadian ethnic groups, East Asian Canadian women of predominantly Chinese descent have the lowest incidence of CVD. However, a greater duration of stay in Canada is linked with increased CVD risk among these women.[107,118] In specialized heart failure clinics in Ontario, more Chinese women had heart failure, compared to non-Chinese and non-SA patients.[119]

Race and/or ethnicity and sex and/or gender independently affect how women are investigated, managed, and treated.[2] One study found that Black people, women in particular, are less likely than White people and White men, respectively, to undergo cardiac catheterization or coronary artery bypass grafting when admitted to the hospital for treatment of chest pain or myocardial infarction.[120] Black and Hispanic patients with coronary artery disease and congestive heart failure had less access and fewer follow-up consultations than European-descent patients.[121] In an attempt to use race, ethnicity, and national origin data in studies assessing CVD morbidity and mortality in women with a history of HDP, one study determined that European-descent women were exceedingly overrepresented, and race and ethnicity information was minimally reported across research studies. Utilization of an intersectional approach was recommended for future studies.[122]

Indigenous women. Indigenous women (including First Nations, Inuit, and Métis people) are particularly vulnerable to CVD; First Nations women have a 76% greater risk of dying from CVD, compared with non-Indigenous Canadian women.[123] Despite the noted falling rates of CVD in Canadian women and men, rates of CVD in terms of prevalence and mortality continue to increase in the Canadian Indigenous population.[124] Based on the 2021 census, 1.8 million Indigenous persons reside in Canada, 51.9% of whom are women, representing 4.5% of the female population of Canada.[125] Indigenous women have not been represented in most cardiovascular research, limiting our understanding of CVD and outcomes in this population. The layering of SDOH issues for Indigenous people living in Canada creates compounding effects on health outcomes. Many Indigenous people live in rural and remote locations, dwellings in need of repair (28% of First Nations vs 7% of non-Indigenous people), crowded dwellings (15% of First Nations vs 3% of non-Indigenous people), and in more socially challenged neighbourhoods.[124,126] Indigenous people also face a lower employment level (48.6% of Indigenous people vs 61.8% of non-Indigenous people), a lower educational attainment level, and a lower income level.[126] SDOH contribute to poorer outcomes in Indigenous women. An important finding is that access to a regular healthcare provider was 2.5 times less likely in this population if they were living in remote areas, compared with those living in more-accessible areas.[127] with "absences of services" being the most-reported reason for not having a healthcare provider. This absence of service occurred irrespective of remoteness, but it was far more frequently seen in those who lived in the most-remote regions of Canada.

Indigenous people living in Canada experience unique SDOH that are manifested as jurisdictional challenges and variable health system coverage experiences, which create barriers to accessing healthcare. Indigenous people in Canada are less likely to obtain urgent CVD treatments, such as coronary angiography within 1 day of AMI.[124,128]

Specifically among Indigenous women, cultural changes with colonization, influencing community structure and processes, have greatly impacted health outcomes for members of Indigenous communities.[126,129] Indigenous people in Canada are more likely to experience hypertension if they have less connection to their traditional cultures, and conversely, those who have stronger connections to their Indigenous identity experience lower rates of hypertension.[130] As with SA populations, First Nations people in Canada are also more likely to engage in healthy behaviours, such as physical activity, if they are connected more strongly to their cultures.[130] The ongoing impacts of colonization, including the legacy of residential schools, ongoing foster care experiences, forced relocations, persistent racism, and social exclusion continue to disconnect Indigenous people from their identities and cultures, and drive health disparities.[126,131]

Importance of race and ethnicity in research. The collection of race and ethnicity data is standard procedure in many parts of the world. Although the Canadian Institute for Health Information is proposing standards for collecting race-based and Indigenous identity data in healthcare, consistency in this practice is lacking.[132] Despite progress having been made over the past few years, by organizations such as the Heart and Stroke Foundation of Canada and government granting agencies such as the Canadian Institutes of Health Research, via the development of sex and/or gender-based inclusion and analysis requirements, a critical need remains for the collection of race and ethnicity data to support research on the effects of racism on health.[133] Also critical is that study leaders be representative of the diverse populations studied, and that all publications include sex-and-gender analysis and reporting. When possible, data should be disaggregated by race and ethnicity.

Conclusions

Grassroots initiatives, such as the Canadian Women's Heart Health Alliance and this Atlas, are helping to raise awareness about the impact of CVD in women. However, CVD in women in Canada continues to be underrecognized, understudied, underdiagnosed, and undertreated. First and foremost, research that identifies sex- and/or gender-specific, ethnic- and/or race-specific, and sociocultural risk factors and their effects on CVD is lacking, even though it is fundamental to our understanding of women's heart health. Strategies that increase the enrollment and retention of women in clinical trials studying CVD are required. Over and above established risk factors for CVD in women, underrecognized risk factors, such as psychosocial, economic, and cultural factors that are influenced by sex and gendered factors, increase CVD risk and must be part of all women's heart health assessments. Vogel et al. note that in order to shape interventions and initiatives to target the reduction of CVD in women, identification of those women who are most susceptible is imperative, including women who are most likely to be affected by social, cultural, and economic factors that indirectly affect risk.[2] Finally, a pressing need exists to establish, enhance, and expand interdisciplinary and community-outreach women's heart health programs across Canada to ensure that all Canadians have access to equitable, diverse, and inclusive cardiovascular care.

Acknowledgements

The authors gratefully acknowledge Lisa Comber for her ongoing coordination of this Atlas. A special thanks goes to Manu Sandhu from the University of Ottawa Heart Institute and Alexa Desjarlais from the University of Calgary for their graphic design of Figure 1. This article was submitted on behalf of the Canadian Women's Heart Health Alliance, a pan-Canadian network of nearly 200 clinicians, scientists, allied health professionals, program administrators, and women with lived experience, 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. This alliance is powered by the Canadian Women's Heart Health Centre at the University of Ottawa Heart Institute.

Ethics Statement

The research reported has adhered to the relevant ehtical guidelines.

Patient Consent

The authors confirm that patient consent is not applicable, as this is a review article and does not include the use of individual-patient data.

Funding Sources

This work was supported by the University of Ottawa Heart Institute Foundation, Ottawa, Ontario, Canada.

Disclosures

The authors have no conflicts of interest to disclose.

References

1. Galea S, Hernán MA. Win-win: reconciling social epidemiology and causal inference. AmJ Epidemiol 2019;189:167-70.

2. Vogel B, Acevedo M, Appelman Y, et al. The Lancet Women and Cardiovascular Disease Commission: reducing the global burden by 2030. Lancet 2021;397:2385-438.

3. Powell-Wiley TM, Baumer Y, Baah FO, et al. Social determinants of cardiovascular disease. Circ Res 2022;130:782-99.

4. Crenshaw KW. On intersectionality: essential writings. Available at: https://scholarship.law.columbia.edu/books/255. Accessed January 5, 2023.

5. Allana S, Ski CF, Thompson DR, Clark AM. Bringing intersectionality to cardiovascular health research in Canada. CJC Open 2021;3:S4-8.

6. Forde AT, Crookes DM, Suglia SF, Demmer RT. The weathering hypothesis as an explanation for racial disparities in health: a systematic review. Ann Epidemiol 2019;33:1-18.e13.

7. Vervoort D, Kimmaliardjuk DM, Ross HJ, et al. Access to cardiovascular care for Indigenous peoples in Canada: a rapid review. CJC Open 2022;4:782-91.

8. Institute of Medicine (US). Committee on Women's Health Research. Women's Health Research: Progress, Pitfalls, and Promise. Washington, DC: National Academies Press, 2010.

9. Pacheco C, Mullen K-A, Coutinho T, et al. The Canadian Women's Heart Health Alliance atlas on the epidemiology, diagnosis, and management of cardiovascular disease in women; chapter 5: sex- and gender-unique manifestations of cardiovascular disease. CJC Open 2021;4:243-62.

10. Lichtman JH, Leifheit EC, Safdar B, et al. Sex differences in the presentation and perception of symptoms among young patients with myocardial infarction. Circulation 2018;137:781-90.

11. Lichtman JH, Leifheit-Limson EC, Watanabe E, et al. Symptom recognition and healthcare experiences of young women with acute myocardial infarction. Circ Cardiovasc Qual Outcomes 2015;8(suppl 1):S31-8.

12. Shah ASV, Anand A, Strachan FE, et al. High-sensitivity troponin in the evaluation of patients with suspected acute coronary syndrome: a stepped-wedge, cluster-randomised controlled trial. Lancet 2018;392:919-28.

13. Beveridge R, Clarke B, Janes L, et al. Implementation guidelines for the Canadian Emergency Department Triage & Acuity Scale (CTAS). Available at: https://ctas-phctas.ca/wp-content/uploads/2018/05/ctased16_98.pdf. Accessed April 30, 2023.

14. Writing Committee Members, Gulati M, Levy PD, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR guideline for the evaluation and diagnosis of chest pain: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol 2021;78:e187-285.

15. Tegg NL, Desmarais OH, Lindsay MP, et al. A survey of female-specific cardiovascular protocols in emergency departments in Canada. CJC Open 2023;5:107-11.

16. Colella TJF, Hardy M, Hart D, et al. The Canadian Women's Heart Health Alliance atlas on the epidemiology, diagnosis, and management of cardiovascular disease in women; chapter 3: patient perspectives. CJC Open 2021;3:229-35.

17. Lundberg GP, Mehta LS, Sanghani RM, et al. Heart centers for women: historical perspective on formation and future strategies to reduce cardiovascular disease. Circulation 2018;138:1155-65.

18. Aggarwal NR, Mulvagh SL. Women's heart programs. In: Aggarwal NR, Wood MJ, eds. Sex Differences in Cardiac Diseases. city: Elsevier, 2021:671-87.

19. Gulati M, Hendry C, Parapid B, Mulvagh SL. Why we need specialised centres for women's hearts: changing the face of cardiovascular care for women. Eur Cardiol 2021;16:e52.

20. Mulvagh SL, Mullen KA, Nerenberg KA, et al. The Canadian Women's Heart Health Alliance atlas on the epidemiology, diagnosis, and management of cardiovascular disease in women—chapter 4: sex- and gender-unique disparities: CVD across the lifespan of a woman. CJC Open 2022;4:115-32.

21. Parvand M, Cai L, Ghadiri S, et al. One-year prospective follow-up of women with INOCA and MINOCA at a Canadian women's heart centre. Can J Cardiol 2022;38:1600-10.

22. Coutinho T. Heart teams for women's heart health: advancing cardiovascular prevention and care for women. In: Mesana T, ed. Heart Teams for Treatment of Cardiovascular Disease: A Guide for Advancing Patient-Centered Cardiac Care. Cham, Switzerland: Springer International, 2019:93-108.

23. McDonnell LA, Pipe AL, Westcott C, et al. Perceived vs actual knowledge and risk of heart disease in women: findings from a Canadian survey on heart health awareness, attitudes, and lifestyle. Can J Cardiol 2014;30:827-34.

24. McDonnell LA, Turek M, Coutinho T, et al. Women's heart health: knowledge, beliefs, and practices of Canadian physicians. J Womens Health (Larchmt) 2018;27:72-82.

25. Wenger NK, Lloyd-Jones DM, Elkind MSV, et al. Call to action for cardiovascular disease in women: epidemiology, awareness, access, and delivery of equitable health care: a presidential advisory from the American Heart Association. Circulation 2022;145:e1059-71.

26. Cushman M, Shay CM, Howard VJ, et al. Ten-year differences in women's awareness related to coronary heart disease: results of the 2019 American Heart Association national survey: a special report from the American Heart Association. Circulation 2021;143:e239-48.

27. Flink LE, Sciacca RR, Bier ML, Rodriguez J, Giardina EG. Women at risk for cardiovascular disease lack knowledge of heart attack symptoms. Clin Cardiol 2013;36:133-8.

28. Gonsalves CA, McGannon KR, Schinke RJ, Pegoraro A. Mass media narratives of women's cardiovascular disease: a qualitative meta-synthesis. Health Psych Rev 2017;11:164-78.

29. Mosca L, Hammond G, Mochari-Greenberger H, et al. Fifteen-year trends in awareness of heart disease in women: results of a 2012 American Heart Association national survey. Circulation 2013;127:1254-1263, e1-29.

30. Muñoz LR, Etnyre A, Adams M, et al. Awareness of heart disease among female college students. J Womens Health (Larchmt) 2010;19:2253-9.

31. McSweeney JC, Rosenfeld AG, Abel WM, et al. Preventing and experiencing ischemic heart disease as a woman: state of the science. Circulation 2016;133:1302-31.

32. Beussink-Nelson L, Baldridge AS, Hibler E, et al. Knowledge and perception of cardiovascular disease risk in women of reproductive age. Am J Prev Cardiol 2022;11:100364.

33. Roth H, LeMarquand G, Henry A, Homer C. Assessing knowledge gaps of women and healthcare providers concerning cardiovascular risk after hypertensive disorders of pregnancy—a scoping review. Front Cardiovasc Med 2019;6:178.

34. Lujan ME, Chizen DR, Pierson RA. Diagnostic criteria for polycystic ovary syndrome: pitfalls and controversies. J Obstet Gynaecol Can 2008;30:671-9.

35. Osibogun O, Ogunmoroti O, Michos ED. Polycystic ovary syndrome and cardiometabolic risk: opportunities for cardiovascular disease prevention. Trends Cardiovasc Med 2020;30:399-404.

36. Ismayilova M, Yaya S. What can be done to improve polycystic ovary syndrome (PCOS) healthcare? Insights from semi-structured interviews with women in Canada. BMC Women's Health 2022;22:157.

37. Ghosh-Swaby OR, Kuriya B. Awareness and perceived risk of cardiovascular disease among individuals living with rheumatoid arthritis is low: results of a systematic literature review. Arthritis Res Ther 2019;21:33.

38. Scalzi LV, Ballou SP, Park JY, Redline S, Kirchner HL. Cardiovascular disease risk awareness in systemic lupus erythematosus patients. Arthritis Rheum 2008;58:1458-64.

39. Khoudary SRE, Aggarwal B, Beckie TM, et al. Menopause transition and cardiovascular disease risk: implications for timing of early prevention: a scientific statement from the American Heart Association. Circulation 2020;142:e506-32.

40. Nanna MG, Wang TY, Xiang Q, et al. Sex differences in the use of statins in community practice. Circ Cardiovasc Qual Outcomes 2019;12:e005562.

41. Butalia S, Lee-Krueger RCW, McBrien KA, et al. Barriers and facilitators to using statins: a qualitative study with patients and family physicians. CJC Open 2020;2:530-8.

42. Udell JA, Koh M, Qiu F, et al. Outcomes of women and men with acute coronary syndrome treated with and without percutaneous coronary revascularization. J Am Heart Assoc 2017;6:e004319.

43. Udell JA, Fonarow GC. Sustained sex-based treatment differences in acute coronary syndrome care: insights from the American Heart Association Get With The Guidelines Coronary Artery Disease Registry. Clin Cardiol 2018;41:758-68.

44. DeFilippis EM, Van Spall HGC. Is it time for sex-specific guidelines for cardiovascular disease? J Am Coll Cardiol 2021;78:189-92.

45. Parry M, Van Spall HGC, Mullen KA, et al. The Canadian Women's Heart Health Alliance atlas on the epidemiology, diagnosis, and management of cardiovascular disease in women—chapter 6: sex- and gender-specific diagnosis and treatment. CJC Open 2022;4:589-608.

46. Thande NK, Wang M, Curlin K, Dalvie N, Mazure CM. The influence of sex and gender on health: how much is being taught in medical school curricula? J Womens Health (Larchmt) 2019;28:1748-54.

47. Miller VM, Rice M, Schiebinger L, et al. Embedding concepts of sex and gender health differences into medical curricula. J Women's Health 2013;22:194-202.

48. Anderson NN, Gagliardi AR. Medical student exposure to women's health concepts and practices: a content analysis of curriculum at Canadian medical schools. BMC Med Educ 2021;21:435.

49. Adreak N, Srivaratharajah K, Mullen KA, et al. Incorporating a women's cardiovascular health curriculum into medical education. CJC Open 2021;3(12 suppl):S187-91.

50. Norris CM, Yip CYY, Nerenberg KA, et al. State of the science in women's cardiovascular disease: a Canadian perspective on the influence of sex and gender. J Am Heart Assoc 2020;9:e015634.

51. Tannenbaum C, Clow B, Haworth-Brockman M, Voss P. Sex and gender considerations in Canadian clinical practice guidelines: a systematic review. CMAJ Open 2017;5:E66-73.

52. Migeon BR. The role of X inactivation and cellular mosaicism in women's health and sex-specific diseases. JAMA 2006;295:1428-33.

53. Johnson JL, Greaves L, Repta R. Better science with sex and gender: facilitating the use of a sex and gender-based analysis in health research. Int J Equity Health 2009;8:14.

54. Canadian Institutes of Health Research. Science is better with sex and gender: Strategic plan 2018-2023. Available at: https://cihr-irsc.gc.ca/e/51310.html. Accessed August 5, 2022.

55. Baum F, Musolino C, Gesesew HA, Popay J. New perspective on why women live longer than men: an exploration of power, gender, social determinants, and capitals. Int J Environ Res Public Health 2021;18:661.

56. Diez Roux AV, Mujahid MS, Hirsch JA, Moore K, Moore LV. The impact of neighborhoods on CV risk. Global Heart 2016;11:353-63.

57. Palacio A, Mansi R, Seo D, et al. Social determinants of health score: Does it help identify those at higher cardiovascular risk? Am J Managed Care 2020;26:e312-8.

58. Brooks JL, Berry DC, Currin EG, et al. A community-engaged approach to investigate cardiovascular-associated inflammation among American Indian women: a research protocol. Res Nurs Health 2019;42:165-75.

59. Campbell DJ, King-Shier K, Hemmelgarn BR, et al. Self-reported financial barriers to care among patients with cardiovascular-related chronic conditions. Health Rep 2014;25:3-12.

60. Havranek EP, Mujahid MS, Barr DA, et al. Social determinants of risk and outcomes for cardiovascular disease: a scientific statement from the American Heart Association. Circulation 2015;132:873-98.

61. Tu JV, Chu A, Maclagan L, et al. Regional variations in ambulatory care and incidence of cardiovascular events. CMAJ 2017;189:E494-501.

62. Xiao Y-YK, Graham G. Where we live: the impact of neighborhoods and community factors on cardiovascular health in the United States. Clin Cardiol 2019;42:184-9.

63. Pepine CJ, Ferdinand KC, Shaw LJ, et al. Emergence of nonobstructive coronary artery disease: a woman's problem and need for change in definition on angiography. J Am Coll Cardiol 2015;66:1918-33.

64. Gulati M. Improving the cardiovascular health of women in the nation: moving beyond the bikini boundaries. Circulation 2017;135:495-8.

65. Lee HS. Why should we be concerned about early menarche? Clin Exp Pediatr 2021;64:26-7.

66. Suglia SF, Campo RA, Brown AGM, et al. Social determinants of cardiovascular health: early life adversity as a contributor to disparities in cardiovascular diseases. J Pediatr 2020;219:267-73.

67. Windram J, Grewal J, Bottega N, et al. Canadian Cardiovascular Society: clinical practice update on cardiovascular management of the pregnant patient. Can J Cardiol 2021;37:1886-901.

68. Costanian C, McCague H, Tamim H. Age at natural menopause and its associated factors in Canada: cross-sectional analyses from the Canadian Longitudinal Study on Aging. Menopause 2018;25:265-72.

69. Pelletier R, Khan NA, Cox J, et al. Sex versus gender-related characteristics: Which predicts outcome after acute coronary syndrome in the young? J Am Coll Cardiol 2016;67:127-35.

70. Miani C, Wandschneider L. Measurement of gender as a social determinant of health in epidemiology—a scoping review. PLoS One 2021;16:e0259223.

71. Edwards ES, Sackett SC. Psychosocial variables related to why women are less active than men and related health implications. Cli Med Insights Women's Health 2016;9(suppl 1):47-56.

72. O'Neil A, Scovelle AJ, Milner AJ, Kavanagh A. Gender/sex as a social determinant of cardiovascular risk. Circulation 2018;137:854-64.

73. Rich-Edwards JW, Mason S, Rexrode K, et al. Physical and sexual abuse in childhood as predictors of early-onset cardiovascular events in women. Circulation 2012;126:920-7.

74. Cotter A. Intimate partner violence in Canada, 2018: an overview. Available at: https://www150.statcan.gc.ca/n1/pub/85-002-x/2021001/article/00003-eng.htm. Accessed May 25, 2023.

75. Burczycka M. Workers' experiences of inappropriate sexualized behaviours, sexual assault and gender-based discrimination in the Canadian provinces. Available at: https://www150.statcan.gc.ca/n1/en/pub/85-002-x/2021001/article/00015-eng.pdf?st=Z-npUU_E. Accessed May 25, 2023.

76. Statistics Canada. More than half of women provide care to children and care-dependent adults in Canada. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/221108/dq221108b-eng.htm. Accessed May 25, 2023.

77. Bouchard K, Greenman PS, Pipe A, Johnson SM, Tulloch H. Reducing caregiver distress and cardiovascular risk: a focus on caregiver-patient relationship quality. Can J Cardiol 2019;35:1409-11.

78. Parry M. Caregiver burden and cardiovascular disease: Can we afford to keep the health of caregivers in Canada invisible? Can J Cardiol 2019;35:1267-9.

79. Caceres BA, Streed CG, Corliss HL, et al. Assessing and addressing cardiovascular health in LGBTQ adults: a scientific statement from the American Heart Association. Circulation 2020;142:e321-32.

80. Streed CG, Beach LB, Caceres BA, et al. Assessing and addressing cardiovascular health in people who are transgender and gender diverse: a scientific statement from the American Heart Association. Circulation 2021;144:e136-48.

81. Lindley KJ, Aggarwal NR, Briller JE, et al. Socioeconomic determinants of health and cardiovascular outcomes in women: JACC review topic of the week. J Am Coll Cardiol 2021;78:1919-29.

82. Veenstra G. Race, gender, class, and sexual orientation: intersecting axes of inequality and self-rated health in Canada. Int J Equity Health 2011;10:3.

83. Norris CM, Johnson NL, Hardwicke-Brown E, et al. The contribution of gender to apparent sex differences in health status among patients with coronary artery disease. J Womens Health (Larchmt) 2017;26:50-7.

84. Raparelli V, Norris CM, Herrero MT, et al. The GOING-FWD (Gender Outcomes INternational Group: to Further Well-being Development) project [abstract 51]. Can J Cardiol 2021;37:e20.

85. Raparelli V, Norris CM, Bender U, et al. Identification and inclusion of gender factors in retrospective cohort studies: the GOING-FWD framework. BMJ Global Health 2021;6:e005413.

86. Tadiri CP, Raparelli V, Abrahamowicz M, et al. Methods for prospectively incorporating gender into health sciences research. J Clin Epidemiol 2021;129:191-7.

87. Méline J, Chaix B, Pannier B, et al. Neighborhood walk score and selected cardiometabolic factors in the French RECORD cohort study. BMC Public Health 2017;17:960.

88. Unger E, Diez-Roux AV, Lloyd-Jones DM, et al. Association of neighborhood characteristics with cardiovascular health in the multi-ethnic study of atherosclerosis. Circ Cardiovasc Qual Outcomes 2014;7:524-31.

89. Mujahid MS, Moore LV, Petito LC, et al. Neighborhoods and racial/ethnic differences in ideal cardiovascular health (the Multi-Ethnic Study of Atherosclerosis). Health Place 2017;44:61-9.

90. Clougherty JE. A growing role for gender analysis in air pollution epidemiology. Environ Health Perspect 2010;118:167-76.

91. Leclerc K. Portrait of women by the relative remoteness of their communities, series 1: sociodemographic profile. Available at: https://www150.statcan.gc.ca/n1/en/pub/45-20-0002/452000022021001-eng.pdf?st=NWfVqbkH. Accessed May 23, 2023.

92. Jaffer S, Foulds HJA, Parry M, et al. 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. CJC Open 2021;3:1-11.

93. Sponholtz TR, Vasan RS. Contribution of the neighborhood environment to cross-sectional variation in long-term CVD risk scores in the Framingham Heart Study. PloS One 2018;13:e0201712.

94. Schultz WM, Kelli HM, Lisko JC, et al. Socioeconomic status and cardiovascular outcomes: challenges and interventions. Circulation 2018;137:2166-78.

95. Statistics Canada. Disaggregated trends in poverty from the 2021 Census of Population. Available at: https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-X/2021009/98-200-X2021009-eng.cfm. Accessed May 26, 2023.

96. Liu C, Wang D, Liu C, et al. What is the meaning of health literacy? A systematic review and qualitative synthesis. Fam Med Community Health 2020;8:e000351.

97. Fiscella K, Tancredi D, Franks P. Adding socioeconomic status to Framingham scoring to reduce disparities in coronary risk assessment. Am Heart J 2009;157:988-94.

98. Anand SS, Razak F, Davis AD, et al. Social disadvantage and cardiovascular disease: development of an index and analysis of age, sex, and ethnicity effects. Int J Epidemiol 2006;35:1239-45.

99. Spall HGCV, Lala A, Deering TF, et al. Ending gender inequality in cardiovascular clinical trial leadership. J Am Coll Cardiol 2021;77:2960-72.

100. Ironside A, Ferguson LJ, Katapally TR, et al. Social determinants associated with physical activity among Indigenous adults at the University of Saskatchewan. Appl Physiol Nutr Metab 2021;46:1159-69.

101. Joo JY, Liu MF. Culturally tailored interventions for ethnic minorities: a scoping review. Nursing Open 2021;8:2078-90.

102. Hassen N, Lofters A, Michael S, et al. Implementing anti-racism interventions in healthcare settings: a scoping review. Int J Environ Res Public Health 2021;18:2993.

103. Mahabir DF, O'Campo P, Lofters A, et al. Experiences of everyday racism in Toronto's health care system: a concept mapping study. Int J Equity Health 2021;20:74.

104. Gasevic D, Ross ES, Lear SA. Ethnic differences in cardiovascular disease risk factors: a systematic review of North American evidence. Can J Cardiol 2015;31:1169-79.

105. Rana A, de Souza RJ, Kandasamy S, Lear SA, Anand SS. Cardiovascular risk among South Asians living in Canada: a systematic review and meta-analysis. CMAJ Open 2014;2:E183-91.

106. Statistics Canada. Immigration and ethnocultural diversity: key results from the 2016 Census. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025b-eng.htm. Accessed August 8, 2022.

107. Chiu M, Austin PC, Manuel DG, Tu JV. Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. Can Med Assoc J 2010;182:E301-10.

108. Fernando E, Razak F, Lear SA, Anand SS. Cardiovascular disease in South Asian migrants. Can J Cardiol 2015;31:1139-50.

109. Anand SS, Tarnopolsky MA, Rashid S, et al. Adipocyte hypertrophy, fatty liver and metabolic risk factors in South Asians: the molecular study of health and risk in ethnic groups (mol-SHARE). PloS One 2011;6:e22112.

110. Amrock SM, Duell PB, Knickelbine T, et al. Health disparities among adult patients with a phenotypic diagnosis of familial hypercholesterolemia in the CASCADE-FH patient registry. Atherosclerosis 2017;267:19-26.

111. Razak F, Anand SS, Shannon H, et al. Defining obesity cut points in a multiethnic population. Circulation 2007;115:2111-8.

112. World Health Organization. The Asia-Pacific perspective: redefining obesity and its treatment. Available at: https://apps.who.int/iris/bitstream/handle/10665/206936/0957708211_eng.pdf?sequence = 1&is. Accessed June 3, 2023.

113. National Institute for Health and Care Excellence (NICE). Obesity: identification, assessment and management. Available at: https://www.nice.org.uk/guidance/cg189/chapter/Recommendations#identifying-and-assessing-overweight-obesity-and-central-adiposity. Accessed June 2, 2023.

114. Zimmet P, Alberti KGMM, Serrano Ríos M. Una nueva definición mundial del síndrome metabólico propuesta por la Federación Internacional de Diabetes: fundamento y resultados [A new international Diabetes Federation worldwide definition of the metabolic syndrome: the rationale and the results]. Rev Esp Cardiol 2005;58:1371-6 [in Spanish].

115. Bodicoat DH, Gray LJ, Henson J, et al. Body mass index and waist circumference cut-points in multi-ethnic populations from the UK and India: the ADDITION-Leicester, Jaipur Heart Watch and New Delhi cross-sectional studies. PloS One 2014;9:e90813.

116. Caleyachetty R, Barber TM, Mohammed NI, et al. Ethnicity-specific BMI cutoffs for obesity based on type 2 diabetes risk in England: a population-based cohort study. Lancet DiabetEndocrinol 2021;9:419-26.

117. Zhu S, Heymsfield SB, Toyoshima H, et al. Race-ethnicity—specific waist circumference cutoffs for identifying cardiovascular disease risk factors 1—32. Am J Clin Nutr 2005;81:409-15.

118. Tu JV, Chu A, Rezai MR, et al. The incidence of major cardiovascular events in immigrants to Ontario, Canada: the CANHEART Immigrant Study. Circulation 2015;132:1549-59.

119. Choi D, Nemi E, Fernando C, Gupta M, Moe GW. Differences in the clinical characteristics of ethnic minority groups with heart failure managed in specialized heart failure clinics. JACC Heart Fail 2014;2:392-9.

120. Vaccarino V, Rathore SS, Wenger NK, et al. Sex and racial differences in the management of acute myocardial infarction, 1994 through 2002. N Engl J Med 2005;353:671-82.

121. Cook NL, Ayanian JZ, Orav EJ, Hicks LS. Differences in specialist consultations for cardiovascular disease by race, ethnicity, gender, insurance status, and site of primary care. Circulation 2009;119:2463-70.

122. Johnston A, Tseung V, Dancey SR, et al. Use of race, ethnicity, and national origin in studies assessing cardiovascular risk in women with a history of hypertensive disorders of pregnancy. CJC Open 2021;3:S102-17.

123. Prince SA, McDonnell LA, Turek MA, et al. The state of affairs for cardiovascular health research in Indigenous women in Canada: a scoping review. Can J Cardiol 2018;34:437-49.

124. Reading J. Confronting the growing crisis of cardiovascular disease and heart health among Aboriginal peoples in Canada. Can J Cardiol 2015;31:1077-80.

125. Statistics Canada. Indigenous population continues to grow and is much younger than the non-Indigenous population, although the pace of growth has slowed. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/220921/dq220921a-eng.htm. Accessed May 28, 2023.

126. Reading CL, Wien F. Health inequalities and social determinants of Aboriginal peoples' health. Available at: https://www.ccnsa-nccah.ca/docs/determinants/RPT-HealthInequalities-Reading-Wien-EN.pdf. Accessed October 28, 2021.

127. Statistics Canada. Health and well-being of women and girls living in communities at varying levels of remoteness, 2015 to 2018. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/220321/dq220321a-eng.htm. Accessed May 28, 2022.

128. Bresee LC, Knudtson ML, Zhang J, et al. Likelihood of coronary angiography among First Nations patients with acute myocardial infarction. Can Med Assoc J 2014;186:E372-80.

129. Chandler MJ, Lalonde C. Cultural continuity as a hedge against suicide in Canada's First Nations. Transcultural Psychiatry 1998;35:191-219.

130. Foulds HJA, Bredin SSD, Warburton DER. Ethnic differences in vascular function and factors contributing to blood pressure. Can J Public Health 2018;109:316-26.

131. Martin D, Miller AP, Quesnel-Vallée A, et al. Canada's universal health-care system: achieving its potential. Lancet 2018;391:1718-35.

132. Canadian Institute for Health Information. Proposed standards for race-based and Indigenous identity data collection and health reporting in Canada. Available at: https://www.cihi.ca/sites/default/files/document/guidance-and-standards-for-race-based-and-indigenous-identity-data-en.pdf. Accessed January 11, 2023.

133. Datta G, Siddiqi A, Lofters A. Transforming race-based health research in Canada. Can Med Assoc J 2021;193:E99-100.