The Lancet Regional Health - Americas 4 (2021) 100071

Contents lists available at ScienceDirect

The Lancet Regional Health - Americas

journal homepage: www.elsevier.com/locate/lana

Research paper

Prevalence and determinants of ideal cardiovascular health in a latin women cohort: a cross-sectional study

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ARTICLE INFO

Article history:
Received 9 June 2021
Revised 19 August 2021
Accepted 25 August 2021
Available online 11 September 2021

Keywords:
Cardiovascular Health
Women
Risk factors
Epidemiology

ABSTRACT

Background: Ideal cardiovascular health (CVH) sought to reduce cardiovascular (CV) morbidity and mortality. In Chile, CV mortality in women is high. The study's main aim was to determine the prevalence of ideal CVH, and the factors and behaviors associated with ideal CVH in women from Santiago de Chile.

Methods: Cross-sectional study in women between 35 - 70 years old who were selected through a probabilistic, multistage, and geographically stratified sampling. The study included a survey on demographic and CV risk factors and anthropometric, blood pressure, and biochemical measurements. Three categories were used to characterize low (0-2), intermediate (3-4), and high (5-7) levels of AHA's Ideal CVH index. We assessed the prevalence of ideal CVH by age, education level, and socioeconomic status and determined the independent associations of different variables with ideal CVH.

Findings: 620 women, mean age 51± 4 years old, were recruited. Ideal CVH prevalence was 14.3%; none of the women presented an ideal healthy diet, and only 22.6% reached an ideal BMI. The best predictors of ideal CVH were a high education level (OR= 2.85; 1.43 to 5.92; $p < 0.01$), having less than two alcoholic drinks per day (OR= 4.09; 1.60 to 13.77; $p< 0.01$), and having a pregnancy history without preeclampsia and/or gestational diabetes (OR=1.94; 1.07 to 3.71; p=0.04).

Interpretation: This study demonstrates a low ideal CVH prevalence in Chilean women. Education level was a significant factor associated with ideal CVH. But also, women-specific risk factors, such as a history of preeclampsia/gestational diabetes, and alcohol consumption, were important factors related to CVH.

Funding: This study was supported by grants from Fundación SOCHICAR de la Sociedad Chilena de Cardiología y Cirugía Cardiovascular, the American Heart Association and an unrestricted grant by TEVA Pharmaceuticals.

Research in context

Evidence before this study

The construct of ideal cardiovascular health (CVH) was proposed in 2010 with the primary aim to reinforce primordial prevention in the community to reduce CV mortality. Previous studies have shown a low ideal CVH prevalence in

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https://doi.org/10.1016/j.lana.2021.100071

many countries of the world. Nevertheless, data about ideal CVH are scarce in Latin America. Brazil and Peru have reported a low ideal CVH with better prevalence in women than in men. Determinants of ideal CVH in Brazil were age, education level, and income. In Chile, women present with a significant and growing burden of cardiovascular risk factors and higher cardiovascular mortality. It is known that ideal CVH associates with better cardiovascular outcomes. However, the prevalence of ideal CVH in a representative cohort of urban Chilean women is unknown. Also, no data are reported on women-specific conditions and their impact on ideal CVH.

Added value of this study

This study is the first women-only cohort study performed in a representative sample of women in urban Latin America investigating ideal CVH and its determinants. We report a low ideal CVH in women, with a prevailing unhealthy diet, obesity, and smoking. Furthermore, the findings confirm that education level is one of the most critical factors conducing to an ideal CVH. But also, history of preeclampsia and/or gestational diabetes, women-specific risk factors for cardiovascular disease, and alcohol ingestion, a social risk factor, resulted in significant determinants of CVH in this cohort.

Implications of all the available evidence

Ideal CVH prevalence is low among women of all ages. Our results highlight that primordial prevention in women should start earlier, at young ages, to reinforce healthy behaviors. Therefore, ensuring lifelong and quality education in women is a clue. Women's health programs, including education about sex-specific risk factors and social determinants of health, like alcohol consumption, are warranted to achieve better CVH worldwide.

1. Introduction

Cardiovascular disease (CV) is the leading cause of death in developed and developing countries [1]. It is also the leading cause of mortality in Chile, representing 27.3% of all deaths in women and 25.6% in men [2]. These numbers would be expected to increase in the following decades, secondary to the aging of the population and the lack of control of traditional CV risk factors [3]. This scenario is also present in Chile since there has been an increase in life expectancy and a sustained growth in CV risk-factor prevalence [4]. Regarding this matter, in 2010, the American Heart Association (AHA) proposed a construct of ideal cardiovascular health (CVH) to reduce CV mortality by 20% by 2020 in the USA [5]. This concept grouped seven ideal conditions, both behaviors, and CV risk factors, in the absence of clinical CV disease, with the primary aim to reinforce primordial prevention in the community. Worldwide, this concept has been well accepted by professionals associated with the prevention and care of CVH.

It is important to highlight women experience higher CV mortality rates after a myocardial infarction (MI) in many countries and present with worse outcomes [6]. For example, data from the USA states that more women than men die (within a year of this first acute MI [7]. In Chile, Nazzal and Alonso reported that young women with an acute MI had higher in-hospital mortality than men [8].

On the other hand, the last Chilean National Health Survey revealed that women presented a high prevalence of obesity and diabetes [4]. Therefore, it would be desirable to improve CVH. However, no precise data were focused on the prevalence of ideal CVH in Latin American women. Also, none is said related to the association of sex-specific factors such as gestational diabetes, and other under-recognized risk factors in women, like psychosocial risk factors (depression and alcohol consumption), and poor education level or socioeconomic inequities, which could affect ideal CVH. It is essential to underline that in Latin America, there is a strong relationship between education level and socioeconomic condition, which also can influence health behaviors. The above has not been thoroughly investigated in Latin American countries concerning this new construct of ideal CVH. Finally, there has been a significant change in the labor force in the last 10 years in Chile, with almost 50% of women currently working full or part-time [9]. This last fact may impact CVH in our women.

The primary aim of our study was to determine the prevalence of ideal CVH in a representative sample of women from Santiago de Chile. As a secondary aim, we examined the association of ideal CVH with women-specific conditions, sociodemographic variables, and psychosocial risk factors.

2. Methods

2.1. Study design

ESCI (the Spanish acronym for "Study of ideal cardiovascular health in women") is a cross-sectional study performed in a cohort of women from Santiago de Chile, Metropolitan Region, carried out between May and August 2015. ESCI assessed the seven ideal CV metrics and behaviors recommended by AHA in 2010 [5]. ESCI baseline data were collected during two home visits. At the first visit, a survey interviewer completed a face-to-face interview using a tablet PC. At the second visit, a nurse obtained anthropometric and blood pressure (BP) measurements and blood and urine samples. For purposes of this study, the reported data only considered the n=620 participants with complete data on both home visits. The Santiago East Metropolitan Region Ethics Committee approved the study, and all participants signed the informed consent before study inclusion.

2.2. Sample

ESCI sought to study women between 35 to 70 years old, residents of Santiago. This region represents approximately 40% of the Chilean population and includes 52 boroughs/districts.

The sample design was probabilistic, multistage, and geographically stratified. The details of the study sample design have been described previously [10]. Briefly, before sample selection, nine strata were created by crossing three socioeconomic levels and three age groups at the borough level. These three socioeconomic strata were formed, estimating the average of the total per capita income of the household residents of the 52 boroughs using data from the Chilean National Socioeconomic Characterization (CASEN) Survey 2011 [11]. In addition, the boroughs were grouped into three strata formed according to the predominance of women of specific age ranges [35-44, 45-54, 55-70 years old). In each of the nine sampling strata, two boroughs were selected as the primary sampling units (PSU), yielding a total of 18 sampled boroughs. A total of 2717 housing units were initially chosen for the "screening" stage and, after discarding ineligible (n=318 units), non-responding (n=592 units), we completed 1817 interviews that helped identify 1027 households with at least one eligible female. The units discarded (n=790) included households with not a single female aged 35-70 years old and households with ineligible females. Following the protocol, only one female was randomly selected from each one of those 1027 eligible households. A total of 723 participants completed the first visit and 620 the second visit. Response rates were calculated for each stage of the survey. The household

screener response rate was 75% (Supplementary Figure 1). We excluded pregnant participants and those with a history of stroke, myocardial infarction, and renal failure on dialysis. The "Centro de Estudios y Encuestas Longitudinales" of the Pontificia Universidad Católica de Chile conducted the fieldwork.

2.3. Data collection and biochemical variables determination

ESCI baseline data were collected during two home visits. At a first visit, a nurse completed n=620 face-to-face interviews. She obtained anthropometric and blood pressure (BP) measurements and blood and urine samples at the second visit. For purposes of this study, the reported data only considered the participants who completed both home visits.

A group of cardiologists, dietitians, nurses, and an expert in survey methodology designed the survey. We included questions about the history of traditional CV risk factors and the associated pharmacological therapy, and for the physical activity assessment, the Global Physical Activity Questionnaire (GPAQ) was used [12]. In addition, a specific diet questionnaire based on the ideal CVH diet, as proposed by AHA, was applied. Regarding the diet, the survey interviewer had nutritional sheets and serving-size instruments.

Moreover, the survey included the Patient Health Questionnaire (PHQ- 9) [13, 14] to assess depressive symptoms. Depression was defined by the PHQ-9 score and classified as mild-to-moderate depressive symptoms [10 to 19 points) and major depression ($\geq$ 20 points) [13, 14]. We also included sex-specific questions about gestational diabetes and preeclampsia. For alcoholic consumption, we used ad-hoc cards with sampling portions. The socioeconomic level was classified into three groups: low, medium-low, and medium-high, determined by the boroughs of the participant's residence, which relates to the average household per capita income based on CASEN 2011(low from ~276 to 340 US dollars; middle: ~345 to 438 US dollars, and high: ~459 to 2763 US dollars). The low socioeconomic level represents the minimum wage per capita in Chile in the study period. Employment status (full or part-time) was also registered. Finally, education level was categorized by asking for the years of formal education, and the highest qualification received, into three categories: low (primary school or less; 0-8 years), middle (complete or incomplete secondary education; 9-12 years), and high (complete or incomplete university or technical studies; >12 years). Trained nurses took blood pressure with a brachial automatic validated monitor (Omron HEM7200) after at least 5 minutes resting in the sitting position. Three measurements were done every 2 minutes, and the mean was recorded. Weight and height approximated to the nearest 0.1 kg and 0.1 cm, in a standing position without shoes and outer garments, using a digital weight (Seca model 803) and a stadiometer. Body mass index (BMI) was computed by dividing weight (kg) by height squared (m^2). Venous blood samples were obtained after a minimum of 8 hours of fasting and alcohol withdrawal of 24 hours. We determined total cholesterol levels and glycemia using Cobas from Roche 8000 modular analyzer series (Hitachi). With a morning isolated urine sample, we obtained urinary creatinine and sodium to calculate an estimated 24-hour salt consumption determined by Tanaka et al. formula [15], which has been validated in Chilean subjects. [16]

2.4. Cardiovascular health metrics

Ideal CVH was assessed looking for the 7 health metrics as defined by AHA:1) no smoking or quitting > 12 months, 2) BMI < 25 kg/m^2, 3) moderate exercise $\geq$ 150min/week (wk) or $\geq$ vigorous 75 min/wk, 4) healthy diet: considering intake of 4 of the following 5 components: vegetable and/or fruits $\geq$ 4.5 cups/wk, fish $\geq$ 200 gr/wk, fiber-rich whole grains $\geq$ 90 gr/day, sodium < 1500 mg/day and sweetened beverages $\leq$ 450 Kcal/wk, 5) total cholesterol < 200/mg/dL without pharmacological treatment, 6) optimal blood pressure < 120/80 mmHg without pharmacological treatment, and 7) glycemia <100 mg/dL without pharmacological treatment [5]. Also, to delineate the spectrum of CVH, each metric was studied, looking into the intermediate and poor categories defined by AHA (Supplementary Table 1). We defined poor, intermediate, and ideal CVH as the presence of 0 to 2, 3 to 4, and 5 to 7 ideal health metrics. Finally, in regards to diet, each of the five components was classified in a poor and intermediate category, in addition to the ideal concept (Supplementary Table 2).

2.5. Statistical Analysis

All results were estimated using sample weights that account for probabilities of selection (following the complex sample design), corrected for nonresponse using propensity score adjustment, and calibrated to external population totals of females grouped in 7 age categories (from 35-39 to 65-70 years old) across the 9 sampling strata. Therefore, the results represent all women aged 35 to 70 years old living in the Metropolitan Region of the country (n=1.462.807).

Results are presented as mean $\pm$ standard deviation (SD) or frequency (%) where suitable. The primary response was the number of factors of ideal CVH (0 - 2, 3 - 4, 5 - 7) or the probability of being in the highest category [5–7]. For the latter, an increased likelihood of ideal CVH is presented in odds ratios, defined as the probability of high CVH compared to low. Therefore, odds ratios greater than 1.0 represent propensity to ideal CVH. Univariate relationships with ideal CVH factors were assessed by ordinal chi-square tests (ref. Agresti), while multivariate associations with better CVH were tested using logistic regression models.

Role of the funding source

Fundación SOCHICAR of the Sociedad Chilena de Cardiología y Cirugía Cardiovascular participated in the study design and data collection. The Fundación SOCHICAR did not participate in data analysis, interpretation of the data, the writing of the report, and the decision to submit the paper for publication.

American Heart Association and TEVA Pharmaceuticals did not participate in the study design, data collection, analysis, interpretation of data, the writing of the report, and the decision to submit the paper for publication.

3. Findings

The mean age of the population was 51$\pm$ 4 years old. Table 1 shows the sociodemographic and clinical characteristics of the cohort. Most of the women presented a medium education level (8 to 12 years of education), more than 50% worked full or part-time, and the majority was overweight or obese.

Ideal CVH prevalence was 14.3%. Intermediate and poor CVH was 57.1% and 28.6 %, respectively. Table 2 shows the prevalence of ideal, intermediate, and poor CVH for each of the 7 metrics in the cohort and by age categories, weighted for the population size of Santiago, Metropolitan Region. Eighty percent of women had an ideal fasting glycemia, and around 60% did not smoke (Figure 1). By contrast, none presented an ideal healthy diet, and only 22.6% reached the ideal BMI. Concerning diet, the worst achieved component was sodium intake and ingestion of fiber-rich whole grains. By contrast, sugar-sweetened beverages and fish consumption were the best accomplished (Supplementary Figure 2).

Total cholesterol was significantly better in younger women, like blood pressure, physical activity, and glycemia. On the other

Table 1
Age, demographic characteristics, body mass index, blood pressure, and biochemical variables in the study population.

Characteristics	Total N= 620
Age years, mean (SD)	51.4 (9.5)
Education, n (%)	
Low	159 (25.6)
Medium	317 (51.1)
High	144 (23.3)
Socioeconomic Level, n (%)	
Low	163 (26.4)
Medium-Low	186 (30.0)
Medium-High	271 (43.6)
Marital Status, n (%)	
Married or living together	416 (67.1)
Separated, single or widowed	204 (32.9)
Employment status, n (%)	
Full or part-time	331 (53.4)
Anthropometry	
BMI, mean (SD)	29.2 (5.8)
Blood Pressure	
Systolic (mmHg), mean (SD)	128.3 (21.2)
Diastolic (mmHg), mean (SD)	75.8 (10.2)
Biochemical Variables	
Total cholesterol (mg/dL), mean (SD)	194.8 (50.5)
LDL-C (mg/dL), mean (SD)	114.6 (31.6)
Non-HDL (mg/dL), mean (SD)	143.5 (49.9)
Glycemia (mg/dL), mean (SD)	98.6 (45.3)
Physical activity measurement	
MET-min/week, median(IQR)	1120 (4500)

Education level: low (primary school or less; 0-8 years), middle (complete or incomplete secondary education; 9-12 years), and high (complete or incomplete university or technical studies; >12 years; Socioeconomic level: classified into three groups: low, medium-low, and medium-high, determined by the boroughs of the participant's residence, which relates to the average household per capita income based on CASEN 2011(low from ~276 to 340 US dollars; middle: ~345 to 438 US dollars, and high: ~459 to 2763 US dollars); BMI: body mass index; MET: metabolic equivalent.

hand, non-smoking was significantly more frequent in older women (Table 2).

Table 3 shows the weighted prevalence of ideal, intermediate, and poor CVH for each of the 7 metrics in the cohort by education status. A better healthy diet and ideal BMI were significantly associated with a higher education level, as were an ideal fasting plasma glucose and a blood pressure <120/80 mmHg. Table 4 shows the univariate and multivariate regression analysis for the association between sociodemographic and clinical characteristics with ideal CVH. Age < 45 years old, a high education level, no history of preeclampsia or gestational diabetes during pregnancy, and drinking less than 2 glasses of alcohol per day were all significantly associated with an ideal CVH in Model 1. The multivariate analysis adjusting by age and all the other variables used in model 1 verified the same determinants related to ideal CVH (Model 2). Socioeconomic status did not associate with better CVH either in the univariate model or in the multivariate.

4. Discussion

Our study showed a low ideal CVH prevalence in this Chilean women cohort. This finding was mainly driven by unhealthy behaviors, such as lack of an ideal diet, a high prevalence of overweight/obesity, and smoking. On the other hand, a high educational level (more than 12 years of formal education), a pregnancy history without preeclampsia and/or gestational diabetes, and consuming less than 2 alcoholic drinks per day were significantly associated with an ideal CVH.

The concept of ideal CVH appears back in 2010 in the core of the AHA [5]. AHA defined it as "the presence of 7 factors or health behaviors to improve the possibility of living free of coronary heart disease (CHD) and stroke". The construct pursued the need to revert the significant increase in CV risk factors and decrease CVD morbidity and mortality [5].

Table 2
Weighted prevalence of cardiovascular health status for each metric in the study population (total and by age categories).

METRICS		AGE CATEGORIES			
	Total %	35-44 yo n=154, %	45-54 yo n=244, %	55-70 yo n=221, %	p value*
Physical Activity					
Poor	10.1	7.4	11.7	10.5	
Intermediate	21.6	15.4	21.3	26.5	
Ideal	68.3	77.2	67.0	63.0	< 0.001
Healthy Diet					
Poor	81.9	84.0	86.6	75.7	
Intermediate	18.1	16.0	13.4	24.3	
Ideal	0	0	0	0	-
Body Mass Index					
Poor	38.7	38.0	36.6	41.2	
Intermediate	38.7	41.3	42.6	33.0	
Ideal	22.6	20.8	20.7	25.9	NS
Smoking					
Poor	35.9	45.6	37.3	27.4	
Intermediate	3.2	5.0	2.0	2.9	
Ideal	60.9	49.4	60.7	69.7	< 0.01
Total Cholesterol					
Poor	15.9	6.2	12.7	26.2	
Intermediate	33.2	23.9	38.2	35.5	
Ideal	50.9	69.9	49.2	38.4	< 0.0001
Fasting Plasma Glucose					
Poor	10.3	2.7	9.2	17.1	
Intermediate	9.1	4.0	10.4	11.8	
Ideal	80.6	93.3	80.4	71.2	< 0.0001
Blood Pressure					
Poor	13.3	3.8	13.4	20.4	
Intermediate	50.0	35.1	48.0	63.1	
Ideal	36.7	61.1	38.5	16.6	< 0.0001

Ordinal Chi-square test; yo: years old

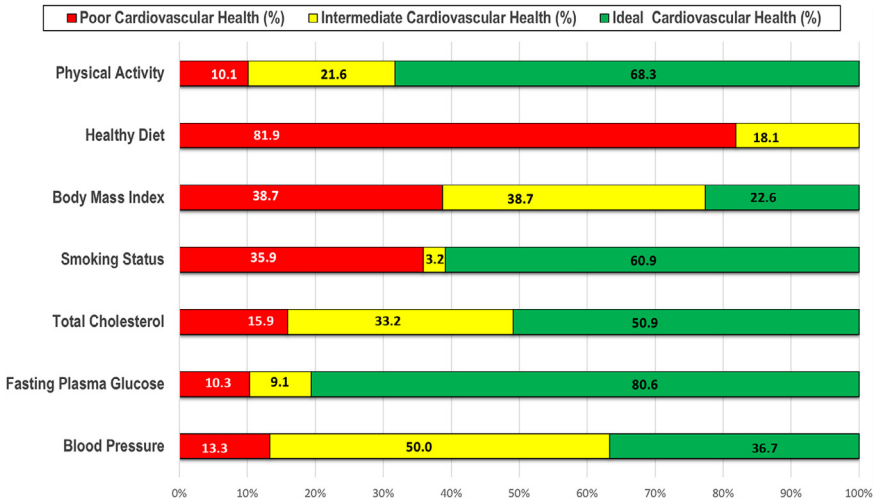

Figure 1. Weighted prevalence of ideal, intermediate, and poor cardiovascular health estimates in each of the seven metrics in the study population (N= 620)

Table 3
Weighted prevalence of cardiovascular health status for each metric of Ideal Cardiovascular Health in the Total Study Population and by Educational Level.

		EDUCATION LEVEL**			
CVH METRICS	Total (%)	Low (n= 176), %	Middle (n=334), %	High (n=110), %	P value*
Physical Activity					
Poor	10.10	8.50	12.90	5.60	
Intermediate	21.60	27.80	17.20	24.40	
Ideal	68.30	63.70	69.90	70.00	<0.0001
Healthy Diet					
Poor	81.90	85.90	84.40	71.80	
Intermediate	18.10	14.10	15.60	28.20	
Ideal	0	0	0	0	<0.0001
Body Mass Index					
Poor	38.70	49.00	39.80	24.90	
Intermediate	38.70	38.50	39.20	37.70	
Ideal	22.60	12.50	21.00	37.40	<0.0001
Smoking					
Poor	35.90	33.20	38.40	33.50	
Intermediate	3.20	6.50	2.30	1.40	
Ideal	60.90	60.40	59.30	65.10	NS
Total Cholesterol					
Poor	15.80	18.40	18.10	1 8.0	
Intermediate	33.20	31.70	32.10	37.50	
Ideal	50.90	50.00	49.80	54.50	NS
Fasting Glycemia					
Poor	10.3	17.4	9.4	4.4	
Intermediate	9.10	14.30	9.00	3.90	
Ideal	80.60	68.30	81.60	91.70	<0.01
Blood Pressure					
Poor	13.30	13.30	11.70	15.70	
Intermediate	50.00	50.00	51.30	36.60	
Ideal	36.70	36.70	37.10	47.80	0.02

* Ordinal Chi-square test; Education level: low (primary school or less; 0-8 years), middle (complete or incomplete secondary education; 9-12 years), and high (complete or incomplete university or technical studies; >12 years)

Our results highlight a low percentage of ideal CVH in the studied population. It is probable, as demonstrated in studies coming from the US that the healthy diet as described by AHA might be the most significant challenge. For example, Bambs et al [17] showed 39% of ideal healthy diet in US women, only considering ≥3 servings per day of fruits and vegetables. In this sense, our study was more rigorous, as we measured each of the 5 components of the healthy diet as described in the main paper by Lloyd-Jones et al. [5]. Moreover, we determined the approximate amount of salt consumption through the measurement of urinary sodium. This is a unique characteristic of our study, as most of the reported investigations about ideal CVH have been based on diet assessment through self-report questionnaires. None of our women accomplished the target of less than 1200 mg of salt consumption per day.

Of utmost importance is the reduced prevalence of BMI < 25 in Chilean women: less than one out of four women had a normal weight. Along with Mexicans, Chilean women are among the most overweight in Latin America [18]. Even more, the prevalence of obesity determined in our study was 38%, similar to the one reported by the last Chilean National Health Survey 2016-2017 [4]. This high obesity prevalence may be explained by the increased prevalence of leisure-time sedentarism ~ 90% in our cohort and the unhealthy diet, characterized by high levels of sweetened

Table 4
Association between sociodemographic and clinical characteristics with Ideal Cardiovascular Health

	Model 1			Model 2		
	OR	95% CI	P	OR	95% CI	P
Age						
55-70 years (n=221)	1.00			1.00		
45-54 years (n=244)	1.17	0.65 to 2.11	NS	1.15	0.63 to 2.11	NS
35-44 years (n=154)	2.35	1.35 to 4.14	< 0.01	2.37	1.31 to 4.34	<0.01
Educational level						
Low (n=176)	1.00			1.00		
Middle (n=334)	1.62	0.86 to 3.25	NS	1.47	0.78 to 2.95	NS
High (n=110)	3.14	1.59 to 6.50	< 0.01	2.85	1.43 to 5.92	< 0.01
Socio-economic Status						
Low (n=216)	1.00			1.00		
Middle low (n=221)	1.19	0.64 to 2.25	NS	1.39	0.74 to 2.639	NS
Middle high (n=183)	1.25	0.71 to 2.26	NS	1.38	0.78 to 2.51	NS
Employment status						
Unemployed (n=282)	1.00			1.00		
Full or part time (n=338)	1.61	1.00 to 2.64	0.05	1.58	0.97 to 2.59	0.07
Depression symptoms (PHQ-9)						
≥10 points (n=124)	1.00			1.00		
<10 points (n=496)	1.7	0.96 to 3.20	0.08	1.61	0.89 to 3.09	NS
Preeclampsia and/or gestational diabetes						
With records (n=160)	1.00			1.00		
Without records(n=460)	1.89	1.06 to 3.59	0.04	1.94	1.07 to 3.71	0.04
Alcohol consumption						
≥ 2 drinks (n=82)	1.00			1.00		
<2 drinks (n=538)	4.30	1.7 to 14.64	<0.01	4.09	1.60 to 13.77	<0.01

Model 1: Adjusted by Age, except for Age. Model 2: Adjusted by all other variables; OR: Odds Ratio; CI: Confidence Intervals. PHQ-9: Patient Health Questionnaire-9

beverages and salty and processed foods. Obesity, despite all the efforts made by different public policies, has been steadily increasing since the CARMELA study in 2004 [29,4%) [19].

Following the behavioral analysis, around 61% of women did not smoke. However, Chilean women are characterized by a high tobacco consumption compared to other Latin American women [19]. These numbers might be attributed to the higher sociodemographic index of Chile, as is shown in the last Global Burden Disease Tobacco Collaborators study [20]. The difference in smoking prevalence between women and men is small in our country by contrast with most Latin American countries, in which men have the highest prevalence [20]. Also, very alarming is that Chilean girls have a higher tobacco use prevalence than boys [21]. The tobacco industry is taking advantage of this behavior, targeting its marketing strategies to this population segment [21]. To fight against this threat, governments should strongly encourage healthy behaviors from a very young age. Some improvement has been achieved with the new smoking bans in public places and closed buildings.

Ideal physical activity was accomplished by 68% of women, representing the best prevalence among health behaviors. Nevertheless, leisure-time physical activity, defined as the exercise during free time, was ~90%, extremely deficient. This dissociation between physical activity assessed through the GPAQ questionnaire versus leisure-time physical activity could be attributed to the considerable prevalence of working women in Chile, some of whom spend a lot of time transporting to and from their workplaces by walking or riding a bike. Our numbers contrast with other studies [17, 22], but they are similar to others, like Ogunmoroti et al. [23], who reported 70% of ideal physical activity. The divergences are probably related to the definition of physical activity, which in some studies like ours included commuting, work, and leisure-time physical activity versus others, which only considered leisure-time activity. In the landmark AHA special report on ideal CVH, there is no recommendation about which definition and physical activity questionnaires should be used. Our study used the validated GPAQ questionnaire, which details minutes spent in transportation, working, and leisure-time activities during a week [12].

In general, ideal health factor metrics were higher than ideal behavioral metrics: glycemia < 100 mg/dL and total cholesterol < 200 mg/dL were present in more than 50% of women. The worst prevalence was ideal BP, with ~37%; however, this is similar to data from the US and South American cohorts in urban subjects [23–25]. Most published studies have shown that ideal BP is difficult to accomplish: data from two urban cohorts, one from the USA and the other from China, have reported less than 20% prevalence of ideal BP [17, 26]. Our numbers contrast with Peruvian data from Benziger et al. They demonstrated around 63.4% of ideal BP in women [22]. However, in that study, 30% of the population came from Lima, the capital city, while ~70 % came from Andean and coastal regions with a considerable rural population.

In our study, we have shown that a high education level is strongly associated with ideal CVH. High-educated women (OR: 2.85; CI: 1.43-5.92) showed a better ideal CVH prevalence than their low and middle-educated counterparts. Our results agree with those from Jankovic et al. [27]. A large cohort of men and women in the Republic of Srpska demonstrated that low and middle-educated women had a significantly smaller number of ideal CVH metrics, ideal behavior metrics, and ideal health factor metrics compared with women with high education. These results also were more noticeable in women than in men. A study from Denmark published in 2012 confirmed that education level is essential. They found a 5-fold difference in better ideal CVH in 2006 between the highest and lowest educated women versus no difference twenty years earlier [28]. This finding clearly showed that the gap between education levels according to ideal CVH had worsened for women in that country.

Our paper assessed education level and socioeconomic strata as two parameters that could influence ideal CVH. However, both the univariate model (adjusted by age) and the multivariate model showed that socioeconomic level in our cohort did not determine a better CVH. It is essential to highlight that education level was

significantly associated with socioeconomic status in our study (Kendall's Tau rank correlation 0.34, $p<0.0001$, data not shown), but only the high education level remained significant when analyzed together. Our results contrast with data from Brazil and China, which reported that better education and socioeconomic strata influenced CVH scores [29, 30]. In our population of women, education and income behaved differently.

To the best of our knowledge, this is the first report associating preeclampsia and gestational diabetes, two sex-specific CV risk factors with ideal CVH. Furthermore, we demonstrated that not having these disorders during pregnancy were determinants of a better CVH. These findings are important, as we can prevent developing these diseases in women through a healthy lifestyle. Women with preeclampsia have an increased risk for traditional CV risk factors, and they have more chance of developing CHD, stroke, peripheral artery disease, and heart failure [31]. On the other hand, diabetes implies more diabetogenic risk and identifies young women with a two-fold higher risk of CV events [32]. Therefore, our results should encourage all health-related professionals to follow these women promoting CVH health actively, and thus CVD in the future.

Low alcoholic consumption (< 2 drinks/day) was also a significant determinant of ideal CVH. Similar data have been shown in a substudy of the MESA cohort in which more than 2 drinks daily were unfavorable; however, < 1 alcohol (light) and 1-2 glasses (moderate) in MESA showed a more favorable CVH prevalence in women [33]. Nevertheless, according to the 2020-2025 Dietary Guidelines for Americans, only one alcoholic drink is considered acceptable in women [34]. In this regard, it is important not to promote more than one drink per day in women, especially in a country like ours in which the less educated people present with a higher prevalence of heavy drinking.

4.1. Caveats and strengths

This paper has limitations. First, as the survey was done only in women, we did not have a concurrent population of men for comparisons. Therefore, the results are not generalizable to men. Second, this is a cross-sectional study, therefore, we can only determine associations but not causality. Third, data collection on physical activity, diet, and alcohol intake were obtained by self-report, so we cannot exclude recall bias or social desirability. Finally, our sample size could seem small. It is always desirable to count on a large sample size to test all relevant hypotheses about the data, like interaction terms, which we have not considered due to sampling size limitations. However, we believe that the additive models presented support our discussion.

Our study also has many strengths. First, it is a representative sample of women of all urban Santiago selected by a stratified and multistage probability design. Second, data collection was carried out using standardized measurements. Third, we could analyze the sample by economic status according to geographic areas within the Metropolitan Region and family incomes, which allowed us to classify this parameter accurately. Fourth, in this study, we followed the recommendations of the 7 AHA ideal metrics, as stated by Lloyd Jones et al. [5]. Specifically, we focused on the ideal diet, including the five components assessment. For example, urinary sodium excretion was measured as a more reliable determination of daily salt intake, which has not been the rule in most published papers.

In conclusion, our study shows a low ideal CVH prevalence in women from Santiago. Furthermore, it supports the evidence that a high education level, a pregnancy history without preeclampsia and/or gestational diabetes, and less than 2 alcoholic drinks per day are potent factors associated with an ideal CVH.

Contributors

MA and PV were involved in the conceptual design, analysis, interpretation of the data, and manuscript writing.

CN was involved in statistical analysis and interpretation of the data.

CCC was involved in the survey's design and data collection.

AB was involved in data collection.

RL was involved in the interpretation of data and writing of the manuscript.

All authors revised the manuscript critically for important intellectual content, approved the final version for publication, and agreed to send the paper to The Lancet Regional Health - Americas.

Declaration of Interests

Monica Acevedo: Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events: Axon Pharma, Novo Nordisk, Eli lilly, AstraZeneca, Boehringer Ingelheim; Tecnofarma, Bayer, Ferrer. Participation on a Data Safety Monitoring Board or Advisory Board: Axon Pharma, NovoNordisk. Support for attending meetings and/or travel: European Congress of Cardiology travel and registration expenses, 2019 by Boehringer Ingelheim. Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid: Director Fundación SOCHICAR, unpaid; Senior advisor, The Lancet Women and Cardiovascular Disease Commission Paola Varleta: Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events: Axon Pharma, Novo Nordisk, AstraZeneca, Boehringer Ingelheim; Tecnofarma, Abbott. Participation on a Data Safety Monitoring Board or Advisory Board: Axon Pharma, NovoNordisk. Support for attending meetings and/or travel: European Congress of Cardiology travel and registration expenses, 2019 by Boehringer Ingelheim. Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid: Director Fundación SOCHICAR, unpaid. Carolina Casas-Cordero: None. Amalia Berríos: None. Carlos Navarrete: None. Rosario López: None.

Data sharing statement

The study data that underline the results of this work will be available for investigators after approval by the Foundation "Fundación SOCHICAR." Please email the corresponding authors for more information.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.lana.2021.100071.

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