CJC Open 6 (2024) 301–313

Original Article

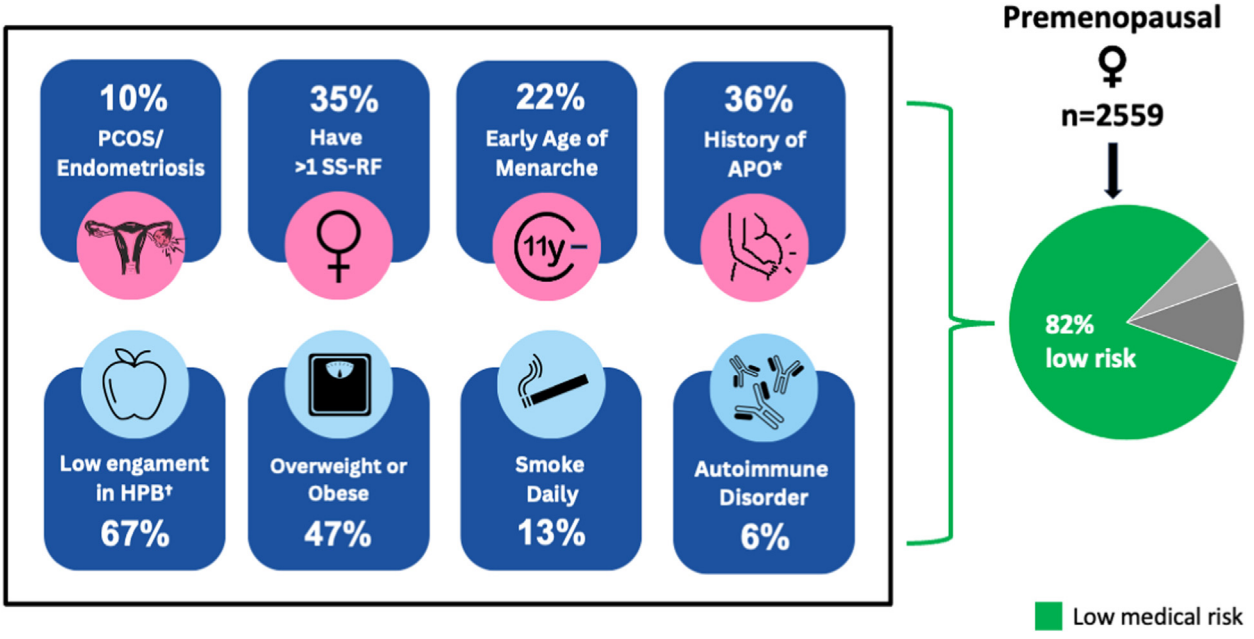
Prevalence of Sex-Specific Cardiovascular Disease Risk Factors, Medical Risk, and Engagement in Health-Promoting Behaviours in Premenopausal Females

Natalie Szakun, BKIN,[a] Sarah Liva, RN, PhD,[b] Michael E. Bodner, PhD,[a] Angela Wolff, RN, PhD,[b] Mi-Yeon Kim, RN, PhD,[b] and Anita T. Cote, PhD[a,c]

[a] *School of Human Kinetics, Trinity Western University, Langley, British Columbia, Canada*

[b] *School of Nursing, Trinity Western University, Langley, British Columbia, Canada*

[c] *Faculty of Medicine, Division of Cardiology, University of British Columbia, Vancouver, British Columbia, Canada*



ABSTRACT

Background: Several sex-specific risk factors (SS-RFs) increase a women's risk for cardiovascular disease (CVD) but are often overlooked during risk assessment. The purpose of this study was to identify the prevalence of SS-RFs and assess CVD risk, knowledge, perceptions and behaviours in premenopausal Canadian women.

Methods: An online survey was distributed across Canada to premenopausal biological females (19-49 years of age). The survey

RÉSUMÉ

Contexte : Plusieurs facteurs de risque liés au sexe (FR-LS) font augmenter le risque de maladies cardiovasculaires (MCV) chez les femmes, mais sont souvent négligés durant l'évaluation des risques. L'objectif de la présente étude était de déterminer la prévalence des FR-LS et d'évaluer le risque de MCV, les connaissances, les perceptions et les comportements au sein des femmes canadiennes préménopausées.

https://doi.org/10.1016/j.cjco.2023.11.003

gathered demographics, medical history, engagement in health-promoting behaviours, and knowledge and perceptions of CVD risk. CVD risk was calculated using medical risk and SS-RFs were tabulated from medical history.

Results: A total of 2559 participants (33 ± 8 years) completed the survey. The majority of our sample (82%) was classified as low medical risk. Of those classified as low risk, 35% had at least 1 SS-RF. Of high-risk individuals, 70% underestimated their risk, 21% of whom perceived themselves as low risk. Engagement in health behaviours was suboptimal. Knowledge of traditional CVD risk factors and prevention was relatively high; however, less than one-half were aware of SS-RFs such as early menopause (39.4%).

Conclusions: Considering both traditional and SS-RFs, 47% of premenopausal Canadian women may be at risk for developing CVD. Of those deemed low medical risk for developing CVD, more than one-third reported having at least 1 SS-RF. Canadian women have poor knowledge of the risks associated with SS-RFs, lack sufficient awareness of the need for prevention of CVD, and are not engaging in sufficient health-promoting behaviours to mitigate future CVD risk.

Méthodes : Une enquête en ligne a été distribuée aux femmes biologiques préménopausées (19-49 ans) du Canada. L'enquête a permis de recueillir les données démographiques, les antécédents médicaux, les renseignements sur l'adoption de comportements favorisant la santé, les connaissances et les perceptions du risque de MCV. Le risque de MCV a été calculé à partir du risque médical, et les FR-LS, compilés à partir des antécédents médicaux.

Résultats : Un total de 2 559 participantes (33 ± 8 ans) ont rempli l'enquête. La majorité de notre échantillon (82 %) a été classifiée dans la catégorie de faible risque médical. Parmi celles classifiées dans la catégorie de faible risque, 35 % avaient au moins 1 FR-LS. Parmi les personnes exposées à un risque élevé, 70 % sous-estimaient leur risque, et 21 % parmi elles se percevaient exposées à un faible risque. L'adoption de comportements liés à la santé était sous-optimale. Les connaissances sur les facteurs de risque de MCV traditionnels et sur la prévention étaient relativement élevées. Toutefois, moins de la moitié connaissaient les FR-LS telle la ménopause précoce (39,4 %).

Conclusions : Si l'on tient compte des FR traditionnels et des FR-LS, 47 % des femmes canadiennes préménopausées sont exposées au risque d'avoir une MCV. Parmi celles jugées à faible risque médical de MCV, plus d'un tiers ont déclaré avoir au moins 1 FR-LS. Les femmes canadiennes connaissent peu les risques associés aux FR-LS, ne disposent pas d'informations suffisantes sur la nécessité de la prévention des MCV, et n'adoptent pas suffisamment de comportements favorisant la santé pour atténuer le risque futur de MCV.

Lay Summary

Cardiovascular disease (CVD) is the leading cause of death for women worldwide. Much of the risk for developing CVD can be attributed to female reproductive factors. In this study, almost one-half of premenopausal women reported traditional or SS-RFs. Those with SS-RFs are unaware that they possess risk factors for CVD, and they do not engage in enough healthy lifestyle behaviours that are important for preventing CVD.

Cardiovascular disease (CVD) is the leading cause of death among women worldwide, posing a significant burden on individual health and health care systems as a whole.[1] Historically, CVD was viewed as a disease that primarily affects men,[2-4] yet recent estimates show women have an increased population-adjusted risk of mortality compared with men (20.9% vs 14.9%, respectively).[4] By midlife, most women have at least one risk factor for CVD,[5,6] yet many are unaware of their risk status and lack knowledge of risk factors.[7-9] When asked about personal risk of CVD, approximately 50% of women underestimate their risk of CVD,[10] and 60% of women deemed high CVD risk believe their risk to be low to moderate.[7]

Much of the underestimation of women's risk of CVD can be attributed to the lack of awareness of sex-specific CVD risk factors (SS-RFs). In addition to traditional risk factors (eg, smoking, family history of heart disease), an increased risk of CVD is associated with female reproductive factors that occur from menarche to menopause[11] such as early menarche,[12,13] polycystic ovary syndrome (PCOS),[11,14-16] breast cancer,[17] and early menopause.[18,19] Furthermore, adverse pregnancy outcomes (APOs)—specifically, hypertensive disorders, gestational diabetes, and preterm deliveries—increase the risk of death from ischemic heart disease 2-fold[20] and double the risk of a CV event within the first decade postpartum.[21] Thus, recognizing female SS-RFs, in addition to traditional risk factors, is important to increase the effectiveness of primary prevention of CVD. In addition, a more thorough and complete risk assessment can better inform current health messaging related to behaviour associated with the mitigation of CVD risk. Accordingly, the aims of this study were to determine the prevalence of SS-RFs, medical risk, and engagement in health-promoting behaviours in a sample of Canadian premenopausal women and evaluate the association between knowledge and perceptions of CVD risk with engagement in health-promoting behaviours. We hypothesized that perception of CVD risk would be positively associated with knowledge—but not engagement—in health-promoting behaviours.

Methods

Study design and population sample

Ethics approval was obtained by Trinity Western University's Human Research Ethics Board, in accordance with the latest Tri-Council Policy Statement and Canadian Association of Research Ethics Boards standards.

A national cross-sectional study was conducted in September and October 2021. Recruitment and survey

Received for publication August 11, 2023. Accepted November 4, 2023.

Corresponding author: Dr Anita T. Cote, Trinity Western University, School of Human Kinetics, CANIL Building, Room 115, 22500 University Drive, Langley, British Columbia V2Y 1Y1, Canada. Tel.: +1-604-513-2121, ext 3726.

E-mail: anita.cote@twu.ca

See page 310 for disclosure information.

distribution was directed through a third-party survey company (Hosted in Canada Surveys; Nepean, Ontario). The survey company worked with partner organizations that offered incentives for potential respondents (eg, reward points or cash). Survey responses were then sent to Hosted in Canada Surveys for compilation and storage until the target sample is achieved. The composite 68-item survey was developed for our target population by adapting a combination of questions from 6 health questionnaires. These questions were assembled into 4 sections: daily life and heart disease perceptions/experiences, general health, cardiovascular health, and demographics.[7,8,22-25] The inclusion of previously established conventional risk-related questions, as well as questions related to SS-RFs, allowed us to compare current findings with past results while also obtaining new information pertaining to risk factors and lifestyle. Participants who trialed the survey provided feedback to improve readability and understanding, and edits were also made based on current wording recommendations.[26-29] Participants provided electronic informed consent upon entering the survey link. The survey was only available in English (Supplemental Appendix S1).

The inclusion criteria and desired sampling distribution were provided to the survey company that they matched to the demographics in their database and target distribution of the survey. Stratified sampling was applied to control for participation rates from each geographic region, ensuring proportional distribution of responses reflective of the most recent Canadian census.[30] The survey closed when the target recruitment was met.

Inclusion criteria were biologically female at birth, premenopausal, 19+ years of age, and currently residing in Canada. Screening questions at the start of the survey asked participants to declare their biological sex at birth and whether they had or had not menstruated in the past 12 months. If participants answered they had not menstruated in the past 12 months (which could indicate menopause), subsequent questions confirmed whether it was because of pregnancy or hormonal contraception. Logic functions in the survey algorithm allowed for continuance of the survey if pregnancy or hormonal contraception was indicated. If the answers suggested the participant to be in menopause, the survey ended. To limit the number of ineligible women because of menopause, the survey was sent to those $\leq$ 49 years of age by the survey company; however, if someone older than 49 obtained the survey and completed it, as long as she met the criteria, the results were included.

Survey components

Knowledge, perceptions, and experiences. Participants' perceived risk, knowledge, attitudes, exposure, and personal experiences with heart disease (HD) were measured via 16 questions derived from 2 previous studies conducted by McDonnell et al. in 2014[7] and Bairey et al. in 2017.[8] Knowledge questions addressed what participants knew about risk of heart disease relative to other diseases, attitudes and experiences toward heart disease, knowledge of CVD-prevention behaviours, perceptions of personal risk of developing heart disease, and engagement with health care providers about their heart health. This section also explored participants' knowledge and behaviour changes as a result of heart health tests and reasons for not discussing heart health more with health care providers. Response options to knowledge questions included "choosing all that apply," recognition (yes/no/not sure), or involved a 4-point Likert scale (1 = "strongly agree" to 4 = "strongly disagree"). Participants reported their perceived personal risk as ("low," "moderate," or "high").

General and reproductive health. The Short Form Health Survey[22] was adapted to assess physical and emotional health status through 16 questions. A detailed medical history, including prescribed medication, seeing a health care provider or on a hospital waiting list, was included in this section. Reproductive medical history included current reproductive status (screening),[23] age of menarche, use of hormonal birth control, and perimenopausal symptoms. Pregnancy history questions included respondents' age of first pregnancy, number of births, physical activity levels pre, during, and postpartum and diagnosis of an APO (gestational hypertension, gestational diabetes, pre-eclampsia, preterm birth).

Cardiovascular health and lifestyle. Cardiovascular health history questions were adapted from previously developed questionnaires.[7,31] This section consisted of 24 questions that included medical history, family history, and current medication for diabetes, stroke/transient ischemic attack (TIA), peripheral vascular disease, and hypertension, respectively. Biometrics (eg, height, blood pressure, cholesterol levels) were obtained via self-reported data. When respondents were not aware of their numerical values for blood pressure or cholesterol (ie, total levels, high- and low-density lipoprotein), participants were prompted to record their values categorically, based on what they have been told by their health care providers ("healthy," "average," "unhealthy," and "I really don't know"). These qualitative measures were converted into numbers using the Comprehensive Health Improvement Program's criteria.[31] This section also included multiple-choice and short-answer questions that surveyed lifestyle habits pertaining to alcohol consumption, diet, sleep habits, and stress.

Demographic questions. Twelve questions surveyed participant demographics: age, sex, gender, ethnicity, income, occupation, ability, education, health insurance, and province of residence.[26-29] The estimated impact of COVID on socioeconomic status was measured via an adapted MacArthur scale of subjective social status.[32]

Data analysis

Knowledge score. Based on the number of correct answers for the knowledge questions, a summative score was derived, ranging from 0 to 45. Individual knowledge questions specific to lifestyle behaviours were compared with the corresponding behaviour in the lifestyle index (described in the following section) to assess the relationship between knowledge of health-promoting behaviours and engagement.

Medical risk. The risk of CVD was assessed using the Comprehensive Health Improvement Program criteria.[31]

Table 1. Participant sociodemographics

Characteristic	Prevalence (%)
Age (y), n = 2559	
19-29	35.7
30-39	39.0
40-49	25.2
Ethnic origin, n = 2557	
European	56.6
East and Southeast Asian	14.7
South Asian	5.4
African	3.7
Latin, Central and South American	3.5
Indigenous person of Canada	2.6
Middle Eastern	2.0
Other	2.7
Not known/prefer not to disclose	4.0
Indigenous + European	1.7
European + other minority	2.3
Multiple minorities	0.9
Gender identity, n = 2554	
Woman	97.9
Nonbinary	1.3
Two Spirit	0.3
Man	0.2
Other	0.2
Education, n = 2460	
Some high school	3.1
High school diploma or equivalent	20.1
College diploma	23.3
Some university education	11.5
Bachelor's degree	32.0
Master's degree	8.0
Doctorate degree	1.5
Certificate, trade, or vocational	0.6
Annual household income, n = 2556	
< $15,000	5.1
$15,000 - $29,999	12.3
$30,000 -$49,999	16.0
$50,000 - $69,999	16.8
$70,000 - $99,999	19.9
> $100,000	19.9
Do not know	3.3
Prefer not to answer	6.6
Employment status, n = 2554	
Employed	76.8
Unemployed	10.1
On leave	7.2
Unpaid care	5.5
Unpaired care + employed	0.4
Province of residence, n = 2551	
Ontario	36.7
British Columbia	29.2
Québec	12.3
Alberta	9.6
Manitoba	4.0
Nova Scotia	2.5
Saskatchewan	2.1
New Brunswick	1.9
Newfoundland and Labrador	1.2
Prince Edward Island	0.3
Nunavut	0.1
Yukon	0.1
Northwest Territories	0.1
Access to health insurance, n = 2549	
Standard provincial insurance	35.2
Standard provincial insurance + health insurance that I buy	11.6
Standard provincial insurance + health insurance that my employer buys	35.3
Standard provincial insurance + noninsured health benefits for Indigenous/Inuit peoples	1.9
No health insurance	16.1

Participants' medical risk was classified as low (never diagnosed with heart disease, stroke/TIA, or diabetes and met 1 or none of the following criteria: diagnosed high blood pressure, dyslipidemia, family history of heart disease or stroke/TIA, smoker, 55 years of age or older), moderate (participant had never been told by a health care provider that she had heart disease, stroke/TIA, or diabetes but met 2 or more of the following criteria: self-reported diagnosed high blood pressure, dyslipidemia, family history of heart disease or stroke/TIA, smoker, 55 years of age or older), or high (participant had ever been told by a health care provider that she had heart disease, stroke/TIA, diabetes) appropriate for risk estimation in this population.[7,33]

Risk accuracy. The respondents' perceived risk was compared with their medical risk. If an individual ranked her perceived risk below her medical risk, risk accuracy was classified as "underestimated." If a respondent perceived her risk to be greater than her medical risk, the risk accuracy was classified as "overestimated."

Lifestyle index. A lifestyle index was used to evaluate engagement in health-promoting behaviours. The lifestyle index score is positively related to engagement in health-promoting behaviours, with a lower score indicating less adherence to healthy behaviours weekly (Supplemental Appendix S2). Adapted from McDonell et al., 2014,[7] this index awards 0 to 2 points for each of the following health-promoting behaviors: sleep, physical activity, stress, and consumption of fruits and vegetables; and 0 to 1 point for consumption of alcohol, for a score between 0 and 9.

Sex-specific risk index. We created a SS-RF index using questions from the reproductive health questions in the survey. One point was assigned for a positive response to having experienced for each the following conditions: early age of menarche, APO, PCOS, endometriosis, and breast cancer treatment (score 0 to 5). Early age of menarche was positive if the participant's age at the onset of menarche was reported to be $\leq$ 11 years of age.[12]

Statistical analysis

Descriptive statistics were used to present the variables of interest. Prevalence was derived from the frequencies of categorical outcomes and reported as percent, whereas means and standard deviations were calculated for continuous variables. Normality of continuous variables was evaluated using the Shapiro-Wilk test. Proportional differences among categorical variables were assessed using χ^2. Analysis of continuous variables by age, medical risk, perception of risk, and risk accuracy categories were assessed using analysis of variance (ANOVA) or Kruskal-Wallis, depending on normality. Linear regression was applied to evaluate associations between lifestyle index and knowledge, and lifestyle index and perception of CVD risk, while accounting for covariates (age, income, education, family history of heart disease, visits to their health care provider) in the models. Statistical significance was set at $\alpha < 0.05$, and analysis was

Table 2. Participant anthropometrics and medical history by age group

Response, N (%)	Total	19-29 (y)	30-39 (y)	40-49 (y)
BMI (n = 1976)*				
BMI kg/m^2	26.0 ± 6.2	24.9 ± 6.0	26.5 ± 6.3	26.8 ± 6.1
BMI class (n = 1976)*				
Underweight (< 18.4 kg/m^2)	5.6	54.5	29.5	16.1
Healthy (18.5-24.9 kg/m^2)	47.2	38.8	38.0	23.2
Overweight (25- 29.9 kg/m^2)	22.3	29.0	41.4	29.6
Obese (> 30 kg/m^2)	24.9	27.2	44.0	28.8
Waist-to-height ratio (n = 805)*				
Mean ± SD	0.48 ± 0.10	0.46 ± 0.08	0.49 ± 0.10	0.49 ± 0.11
Medical conditions (n = 2559)				
Anxiety	7.1	41.8	37.9	20.3
Autoimmune diseases*	7.2	21.1	42.2	36.8
All cancer†	1.8	23.9	32.6	43.5
Breast cancer	23.9	36.4	18.2	45.5
Depression	5.9	44.0	35.3	20.7
Diabetes*	4.3	20.4	39.8	39.8
Family history of heart disease	20.9	33.2	38.7	28.1
Gynecologic conditions†	11.3	27.3	43.3	29.4
Endometriosis	3.8	36.4	54.5	9.1
PCOS	3.5	50.0	40.0	10.0
Early menarche†	23.2	40.4	36.7	22.9
Heart condition	7.9	32.0	37.9	30.0
High blood pressure	6.1	28.8	41.7	29.5
High total cholesterol†	5.2	21.7	48.1	30.2
Peripheral vascular disease	2.7	30.4	37.7	31.9
Stroke/transient ischemic attack	2.2	32.1	37.5	30.4
Pregnancy*	48.6	16.3	46.8	37.0
Adverse pregnancy outcomes	39.6	18.8	46.3	34.9
Medications (n = 2559)				
Diabetes medication*	4.5	18.4	44.7	36.8
Blood pressure medication*	5.6	17.6	34.5	47.9
Cholesterol medication*	4.2	19.6	37.4	43.0
Hormonal contraception	17.0	33.8	40.3	25.9

All data are presented as prevalence (%) unless otherwise indicated.

Prevalence in the age group columns is the prevalence within that population (total column) and should equal 100%. Conditions indented are prevalence within the primary category (eg, 48.6% of all women surveyed reported having ever been pregnant, and 39.6% of those pregnant women reported an APO, which is 19% of the entire sample).

APO, adverse pregnancy outcome; BMI, body mass index; PCOS, polycystic ovary syndrome.

* $P < 0.01$ by age group.

† $P < 0.05$ by age group.

performed using SPSS V29.0 software (IBM, Armonk, New York, USA).

Results

Sociodemographics

A total of 3151 people accessed the survey. Of those, 281 did not meet the inclusion criteria, 300 had incomplete surveys, and 11 were response removals because of illogical responses. The final sample size was 2559, for a response rate of 81%. Participant sociodemographics are presented in Table 1. Although female sex was part of the inclusion criteria, gender was not controlled or specified. Within our female sample, 98% identified as women.

The mean age of the sample was 33.2 ± 8.1 was representative of the study population based on the most recent census (+/− 2%), as was our sample ethnicity, income, and education. There were minor exceptions in regional representation, with a higher proportion of responses from British Columbia (28.5% vs 13.7%, nationally), and lower proportion of responses from Québec (12% vs 22.5%, nationally),[30] possibly because the survey was only available in English.

Anthropometrics and medical history

Basic self-report anthropometric data and medical history is shown in Table 2, according to 3 age groups. Overall mean body mass index (BMI) was not different by age group; however, when separated by BMI category, more participants aged 19 to 29 years were classified as underweight compared with the 30 to 39 and 40 to 49 age groups, whereas the 2 older groups had a higher prevalence of overweight and obesity; χ^2 analysis also revealed less prevalence of autoimmune diseases, cancer, diabetes, the use of diabetes medication, high total cholesterol, and history of pregnancy in younger respondents. Within the entire sample, 38% reported having at least 1 SS-RF. Figure 1 illustrates the prevalence associated with having 1 or more SS-RF. Of those individuals who have ever been pregnant in the past (n = 1236), 40% experienced APOs, representing 23% (n = 605) of the 2682 pregnancies reported.

Medical risk

The majority of respondents (82%) were classified as low medical risk (Fig. 2A). Medical risk differed by ethnicity, with those of Indigenous decent having the greatest proportion of individuals classified as high risk (16.9%) and the least with

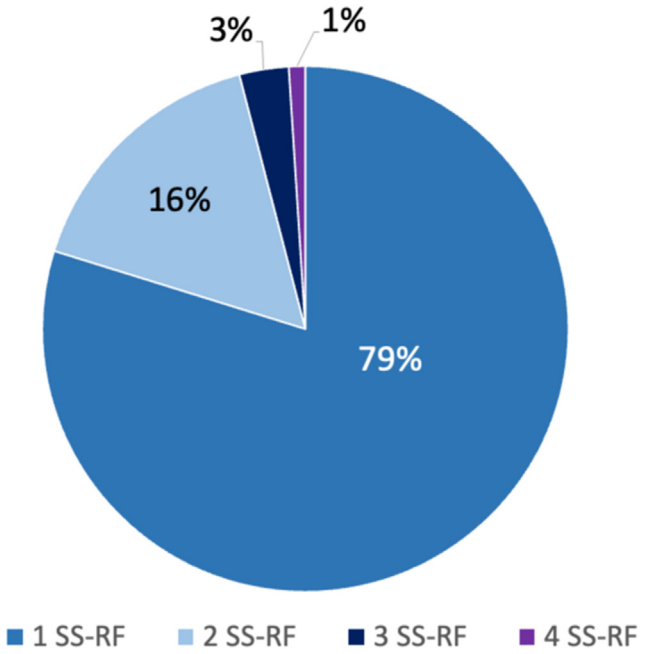


Figure 1. Prevalence associated with having 1 or more sex-specific risk factor (SS-RF). Of the 38% of the total population with SS-RFs, the majority reported having 1 SS-RF, whereas 21% had 2 or more.

low risk (67.8%, $P = 0.005$); comparatively, all other ethnicities had $\geq$ 80% low risk. When medical risk categories were stratified, the prevalence of SS-RF was 35%, 55%, and 49% in those classified as low, moderate, and high medical risk, respectively. Respondents who were identified as moderate to high risk without SS-RF (n = 201), and moderate to high risk with SS-RF (n = 211), and low risk individuals with SS-RF (n = 651), combined to a total prevalence of individuals at risk at 47% (n = 1063). Those who had an early age of menarche were less likely to be classified as low risk compared with those who experienced menarche after the age of 12 (70.5% vs 78.5%, $P = 0.031$). Individuals reporting early age of menarche were more likely to have a BMI classified as obese (37.2% vs 25.4%, $P = 0.001$), unhealthy blood pressure (10.6% vs 5.8%, $P = 0.004$), and taking medication for diabetes (10.2% vs 6.1%, $P = 0.023$) compared with those without early menarche. Of the sample that reported having been pregnant, low-risk individuals were less likely to report having experienced APOs compared with moderate and high-risk women (36%, 47%, and 53%, respectively; $P < 0.001$). There were no mean age differences across 2 risk groups (low and moderate to high) in individuals who had experienced APOs at the time of completing the survey (36.2 $\pm$ 7.1 vs 36.5 $\pm$ 7.2, respectively, $P = 0.652$), but time from first pregnancy was statistically different (11.3 $\pm$ 7.4 and 13.0 $\pm$ 8.5 years, respectively).

Knowledge

The overall knowledge score was 31.4 $\pm$ 8.0, or 70% of the maximum score (range: 2 to 45). Income (standardized B = 0.092, $P < 0.001$) and age (standardized B = 0.075, $P = 0.001$) were found significantly associated with knowledge score, although the linear regression model only explained 1.6% of the variance ($P < 0.001$). Overall knowledge was good for general CVD risk factors, with correct responses given by 66% to 88% of individuals for those questions. Knowledge of female-specific heart-attack symptoms were identified correctly 20% to 52% of the time.

The majority of women (61%) were unaware of the relationship between heart disease and early menopause, being too thin (58%), and autoimmune diseases (53%). Many (44%) did not identify decreasing sitting time as a preventive behaviour or taking prescribed medication (32%) on reducing heart disease. Those with histories of APO were less aware of its associated risk compared with those women without histories of APO (41% vs 36%, respectively, $P = 0.027$).

Risk perception

The majority of respondents (44%) perceived themselves to have moderate risk (PMR) for future CVD, 39% perceived themselves to be low risk (PLR), and 17%

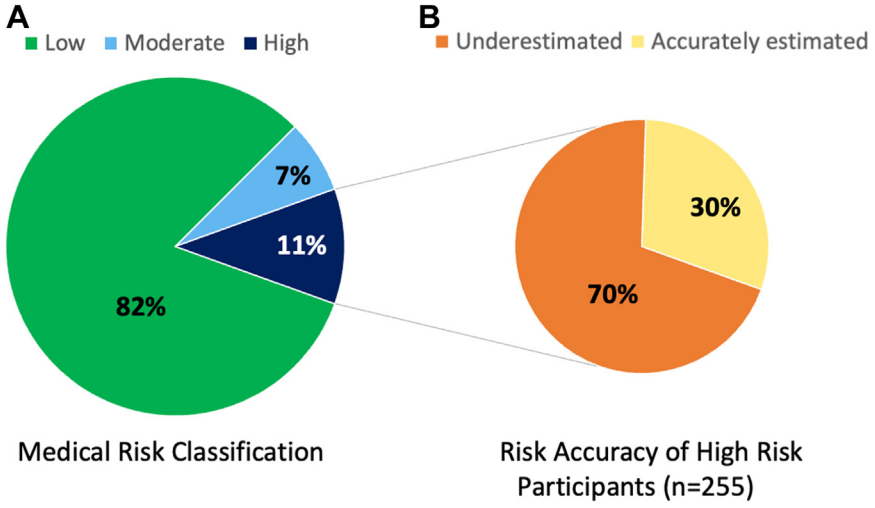


Figure 2. Prevalence of cardiovascular disease risk according to medical risk score (**A**) and risk estimation accuracy of those classified as high risk (**B**). Those who were classified as high medical risk underestimated their risk.

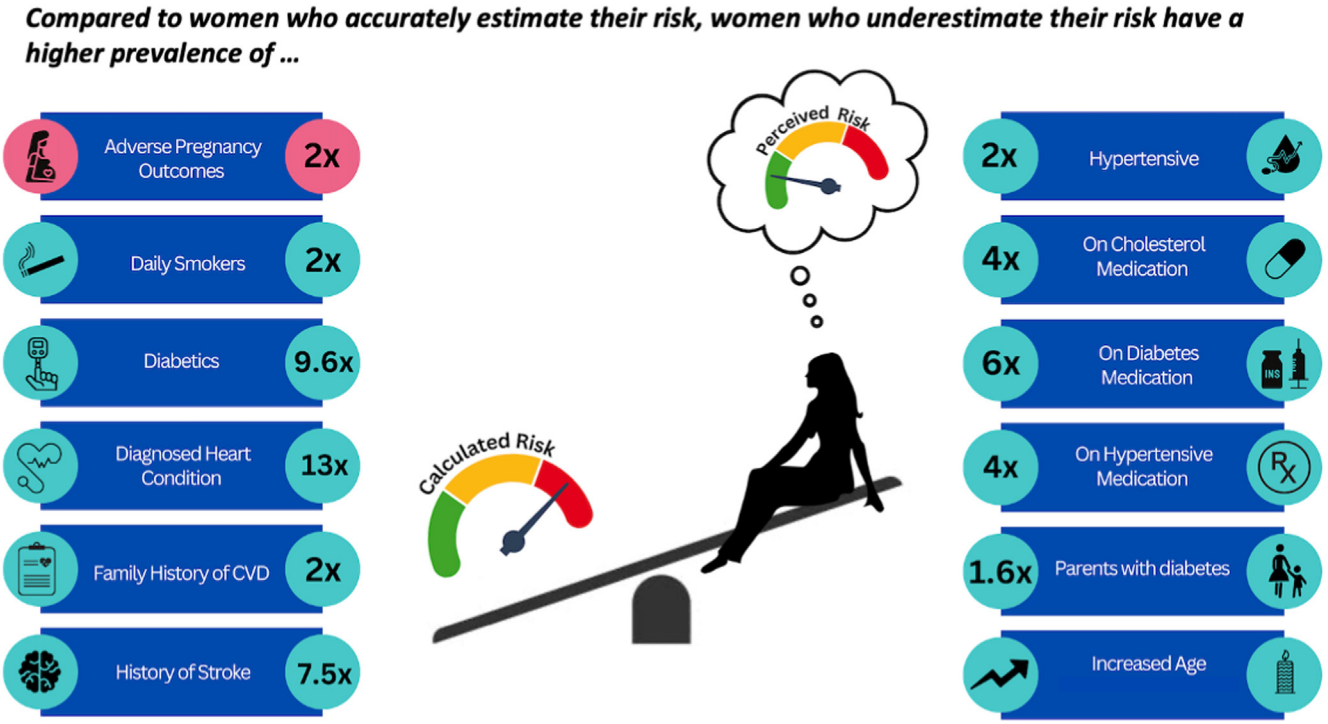


Figure 3. Risk profile of individuals who underestimated their medical risk. The prevalence of risk factors in the underestimators is presented for each factor compared with those who accurately or overestimated their risk. For example, those who underestimated their risk were 2 times more likely to be smokers compared with those who were aware of their risk. Risk factors are coloured to represent traditional (**blue**) and sex-specific risk factors (**pink**).

perceived themselves to be high risk (PHR). Knowledge scores differed among risk-perception groups ($P < 0.001$ each); as median knowledge scores increased, so did risk perception (PLR = 30.1 vs PHR = 33.1; $P < 0.001$). Talking to a health care provider about heart health was reported by 36.6% of respondents, whereas 54.9% of our sample reported speaking to others about their heart health. Those prescribed medication for high cholesterol, blood glucose, and blood pressure were more than twice as likely to indicate PHR ($P < 0.001$); however, a significant proportion of these medication users perceived themselves to be at low risk (28%, 21%, and 29%, for high cholesterol, blood glucose, and blood pressure, respectively). Of those reporting a history of stroke, 27% perceived themselves to be at low risk, whereas 40% of individuals classified as overweight, and 28% of those classified as obese, perceived themselves to be low risk.

Accuracy of risk perception

Of high-risk individuals, 70% (n = 177 of 255) underestimated their risk (Fig. 2B); 21% (n = 52 of 255) perceived themselves to be at low risk. By contrast, only 24% of moderate risk individuals underestimated their personal risk. Accuracy of risk perception was positively associated with knowledge, whereas those who overestimated their risk had higher knowledge compared with those who underestimated their personal risk of CVD (32.5 ± 7.5 vs 29.6 ± 8.9, respectively; $P < 0.001$). There was a significant relationship between the accuracy of risk estimation and sex-specific risk ($P < 0.001$), whereas those who underestimated their risk had a higher sex-specific risk index compared with those who accurately estimated their risk ($P = < 0.001$) and overestimated their risk ($P = 0.028$). Women who reported having APOs were twice as likely to underestimate their risk compared with those without APOs (16% vs 8%, $P < 0.001$). Characteristics of individuals who underestimated their risks of CVD are illustrated in Figure 3.

Lifestyle index

The lifestyle index for the entire sample was 4.6 ± 1.8 (range: 0, 9), a value corresponding to approximately one-half of the maximum score. Overall lifestyle index scores did not differ according to medical risk status; however, when assessed according to each individual lifestyle characteristic, a higher prevalence of low-risk individuals indicated having good sleep and being able to cope more with stress (Table 3). Figure 4 illustrates the prevalence of suboptimal health-promoting behaviours within the lifestyle index for low medical risk individuals relative to moderate- to high-risk individuals. Knowledge of prevention behaviours was not associated with reported engagement with their respective behaviours for daily fruit and vegetable consumption ($P = 0.337$), smoking ($P = 0.453$), or stress ($P = 0.562$). By contrast, a positive association was found between knowledge of achieving 7 to 8 hours a night for prevention of heart disease and getting a good sleep "most nights" ($P = < 0.001$).

Table 3. Prevalence of optimal engagement in health-promoting behaviours within the lifestyle index according to medical risk

	Risk categories			
	Low risk (%)	Moderate risk (%)	High risk (%)	*P* value*
Fruits/vegetables	5.8	5.1	5.1	0.910
Sleep	29.4	19.9	20.2	< 0.001
Activity	60.6	52.6	62.2	0.115
Stress	14.5	25.5	19.6	< 0.001
Alcohol	52.7	53.5	48.6	0.021

Optimal engagement was reported to be highest for physical activity and lowest for consumption of fruits and vegetables similarly across medical risk categories. Reported optimal sleep and coping with stress were higher in the low vs moderate- or high-risk groups. The prevalence of those who self-reported avoiding alcohol was similar between groups; those reporting consumption of 1 drink per day was the highest in the high-risk group, whereas the moderate-risk group had the highest prevalence of 2 or more drinks per day.

*χ^2 analysis.

Discussion

By surveying premenopausal women by design, this study focused on a relatively low-risk population for developing CVD based on traditional risk factors. The main findings of this study are that (1) despite a low prevalence of CVD risk in our sample based on medical risk estimate, close to one-half of women in our study may be considered at risk for developing CVD, given proportions of both traditional and sex-specific risk factors; (2) more than one-third of individuals deemed low medical risk reported at least 1 SS-RF; (3) almost three-quarters of individuals classified as high medical risk underestimated their risk, with a quarter of them perceiving themselves as low risk; (4) accuracy of risk perception was positively associated with CVD risk knowledge; (5) there was a lack of knowledge linking SS-RF to CVD risk; and (6) knowledge and perceptions of CVD risk have little influence on engagement in health-promoting behaviours that are inadequately adhered to across risk tertials. Taken together, these results highlight the need to advance contemporary CVD prevention strategies that include SS-RFs and will close the gap between knowledge of risk and engagement in health behaviours that mitigate risk for Canadian women.

Prevalence of female sex-specific risk factors

The high prevalence of sex-specific risk factors in this premenopausal population shows that CVD risk is much higher than the low estimated risk calculated using recommended risk stratification tools[7,33] Evidence now exists clearly showing these sex-specific risk factors are associated with future CVD morbidity and mortality.[17,34] For the purposes of our study, we chose to focus on those factors that have biological origins related to the female reproductive system: APO, early menarche, breast cancer treatment, PCOS, and endometriosis. Given that other factors associated with CVD risk, such as autoimmune diseases and feminine personality traits (ie, gender factors), occur more often in women, they can also occur in men. Thus, we focused our analysis on those factors unique to women.

Pregnancy disorders

Outside of traditional CVD risk factors, pregnancy disorders provide the greatest additional risk to women, and we found that 40% of those pregnant in the past (19% of the total sample) reported APOs. This is notable, given a recent prospective study showing that the inclusion of APO history in the Framingham Risk Score tool increased the model's 15-year risk prediction.[35] The documentation of pregnancy history should be considered as part of every medical screen for CVD.

Early age of menarche

Close to one-quarter of our sample reported age of menarche < 12 years of age, making it the second most dominant sex-specific CVD risk factor in our study. There is substantive evidence to suggest that early age of menarche (< 12 years) is associated with an increased risk of CVD incidence and related death compared with those who experience menarche at a later age. A recent meta-analysis[13] reported that an increase in the age of menarche by 1 year was associated with a decreased risk of all-cause and ischemic heart disease mortality. Further, age of menarche was inversely related with CVD, ischemic heart disease, and stroke mortality rates.[13] It is important to note, however, that the relationship between early age of menarche and CVD is complex and not fully understood. Many postulate that it is the association of early age of menarche with higher BMI and accumulation of central adiposity, which may, in turn, lead to other CVD risk factors such as high blood pressure, diabetes, and dyslipidemia.[36,37] Indeed, we found a higher prevalence of obesity and unhealthy blood pressure in those reporting early age of menarche. However, others have reported early age of menarche was associated with a 28% rise in CVD mortality independent of BMI and waist circumference.[38] In any case, early age of menarche should be considered another important consideration in clinical health screening.

Endometriosis and PCOS

Approximately 10% of women of reproductive age are affected by PCOS and endometriosis worldwide. Although not every woman in our study who reported gynecologic conditions specified having PCOS or endometriosis, these conditions were captured within the 13% prevalence of gynecologic conditions for the entire sample. Within the low-risk group, 10% indicated having PCOS or endometriosis with no other gynecologic conditions reported. The direct mechanisms remain elusive, but chronic inflammation has been implicated in their pathophysiology, as strong evidence links these conditions to obesity, hypertension, dyslipidemia, and insulin resistance.[39,40]

Breast cancer treatment and early menopause

Research has linked breast cancer treatment and associated cardiotoxicity with increased CVD morbidity and mortality.[41] Only 0.4% of our population reported undergoing breast cancer treatment. This low prevalence may be attributed to our exclusion criteria, as treatment often leads to early menopause (ie, treatment-induced menopause) and relatively young age of our participants. Early menopause, defined as occurring before the age of 45 years, affects approximately 10% of women and is associated with increased rates of CVD morbidity[42-44] and mortality.[45,46]

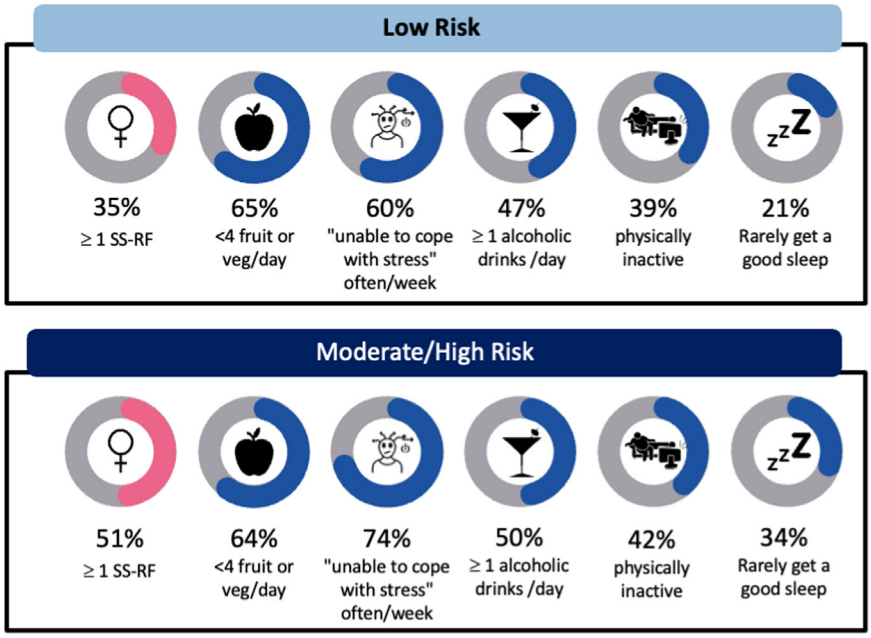


Figure 4. Lifestyle behaviours and characteristics of those with low medical risk relative to those with moderate to high medical risk. Percentages represent the proportion of individuals who reported suboptimal behaviours (**blue**) or presence of sex-specific risk factors (**pink**). Profiles were similar between groups except for stress and sleep, where more individuals with moderate-to-high medical risk experienced poor sleep and diminished ability to cope with stress than low-risk individuals.

SS-RFs and cumulative risk

Although our study reports on the high prevalence of female SS-RFs in premenopausal women, the degree to which these risk factors independently and cumulatively affect future CVD in the presence or absence of traditional risk factors is unknown. A recent systematic review investigated the addition of SS-RFs into current risk prediction tools and found the integration led to marginal, if any, improvements to risk prediction or classification.[47] Age at the time of assessment and the length of prediction time interval are possible confounders. Adding APO into the Framingham Risk Score yielded improvements in 15-year CVD prediction models but not in the established 10-year prediction.[35] And in older populations, the diminishing association of CVD risk seen with the inclusion of SS-RFs is likely caused by the emergence of traditional CVD risk factors in later years that may mask the relationship.[12,48,49] The quantification of cumulative risk is further complicated by the increased odds of developing a subsequent SS-RF when one already exists for an individual. For example, endometriosis has been linked to greater odds of having an APO,[50-53] PCOS,[54] early menopause[39,55] associated with early age of menarche,[56,57] and breast cancer.[58,59] Challenges aside, effective screening involves early identification of risk factors that can be addressed with recommended prevention and or treatment guidelines, with the ultimate goal of improving health outcomes.[58] Thus, despite the need for a greater understanding of the trajectory of risk, in the short term, clinicians can screen for the presence of SS-RFs (Supplemental Appendix S3).

Knowledge and perceptions

Our findings support in part similar findings of participant knowledge scores in a 2014 Canadian study by McDonnell et al.[7] in a similar age group. For example, compared with the findings of McDonnell et al., we also found that knowledge of heart attack symptoms in women increased slightly, and our respondents displayed adequate knowledge about traditional CVD risk factors. In our work, income and age were significantly associated with knowledge; however, as part of our regression model, the explanatory power was markedly reduced, given that the regression model—although significant—explained less than 2% of the variance in knowledge.

We found that although the accuracy of risk perception was higher in our sample compared with McDonnell et al., underestimation of risk in high-risk women remains a concern. As shown in Figure 3, high-risk individuals may have chronic conditions or traditional and SS-RFs. Our survey does not have the data to explore the reasons behind their personal risk perception; however, possible explanations include the belief or overestimation of treatment benefits (ie, statin medication and CVD risk),[60] a lack of awareness of risk because of conscious or unconscious denial,[61] or inadequate health literacy,[62] among other factors. There is a lack of awareness pertaining to the effects of sex-specific CVD risk factors on future CVD risk, particularly in those that possess 1 or more of these risk factors. For example, despite the fact that pregnancy complications and early menopause poses risks to women's heart health, knowledge of these factors was the lowest in our sample. This type of disconnect has been observed in other studies in which knowledge of the relationship between hypertensive disorders of pregnancy and CVD was low or absent.[63,64] The lack of patient follow-up, whether caused by the health system or patient initiative, may also play a role in the level of knowledge and perception of risk. For example, following gestational diabetes, women interpreted a lack of postpartum follow-up to mean their condition was either not serious or had resolved altogether.[65-67]

Interestingly, in our study, those who overestimated their perceived risk were generally more knowledgeable about CVD risks. Greater knowledge may be explained by more frequent visits to health care providers,[33] although—as we, and others, report—many women admit not talking to their health care providers about their personal heart health if it is not brought up first by the health care provider.[33] Further, some clinicians exhibit low levels of knowledge with respect to SS-RF and CVD risk[64] or self-report they are unsure about their effectiveness in supporting female patients in CVD prevention or treatment.[68] As such, as will be discussed here, education efforts targeted at patients and health care providers should remain a priority for improving awareness of heart disease risk in women.

Lack of relationship between knowledge of CVD risk prevention and health-promoting behaviours

In our population, knowledge of prevention behaviours was not associated with engagement in health-promoting behaviours, except for sleep. Although the knowledge of the importance of sleep for preventing heart disease was associated with actual attainment of achieving 7 to 8 hours most nights, the prevalence of achieving recommended sleep was still low; less than one-third of low-risk individuals reported meeting sleep recommendations, whereas less than one-quarter attained optimal sleep in moderate and high-risk profiles. The importance of lifestyle behaviours to promote health and reduce the risk of CVD cannot be overstated[69,70]; however, the disconnect between knowledge of health-promoting behaviours for prevention of CVD and lack of adherence to engaging in a meaningful amounts of healthy lifestyle behaviours requires attention.

Possible solutions to improve awareness of CVD risk and support in lifestyle behaviours

Previous studies have found that knowledge of CVD risk alone is not enough for women to recognize their actual risk[71,72] or engage in risk-reducing behaviours.[73] By contrast, knowledge acquisition via prevention education programs has successfully increased both awareness and preventive health-behaviour actions in women, decreasing CVD risk and associated deaths within their respective cohorts.[33,74] In a randomized control trial following pre-eclampsia, the intervention group that engaged online education modules and a lifestyle coach reported greater knowledge of CVD risk factors, increased self-efficacy for healthy eating, and were less physically inactive compared with a control group that received links that provided CVD risk reading material only.[75] Perhaps a variety of approaches are needed to build knowledge, self-efficacy, and motivation in women to engage in behaviours that mitigate CVD risk. For example, interacting with a live health care professional may resonate with women. Telehealth interventions have demonstrated that virtual connections to health care providers or educators may be an effective way to connect with women while avoiding access barriers.[76] In addition, in an effort to limit or avoid losing connection with patients such as those identified as high risk following APO, lifestyle interventions should begin as soon as possible.[77] There also remains a need for novel female-specific research and education on prevention of heart disease and treatment in women for clinicians and other allied health professionals to have a viable impact on improving cardiovascular health in women.[68] Further research involving novel approaches to improve adherence to a healthy lifestyle is needed to have a meaningful impact on CVD morbidity and mortality in women.

Strengths and limitations

This study surveyed a large representative Canadian sample using a comprehensive and modern assessment of risk in a population that has been largely ignored in CVD risk evaluation and prevention research. As this study was a cross-sectional evaluation, we are unable to infer causal mechanisms of risk. Further, because of the nature of the electronic delivery of the survey, only those with Internet and e-mail could have participated in the study. Despite the potential limitation of electronic delivery, we did recruit a representative sample of the Canadian premenopausal population; however, as the survey was not translated to French, we acknowledge potential limitations in participation from Québec and other places in Canada where the French language may be a person's first or only language.

Conclusions

In summary, 47% of Canadian women are at an increased risk for developing CVD, based on the prevalence of traditional and SS-RFs. Significant gaps remain in women's knowledge of sex-specific CVD risk factors, and many are not adequately engaged in preventive lifestyle behaviours. Clinicians must prioritize screening for all CVD risk factors early in a woman's life and support enhanced education and understanding for patients with respect to their personal risk. Early adulthood is a critical window for prevention of CVD and the promotion of healthy, risk-reducing lifestyle behaviours. Further research should focus on effective preventive strategies that will resonate with women's needs.

Acknowledgements

The authors would like to thank Olga Radivojevic for her assistance with data analysis.

Ethics Statement

Ethics approval was obtained by Trinity Western University's Human Research Ethics Board (21F02), in accordance with the latest Tri-Council Policy Statement and Canadian Association of Research Ethics Boards standards.

Patient Consent

The authors confirm that a patient consent form has been obtained for this article.

Funding Sources

Dr Coté was supported for this project by the Canada Research Chairs Program (CRC) Program (950-231915).

Disclosures

The authors have no conflicts of interest to disclose.

References

1. World Health Organization. The Top 10 Causes of Death. Published December 9, 2020. Available at: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death. Accessed January 5, 2022.
2. Crouch R, Wilson A. Are Australian rural women aware of coronary heart disease? Int J Nurs Pract 2010;16:295-300.
3. Albarran J. Women and coronary heart disease: redressing the balance. Nursing & Critical Care 2003;8:47-8.
4. Anand SS, Islam S, Rosengren A, et al. Risk factors for myocardial infarction in women and men: insights from the INTERHEART study. Eur Heart J 2008;29:932-40.
5. Atsma F, Bartelink MLEL, Grobbee DE, Van Der Schouw YT. Postmenopausal status and early menopause as independent risk factors for cardiovascular disease: a meta-analysis. Menopause 2006;13:265-79.
6. Waheed N, Elias-Smale S, Malas W, et al. Sex differences in non-obstructive coronary artery disease. Cardiovasc Res 2020;116:829-40.
7. 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.
8. Bairey Merz CN, Andersen H, Sprague E, et al. Knowledge, attitudes, and beliefs regarding cardiovascular disease in women: the Women's Heart Alliance. J Am Coll Cardiol 2017;70:123-32.
9. Ramachandran HJ, Wu VX, Kowitlawakul Y, Wang W. Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: an integrative review. Heart Lung 2016;45:173-85.
10. Oertelt-Prigione S, Seeland U, Kendel F, et al. Cardiovascular risk factor distribution and subjective risk estimation in urban women——the BEFRI study: a randomized cross-sectional study. BMC Med 2015;13:52.
11. Okoth K, Chandan JS, Marshall T, et al. Association between the reproductive health of young women and cardiovascular disease in later life: umbrella review. BMJ 2020;371:m35002.
12. Zheng Y, Wen TS, Shen Y, Hu H. Age at menarche and cardiovascular health: results from the NHANES 1999-2016. Menopause 2021;28:18-24.
13. Chen X, Liu Y, Sun X, et al. Age at menarche and risk of all-cause and cardiovascular mortality: a systematic review and dose—response meta-analysis. Menopause 2019;26:670-6.
14. Ding DC, Tsai IJ, Wang JH, Lin SZ, Sung FC. Coronary artery disease risk in young women with polycystic ovary syndrome. Oncotarget 2018;9:8756-64.
15. Legro RS. Polycystic ovary syndrome and cardiovascular disease: a premature association? Endocr Rev 2003;24:302-12.
16. Perrino C, Ferdinandy P, Bøtker HE, et al. Improving translational research in sex-specific effects of comorbidities and risk factors in ischaemic heart disease and cardioprotection: position paper and recommendations of the ESC Working Group on Cellular Biology of the Heart. Cardiovasc Res 2021;117:367-85.
17. Garcia M, Mulvagh SL, Bairey Merz CN, Buring JE, Manson JE. Cardiovascular disease in women. Circ Res 2016;118:1273-93.
18. Zhu D, Chung HF, Pandeya N, et al. Premenopausal cardiovascular disease and age at natural menopause: a pooled analysis of over 170,000 women. Eur J Epidemiol 2019;34:235-46.
19. Wellons M, Ouyang P, Schreiner PJ, Herrington DM, Vaidya D. Early menopause predicts future coronary heart disease and stroke: the Multi-Ethnic Study of Atherosclerosis (MESA). Menopause 2012;19:1081-7.
20. Theilen LH, Fraser A, Hollingshaus MS, et al. All-cause and cause-specific mortality after hypertensive disease of pregnancy. Obstet Gynecol 2016;128:238-44.
21. Kramer CK, Campbell S, Retnakaran R. Gestational diabetes and the risk of cardiovascular disease in women: a systematic review and meta-analysis. Diabetologia 2019;62:905-14.
22. Ware JE, Kosinski M, Keller SD. A 12-item short-form health survey. Med Care 1996;34:220-33.
23. Harlow SD, Gass M, Hall JE, et al. Executive summary of the stages of reproductive aging workshop +10: addressing the unfinished agenda of staging reproductive aging. Climacteric 2012;15:105-14.
24. Smith GN, Louis JM, Saade GR. Pregnancy and the postpartum period as an opportunity for cardiovascular risk identification and management. Obstet Gynecol 2019;134:851-62.
25. My health checkup. Do you know your cardiovascular age?. Available at: https://myhealthcheckup.com/.
26. Bauer GR, Braimoh J, Scheim AI, Dharma C. Transgender-inclusive measures of sex/gender for population surveys: mixed-methods evaluation and recommendations. PLoS One 2017;12:e0178043.
27. Connelly R, Gayle V, Lambert PS. Ethnicity and ethnic group measures in social survey research. Method Innov 2016;9:1-10.
28. Hughes JL, Camden AA, Yangchen T, College AS. Rethinking and updating demographic questions: guidance to improve descriptions of research samples. Psi Chi J Psychol Res 2016;21:138-61.
29. Pilote L. GENESIS-PRAXY gender questionnaire. Psychosom Med-CIHR, https://cihr-irsc.gc.ca/e/50529.html. Accessed December 31, 2020.
30. Statistics Canada, Table 17-10-0134-01 Estimates of population (2016 Census and administrative data), by age group and sex for July 1st, Canada, provinces, territories, health regions (2018 boundaries) and peer groups. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710013401. Accessed January 19, 2024.
31. Comprehensive Health Improvement Program (CHIP) M, https://myhealthcheckup.com/. Accessed May 8, 2022.
32. Goodman E, Adler NE, Kawachi I, Frazier AL, Huang B, Colditz GA. Adolescents' perceptions of social status: development and evaluation of a new indicator. Pediatrics 2001;108:e31.
33. Mosca L, Mochari H, Christian A, et al. National study of women's awareness, preventive action, and barriers to cardiovascular health. Circulation 2006;113:525-34.
34. Agarwala A, Michos ED, Samad Z, Ballantyne CM, Virani SS. The use of sex-specific factors in the assessment of women's cardiovascular risk. Circulation 2020:592-9.
35. Naz MSG, Sheidaei A, Aflatounian A, Azizi F, Tehrani FR. Does adding adverse pregnancy outcomes improve the Framingham Cardiovascular Risk Score in women? Data from the Tehran Lipid and Glucose Study. J Am Heart Assoc 2022;11:e022349.
36. O'Kelly AC, Michos ED, Shufelt CL, et al. Pregnancy and reproductive risk factors for cardiovascular disease in women. Circ Res 2022;130:652-72.
37. Rocha TN, Macêdo PR de S, Vafaei A, et al. The role of multiparity and maternal age at first pregnancy in the association between early menarche

and metabolic syndrome among middle-aged and older women. Menopause 2021;28:1004-11.

38. Lakshman R, Forouhi NG, Sharp SJ, et al. Early age at menarche associated with cardiovascular disease and mortality. J Clin Endocrinol Metab 2009;94:4953-60.

39. Taskin O, Rikhraj K, Tan J, Sedlak T, Rowe TC, Bedaiwy MA. Link between endometriosis, atherosclerotic cardiovascular disease, and the health of women midlife. J Minim Invasive Gynecol 2019;26:781-4.

40. Wekker V, Van Dammen L, Koning A, et al. Long-term cardiometabolic disease risk in women with PCOS: a systematic review and meta-analysis. Hum Reprod Update 2020;26:942.

41. Kirkham AA, Jerzak KJ. Prevalence of breast cancer survivors among Canadian women. J Natl Compr Cancer Netw 2022;20:1005-11.

42. Muka T, Oliver-Williams C, Kunutsor S, et al. Association of age at onset of menopause and time since onset of menopause with cardiovascular outcomes, intermediate vascular traits, and all-cause mortality. JAMA Cardiol 2016;1:767.

43. Tao XY, Zuo AZ, Wang JQ, Tao FB. Effect of primary ovarian insufficiency and early natural menopause on mortality: a meta-analysis. Climacteric 2016;19:27-36.

44. Shin J, Han K, Jung JH, et al. Age at menopause and risk of heart failure and atrial fibrillation: a nationwide cohort study. Eur Heart J 2022;43:4148-57.

45. Roeters van Lennep JE, Heida KY, Bots ML, Hoek A. Cardiovascular disease risk in women with premature ovarian insufficiency: a systematic review and meta-analysis. Eur J Prev Cardiol 2016;23:178-86.

46. Blümel JE, Mezones-Holguín E, Chedraui P, Soto-Becerra P, Arteaga E, Vallejo MS. Is premature ovarian insufficiency associated with mortality? A three-decade follow-up cohort. Maturitas 2022;163:82-7.

47. Tschiderer L, Seekircher L, Willeit P, Peters SAE. Assessment of cardiovascular risk in women: progress so far and progress to come. Int J Womens Health 2023;15:191-212.

48. Parikh NI, Jeppson RP, Berger JS, et al. Reproductive risk factors and coronary heart disease in the women's health initiative observational study. Circulation 2016;133:2149-58.

49. Grandi SM, Smith GN, Platt RW. The relative contribution of pregnancy complications to cardiovascular risk prediction. Circulation 2019;140:1965-7.

50. Azari ZD, Aljubran F, Nothnick WB. Inflammatory MicroRNAs and the pathophysiology of endometriosis and atherosclerosis: common pathways and future directions towards elucidating the relationship. Reprod Sci 2022;29:2089-104.

51. Lalani S, Choudhry AJ, Firth B, et al. Endometriosis and adverse maternal, fetal and neonatal outcomes, a systematic review and meta-analysis. Hum Reprod 2018;33:1854-65.

52. Farland LV, Prescott J, Sasamoto N, et al. Endometriosis and risk of adverse pregnancy outcomes. Obstet Gynecol 2019;134:527-36.

53. Breintoft K, Arendt LH, Uldbjerg N, Glavind MT, Forman A, Henriksen TB. Endometriosis and preterm birth: a Danish cohort study. Acta Obstet Gynecol Scand 2022;101:417-23.

54. Hart R, Doherty DA. The potential implications of a PCOS diagnosis on a woman's long-term health using data linkage. J Clin Endocrinol Metab 2015;100:911-9.

55. Thombre Kulkarni M, Shafrir A, Farland LV, et al. Association between laparoscopically confirmed endometriosis and risk of early natural menopause. JAMA Netw Open 2022;5:e2144391.

56. Lu M-Y, Niu JL, Liu B. The risk of endometriosis by early menarche is recently increased: a meta-analysis of literature published from 2000 to 2020. Arch Gynecol Obstet 2023;307:59-69.

57. Lee JS, Lee YA, Shin CH, Suh DI, Lee YJ, Yon DK. Long-term health outcomes of early menarche in women: an umbrella review. QJM 2022;115:837-47.

58. Allen LA, Shrikrishnapalasuriyar N, Rees DA. Long-term health outcomes in young women with polycystic ovary syndrome: a narrative review. Clin Endocrinol (Oxf) 2022;97:187-98.

59. Ye J, Peng H, Huang X, Qi X. The association between endometriosis and risk of endometrial cancer and breast cancer: a meta-analysis. BMC Womens Health 2022;22:455.

60. Lytsy P, Westerling R. Patient expectations on lipid-lowering drugs. Patient Educ Couns 2007;67:143-50.

61. Snowden A, Marland G, Murray E, McCaig M. Denial of heart disease, delays seeking help and lifestyle changes. Br J Card Nurs 2012;7:124-8.

62. Magnani JW, Mujahid MS, Aronow HD, et al. American Heart Association Council on Epidemiology and Prevention; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Peripheral Vascular Disease; Council on Quality of Care and Outcomes Research; and Stroke Council. Cardiovascular disease: fundamental relevance to primary and secondary prevention; a scientific statement from the American Heart Association. Circulation 2018;138:e48-74.

63. Dubrofsky L, Gundy S, Boesch L, Poolman K, Nerenberg KA, Tobe S. Patient perspectives on a pilot virtual follow-up program after hypertensive disorders of pregnancy: a qualitative study. CJC Open 2023;5:463-71.

64. 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.

65. Sandsaeter HL, Horn J, Rich-Edwards JW, Haugdahl HS. Preeclampsia, gestational diabetes and later risk of cardiovascular disease: women's experiences and motivation for lifestyle changes explored in focus group interviews. BMC Pregnancy Childbirth 2019;19:448.

66. Dennison RA, Ward RJ, Griffin SJ, Usher-Smith JA. Women's views on lifestyle changes to reduce the risk of developing type 2 diabetes after gestational diabetes: a systematic review, qualitative synthesis and recommendations for practice. Diabet Med 2019;36:702-17.

67. Eades CE, France EF, Evans JMM. Postnatal experiences, knowledge and perceptions of women with gestational diabetes. Diabet Med 2018;35:519-29.

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

69. Kaminsky LA, German C, Imboden M, Ozemek C, Peterman JE, Brubaker PH. The importance of healthy lifestyle behaviors in the prevention of cardiovascular disease. Prog Cardiovasc Dis 2022;70:8-15.

70. Barbaresko J, Rienks J, Nöthlings U. Lifestyle indices and cardiovascular disease risk: a meta-analysis. Am J Prev Med 2018;55:555-64.

71. Katz M, Laurinavicius AG, Franco FGM, et al. Calculated and perceived cardiovascular risk in asymptomatic subjects submitted to a routine medical evaluation: the perception gap. Eur J Prev Cardiol 2015;22:1076-82.

72. Konicki AJ. Knowledge of cardiovascular risk factors, self-nurturance, and heart-healthy behaviors in women. J Cardiovasc Nurs 2012;27:51-60.

73. Kling JM, Miller VM, Mankad R, et al. Go red for women cardiovascular health-screening evaluation: the dichotomy between awareness and perception of cardiovascular risk in the community. J Womens Health 2013;22:210-8.

74. Haidinger T, Zweimüller M, Stütz L, Demir D, Kaider A, Strametz-Juranek J. Effect of gender on awareness of cardiovascular risk factors, preventive action taken, and barriers to cardiovascular health in a group of Austrian subjects. Gend Med 2012;9:94-102.

75. Rich-Edwards JW, Stuart JJ, Skurnik G, et al. Randomized trial to reduce cardiovascular risk in women with recent preeclampsia. J Womens Health 2019;28:1493-504.

76. Countouris M, Jaramillo Restrepo V, Bidani S, et al. Feasibility of utilizing Telehealth in a multidisciplinary postpartum hypertension clinic. Women's Health Rep 2022;3:877-86.

77. Gladstone RA, Pudwell J, Pal RS, Smith GN. Referral to cardiology following postpartum cardiovascular risk screening at the Maternal Health Clinic in Kingston, Ontario. Can J Cardiol 2019;35:761-9.

Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2023.11.003.