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Assessment of the American Heart Association's "Life's simple 7" score in French-speaking adults from Québec

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KEYWORDS
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Abstract *Background and aims:* The "Life's Simple 7" (LS7) metrics were developed by the American Heart Association (AHA) to assess and promote cardiovascular health in the American population. The purpose of this study was to assess the overall cardiovascular health of French-speaking adults from the Province of Quebec using the LS7 score.

Methods and results: A total of 777 age and sex-representative participants of five different administrative regions in the Province of Quebec (387 men and 390 women; mean age ± SEM: 41.9 ± 0.1 years) were included in these analyses. Metrics of the LS7 score (smoking, physical activity, diet, body mass index, blood pressure, fasting total cholesterol and blood glucose) were analysed to generate a final score ranging from 0 to 7.

Only 0.5% of participants met all criteria for ideal cardiovascular health. The diet metric showed the lowest prevalence of "ideal" scores (4.8%) whereas not smoking was the metric with the highest prevalence (88.1%). Women had a higher LS7 score than men, while age and education level (negative and positive association, respectively; $p < 0.0001$) were also associated with the LS7 score.

Conclusion: Consistent with studies conducted among other populations, very few French-speaking adults from the Province of Quebec achieve an ideal cardiovascular health. These data indicate that further public health efforts aimed at promoting the LS7 metrics, focusing primarily on diet, are urgently needed. Specific groups, including older adults and those with lower levels of education, should be targeted when developing cardiovascular health promotion interventions.

Abbreviations: AHA, American Heart Association; BMI, Body Mass Index; CVD, Cardiovascular diseases; LS7, Life's Simple 7; NHANES, National Health and Nutrition Examination Survey; PA, Physical Activity; R24W, web-based 24-hour recall; SEM, standard error of the mean; SSBs, Sugar-sweetened beverages.

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Introduction

Cardiovascular diseases (CVD) are one of the leading causes of death around the globe [1]. Consequently, reducing the prevalence and death rate of preventable CVD represents a public health priority. The American Heart Association (AHA) has established a series of recommendations, called the *2020 Impact Goals*, to improve the cardiovascular health of Americans and to reduce death from CVD or stroke by 20% by 2020. As part of the *2020 Impact Goals*, the AHA developed the "Life's Simple 7" (LS7) metrics to assess and promote cardiovascular health among the American population [2]. The metrics include seven subscales referred to as either core health factors (blood pressure, blood glucose and total cholesterol concentration) or behaviors (body mass index (BMI), physical activity (PA), diet and smoking status). Multiple studies have shown that the LS7 score is inversely associated with the risk of stroke, CVD and mortality as well as all-cause mortality [2–4]. To our knowledge, the LS7 has never been assessed among the Canadian population. The province of Quebec has one of the highest age-standardized prevalence of diagnosed ischemic heart disease in Canada [5]. National surveys have also revealed important differences between the Quebec population and populations from other provinces in Canada with respect to dietary habits and attitudes towards eating [6,7]. Additionally, smaller proportions of Quebecers aged between 18 and 34 years exercise for more than 150 min weekly when compared with Canadians from other provinces [8].

The objectives of the current study were to assess the cardiovascular health of a cohort of French-speaking adults from the Province of Quebec (Canada) using AHA's LS7 score and to investigate its associations with socio-demographic characteristics. We hypothesized that ideal cardiovascular health is not prevalent among French-speaking adults from the Province of Quebec and that socio-demographic characteristics such as sex, age and education are associated with the LS7 score.

Methods

Study design and participants

An age- and sex-representative sample of healthy men and women from five administrative regions of the Province of Quebec (Montreal, Capitale-Nationale/Chaudière-Appalaches, Saguenay/Lac St-Jean, Mauricie and Estrie) was recruited for the purpose of the PREDISE study. PREDISE is a web-based multicenter cross-sectional study which primary purpose is to assess relationships between various individual, social and environmental factors and adherence to current healthy eating recommendations in Quebec (Canada) [9]. To be included in the study, participants had to be between 18 and 65 years of age, speak French as the primary language at home, have access to a computer with internet and have a valid email address. The present analyses included a total of 777 participants after exclusion of participants with missing data for any of the LS7 metrics (Supplemental Fig. S1). The study protocol was approved by the ethics committee from each participating institution.

LS7 metrics and score calculation

After recruitment, PREDISE participants completed multiple online questionnaires whereupon they were invited for an in-person visit to one of the five research centers involved in the study for clinical assessment. Blood samples, blood pressure and anthropometric measurements including body weight were obtained during participants' in-person visits. Fasting blood samples (12-hour fast) were used to measure blood glucose concentrations (Hexokinase method, Roche Modular P System) and total cholesterol concentrations (Roche Modular P system; Roche Diagnostics, Mannhein, Germany). Systolic and diastolic blood pressures were obtained from the mean of 3 consecutive measures, taken 3 min apart, in a sitting position, after a 10-min rest period, using an automated blood pressure monitor (Digital BPM HEM-907XL model; Omron). PA was assessed using the International Physical Activity Questionnaire (IPAQ) [10]. Dietary intakes were assessed using a validated web-based 24-hour recall (R24W), completed on three different occasions over a 21-day period. Details about the development and validation of the R24W have been previously published [11,12]. Information on smoking status was self-reported.

The LS7 score comprises seven metrics referred to as either core health behaviors (smoking, PA, BMI and diet) or health factors (blood pressure and total cholesterol and blood glucose concentrations). Each metric's criterion for "ideal" status has been previously established by the AHA: being a non-smoker, engaging in at least 150 min per week of PA (walking or moderate to vigorous exercise), having a BMI <25 kg/m^2, consuming a healthy diet and having blood pressure, total cholesterol and blood glucose measurements that are below 120/80 mmHg, 5.2 mmol/L and 5.6 mmol/L, respectively [2]. To be considered as "ideal", diet had to include at least 4 of the 5 following components: consumption of fruits, vegetables and legumes (total) $\geq$ 4.5 servings/day, fish $\geq$ 0.4 servings/day, whole grains $\geq$3 servings/day, sugar-sweetened beverages (SSBs) $\leq$ 1.3 servings/day and sodium intake $<$1500 mg/day. Serving sizes were calculated based on Canada's Food Guide. Blood pressure, total cholesterol and blood glucose criteria had to be achieved when untreated (i.e. no pharmacological treatment). Based on these criteria, each metric was categorized as "ideal" (score = 1) or "not ideal" (score = 0). The global LS7 score was calculated as the sum of the seven metrics' subscore and thus ranged from 0 to 7, a value of 7 reflecting ideal cardiovascular health.

Statistical analyses

All analyses were undertaken using survey-specific procedures to account for the PREDISE study design. Missing data for education level and household income were imputed using PROC SURVEYIMPUTE. Means, medians and variances of continuous variables were obtained using

PROC SURVEYMEANS. Proportions/variances of categorical variables and differences between sexes were computed using PROC SURVEYFREQ. Potential differences among age groups, education levels, household incomes and regions of residence were assessed using general linear models in PROC SURVEYREG with Tukey-Kramer adjustment for multiple comparisons. Multivariate analyses including all targeted socio-demographic characteristics were also undertaken using this procedure. The age by sex interaction on the LS7 score was also investigated using linear regression adjusting for waist circumference as a covariate in the model to account for variations in body morphology in women after menopause. Analyses were also adjusted for sex and age when needed and were all undertaken using statistical weights to achieve the representativeness of the study sample. SAS Studio (v. 3.6) was used for all analyses. *P-values* lower than 0.05 were considered as statistically significant.

Results

Participants' characteristics

Table 1 presents the characteristics of the 777 men and women who were included in the analyses. Mean age for men and women (SEM) was 41.3 (0.2) and 42.6 (0.2) years, respectively. Overall, the sample was representative of the age and sex of the French-speaking adult population of the Province of Quebec. However, individuals with a higher level of education (≥University) were over-represented in the PREDISE cohort when compared to national population data [13].

Table 1 Participants' characteristics by sex.

	Men (n = 387)	Women (n = 390)
Age, *years*	41.3 ± 0.2	42.6 ± 0.2
Weight, *kg*	84.2 ± 0.8	71.0 ± 0.8
BMI, kg/m^2	27.5 ± 0.2	27.0 ± 0.3
Blood glucose concentration, *mmol/L*	5.45 ± 0.08	5.11 ± 0.03
Systolic blood pressure, *mmHg*	122.7 ± 0.5	114.5 ± 0.6
Diastolic blood pressure, *mmHg*	75.1 ± 0.4	72.7 ± 0.4
Total cholesterol concentration, *mmol/L*	4.76 ± 0.04	4.88 ± 0.04
Education level[a], *n (%)*		
≤ Secondary school	72 (18.5%)	87 (22.4%)
CEGEP[b]	128 (33.2%)	106 (27.1%)
≥ University	187 (48.4%)	197 (50.6%)
Region of residence, *n (%)*		
Montreal	134 (34.5%)	135 (34.7%)
Capitale-Nationale/ Chaudière-Appalaches	147 (38.0%)	148 (37.8%)
Saguenay/Lac St-Jean	36 (9.2%)	37 (9.4%)
Mauricie	33 (8.6%)	33 (8.6%)
Estrie	37 (9.6%)	37 (9.6%)
Household income[c], *n (%)*		
<30 000$	51 (13.1%)	74 (19.1%)
30 000–60 000$	101 (26.1%)	106 (27.2%)
60 000–90 000$	72 (18.7%)	75 (19.2%)
>90 000$	163 (42.0%)	135 (34.5%)

Values are shown as mean and SEM, unless stated otherwise.
[a] 7 missing data were imputed.
[b] CEGEP is a pre-university and technical college institution specific to the Province of Quebec.
[c] 77 missing data were imputed.

LS7 score and subscores

Figure 1 shows the proportion of subjects achieving an ideal subscore for each of the seven LS7 metrics. The three health factors, i.e. blood glucose, total cholesterol concentration and blood pressure, were each considered as being ideal in more than half of the participants. Only 30.8% of participants met the criteria for having an ideal score for all three health factors simultaneously (not shown). Of the four health behaviors, smoking status (i.e. not smoking) showed the highest prevalence (88.1%). The metric with the lowest prevalence was diet, with only 4.8% of participants having an ideal diet subscore based on AHA's criteria. More precisely, of the 5 diet subscore components, low consumption of SSBs was achieved by the most participants in the present study (86.9%), followed by consumption of fruits/vegetables/legumes (61.7%). The prevalence of "ideal" fish (27.8%) and whole grains consumption (16.5%) and of ideal sodium intake (2.4%) were much lower. Only 2.2% of participants had ideal subscores for all four health behaviors simultaneously (not shown).

Figure 2 shows the distribution of the LS7 score, on a scale of 0–7. Only 0.5% of the sample had an ideal cardiovascular health, i.e. achieved all of the LS7 metrics. The mean score in all participants was 4.0 (95% CI 3.9 to 4.1). The majority of participants (70.1%) had a global LS7 score between 3 and 5.

Socio-demographic characteristics

Table 2 presents LS7 scores according to multiple socio-demographic characteristics, including sex and region of residence. As shown in Fig. 3, women had a higher LS7 score than men, due to greater proportions of women achieving an ideal subscore for the three health factors of the LS7 score, i.e. blood glucose, blood pressure and total cholesterol, and BMI. The LS7 score varied according to age, the youngest participants (18–34 y) having the highest LS7 score. Figure 3 also shows the comparisons of each of the LS7 metrics between education levels (panel B) and low and high household income (panel C). In general, those with a university degree had greater subscores for blood glucose, blood pressure, BMI and smoking, while those with a higher household income had higher subscores for blood glucose BMI and PA. When analyzed in a multivariate regression model, sex, age group and education level all remained correlates of the LS7 score, while region of residence and household income did not (not shown).

Discussion

The LS7 score, which reflects core health factors and behaviors relevant to cardiovascular health, was developed

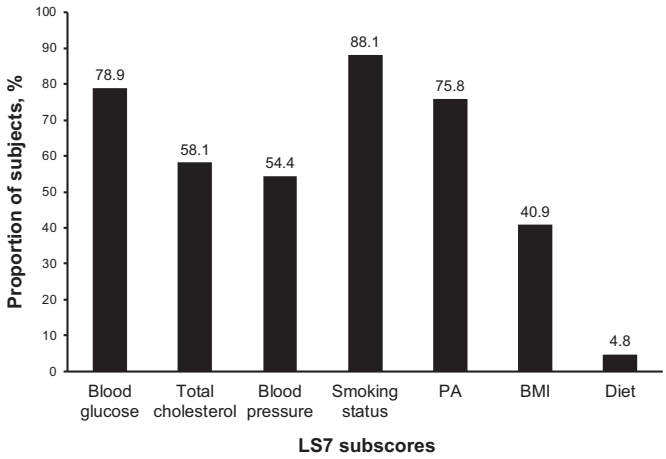

Figure 1 Proportion of subjects (%) with an ideal subscore for each of the LS7 metrics.

by the AHA as a primordial prevention tool for health practitioners to assess and promote cardiovascular health in the American population. These metrics have been repeatedly associated with a lower risk of stroke and CVD and mortality in longitudinal observational studies [2–4]. In the present analyses, we have assessed the LS7 score in an age- and sex-representative sample of French-speaking adults from five administrative regions of the Province of Quebec. These analyses are not trivial considering that Quebec is one of the provinces with the highest age-standardized prevalence of diagnosed ischemic heart disease in Canada [5,7]. We found that only 0.5% of participants achieved all AHA’s criteria for ideal cardiovascular health, with women having a higher score than men. Age and education were also associated with the LS7 score.

Prevalence of ideal cardiovascular health and LS7 subscores

Despite years of public health efforts in Quebec and Canada, very few individuals in our sample presented an ideal cardiovascular health, which is consistent with a number of studies from the United States, Australia, China and Europe [2–4,14–16]. For example, Graciani et al. [14] found in a Spanish cohort that only 0.2% of participants achieved an ideal cardiovascular health based on the AHA’s LS7 metrics. They also found that the ideal diet subscore was the subscore with the lowest prevalence, being achieved by only 11.1% of participants. Similar results were observed in Australia, with only 4.8% of men and women having an ideal diet subscore. It is stressed that only fruits and vegetables were considered by the authors in that study to qualify participants’ diet as ideal [16]. Other studies have reported higher LS7 score in their population [17,18]. However, in these studies the LS7 was assessed on a scale of 0–14 points instead of 0–7 points, thus inflating artificially the prevalence of individuals with an ideal cardiovascular health.

The low prevalence of “ideal diet” found in the present study reflects the relatively poor diet of Canadians, which has been shown to be fairly low in whole grains and fish and high in packaged foods rich in sodium (all components of the LS7’s diet subscore) [19–22]. Achieving the sodium

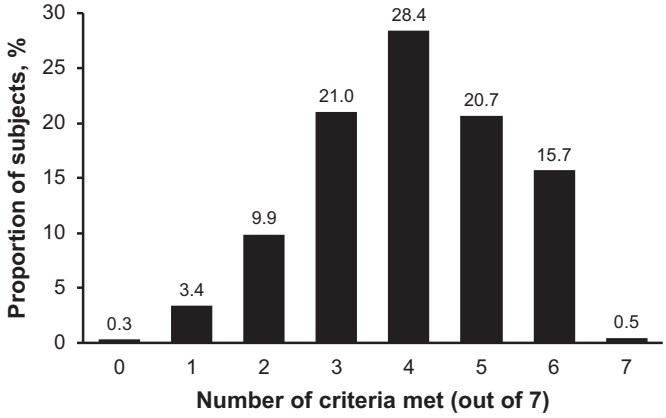

Figure 2 Distribution of LS7 score for ideal cardiovascular health based on the following 7 metrics: blood glucose, total cholesterol concentration, blood pressure, smoking status, physical activity, body mass index and diet. A score of 7 represents an ideal cardiovascular health.

Table 2 Life' Simple 7 (LS7) score according to sociodemographic characteristics in 777 French-speaking adults from the province of Quebec.

Sociodemographic characteristic	LS7 Score[c]	95% CI	p[a]
Sex			<0.0001
Men	3.7[a]	3.6–3.9	
Women	4.3[b]	4.2–4.4	
Age group			<0.0001
18–34 y.	4.5[a]	4.4–4.7	
35–49 y.	4.0[b]	3.9–4.2	
50–65 y.	3.5[c]	3.3–3.6	
Education level			<0.0001
≤ Secondary school	3.8[a]	3.5–4.0	
CEGEP[b]	3.7[a]	3.6–3.9	
≥ University	4.3[b]	4.1–4.4	
Region of residence			0.017
Montreal	4.1[a,b]	3.9–4.2	
Capitale-Nationale/ Chaudière-Appalaches	4.1[a,b]	3.9–4.2	
Saguenay/Lac St-Jean	3.7[a,b]	3.4–4.0	
Mauricie	3.6[b]	3.3–3.9	
Estrie	4.2[a]	4.0–4.5	
Household income (per year)			0.002
<30 000$	3.9[a]	3.7–4.1	
30 000–60 000 $	3.8[a]	3.7–4.0	
60 000–90 000 $	4.1[a,b]	3.9–4.3	
>90 000$ (ref)	4.1[b]	4.0–4.3	

[a] p-values were found using a linear regression model with Tukey-Kramer adjustment for multiple comparisons. Analyses were adjusted for sex and age group when appropriate.
[b] CEGEP is a pre-university and technical college institution specific to the Province of Quebec.
[c] Subgroups without a common superscript letter are significantly different ($p < 0.05$, Tukey-Kramer).

metric of the diet subscore (<1500 mg/day) had the lowest prevalence (2.4%) of all five diet metrics, which is consistent with the results of Graciani et al. [14] who also found it to be the least achieved dietary component in their Spanish cohort. One may argue that the 1500 mg/d target is unrealistic and that the tolerable upper intake level of 2300 mg/d may be a more appropriate metric in this context. Admittedly, using a 2300 mg/d cutoff compared with 1500 mg/d increased the prevalence of participants reaching the sodium intake criterion (from 2.4% to 17.7%) with little effect, however, on the overall prevalence of participants achieving an ideal diet (from 4.8% to 7.9% when using the lower vs. higher sodium cutoff values, respectively). Finally, the very high prevalence of non-smokers in our sample (88%) is in agreement with the very low prevalence of smoking (18.3%) among individuals aged 12 years or more in Canada [23]. The fact that our sample is slightly biased towards a higher education level may also have contributed to the high prevalence of non-smokers in the present study.

Sex and socio-demographic comparisons

Sex, age, education level and household income were associated with the LS7 score in the present study, the mean LS7 score being higher among women, younger participants and those with a higher education and household income. This is generally consistent with the current literature on this topic [3,14,15,24–26]. However, unlike studies by Chang et al. [15] and Simon et al. [24], in which the sex disparity in the LS7 score was explained primarily by a higher prevalence of ideal subscores for blood pressure, blood glucose, smoking status and diet in women when compared with men, there were no significant differences in the smoking status and diet metrics between sexes in the present study.

Studies have suggested that the gap in cardiovascular health between men and women decreases with age. Consistent with this concept, Janković et al. [27] reported that the difference in the LS7 score between men and women was attenuated with age, disappearing after the age of 65. On the other hand, results from a French study has shown that age did not affect the sex-based difference in the LS7 score between men and women aged 50–75 years [24]. The age by sex interaction on the LS7 score was not significant in the present study (not shown), suggesting that age does not attenuate the difference between men and women in cardiovascular health as determined by the LS7 score in French-speaking adults from the Province of Quebec.

The positive association between household income and cardiovascular health is consistent with previous work on this topic [15,28]. Using data from NHANES, Caleyachetty et al. [28] found that participants with low versus high household income were less likely to have a high LS7 score as well as achieving ideal subscores for smoking, PA and blood glucose. In the present study, a difference was found between low and high household income for the blood glucose subscore. However, since very few participants in our sample had a household income <30 000$ per year, our ability to detect differences on other LS7 metrics between income subgroups may have been limited.

Finally, the direct association of cardiovascular health with education found in the present study is also consistent with data from previous reports [29–31]. Woodward et al. [30] recently found a positive association between education and alcohol consumption as well as an inverse association between education and smoking, diabetes, blood pressure and cholesterol levels. On the other hand, lower education has been previously associated with a higher cardiovascular risk mostly due to behavioral and physiological risk factors such as smoking, obesity, physical inactivity and hypertension, which are all included in the LS7 metrics [31]. Here, while our sample was biased towards a higher education level, we found significant differences only for the BMI, smoking status and blood pressure metrics among education level subgroups.

Strengths and limitations

To our knowledge, this is the first study to assess AHA's LS7 metrics in a Canadian sample of adult men and

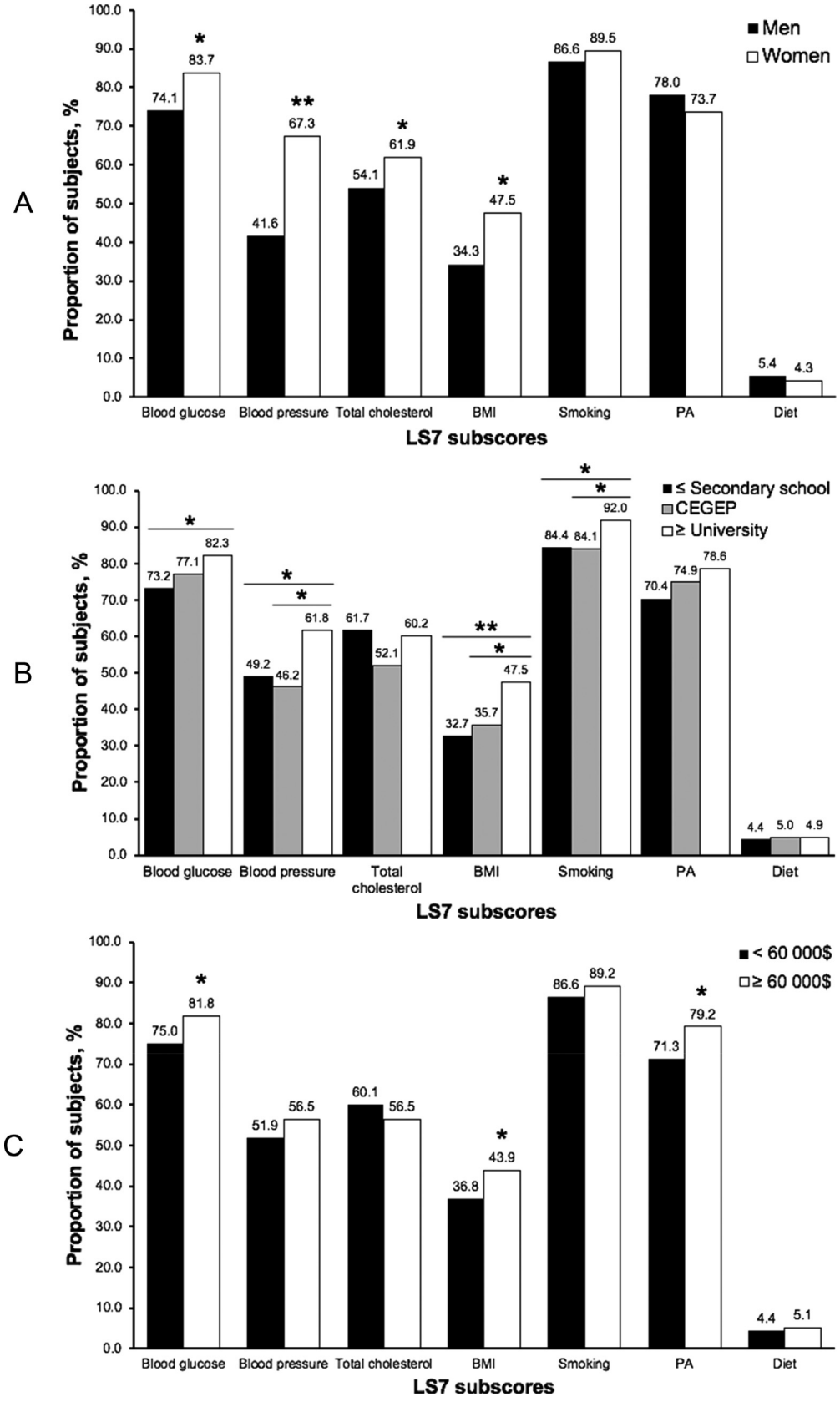

Figure 3 Comparison of the proportion of participants with an ideal subscore for each of the 7 LS7 metrics by sex (A), education level (B) and household income (C). ∗∗ $p < 0.0001$; ∗ $p < 0.05$.

women. We stress that the study comprised only French-speaking adults from the Province of Quebec, with a majority of individuals from European descent. Results cannot be generalized to the rest of the Canadian population and studies in populations with a more diverse representation are needed. Additionally, our results are applicable only to individuals aged between 18 and 65 years. Data used for the calculation of the LS7 metrics were obtained through validated methods under standardized condition, which is an important strength. The LS7 metrics are based on self-reported data for smoking status, PA and diet, which may have provided socially-desirable estimates, hence suggesting that prevalence of ideal LS7 score may be even lower than reported.

Conclusion

These findings suggest that further efforts should be aimed at promoting AHA's cardiovascular health metrics, focusing primarily on a healthy diet, the least prevalent "behavior" of the LS7 metrics. Furthermore, sex and socio-demographic characteristics, such as age and education, should not be overlooked when developing cardiovascular health promotion interventions. Specifically, men, individuals with a lower education and adults over 50 years of age should be primary targets for the promotion of optimal cardiovascular health in the Province of Quebec.

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Conflict of interest

No authors report a conflict of interest related to data presented in this study.

Disclosures

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.numecd.2019.03.006.

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