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Cardiovascular risk factors for heart disease and stroke in women by age and time since menopause, in seven Latin American cities: The CARMELA study

Palmira Pramparo [a,*], Herman Schargrodsky [b], Carlos Boissonnet [c], Beatriz Marcet Champagne [a], Honorio Silva [d], Monica Acevedo [e,f], Elinor Wilson [g]

[a] *InterAmerican Heart Foundation, Dallas, TX, USA*
[b] *Italian Hospital, Buenos Aires, Argentina*
[c] *Centro de Educación Medica e Investigaciones Clínicas ''Norberto Quirno", Buenos Aires, Argentina*
[d] *Center for Experimental Pharmacology and Therapeutics, Harvard, MIT Division of Health Sciences and Technology, Boston, USA*
[e] *Department of Cardiovascular Diseases, Pontificia Universidad, Santiago, Chile*
[f] *Women and Heart Disease Committee, World Heart Federation, USA*
[g] *Assisted Human Reproduction Canada, Ottawa, Canada*

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Summary
Background: The prevalence of cardiovascular risk factors in women in Latin America remains uncertain and may be different among regions. The aim of this study was to evaluate cardiovascular risk factors in relation to age and time since menopause in the female population of the Carmela study.
Methods: The CARMELA study is a cross-sectional, population-based, observational study in 11,550 adults aged 25—64 years. The prevalence of cardiovascular risk factors in 6119 women according to age and time from menopause was studied in Barquisimeto (Venezuela), Bogotá (Colombia), Buenos Aires (Argentina), Lima (Perú), México City (México), Quito (Ecuador), and Santiago (Chile).
Results: The mean age was 44 years. Menopause was reported by 2439 women. Hypertension increased after the age of 35 years in Barquisimeto and Mexico City; metabolic syndrome also showed an increase from that age in Barquisimeto and Lima. The prevalence of tobacco use was high among youth in Santiago and Buenos Aires. Overweight and obesity increased at an early age in some cities. Diabetes increased at age 45 in Bogotá and Mexico City. The impact of time from menopause

* Corresponding author. Address: Peña 3070 5 B, 1425 Buenos Aires, Argentina. Tel./fax: +54 11 4805 4931.
E-mail addresses: p.pramparo@yahoo.com, ppramparo@fibertel.com.ar (P. Pramparo).

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on low density lipoprotein cholesterol (LDLC), and hypertension was different among cities. High density lipoprotein cholesterol (HDL-C) remained constant with age and time from menopause.
Conclusions: Differences in the prevalence of cardiovascular risk factors in women have been found among cities. Some increased alarmingly at young ages, consequently the time from menopause did not show an equal impact on risk factors. Tailored interventions for cardiovascular disease prevention are needed in the region.

Background

Cardiovascular disease is the leading cause of death and disability worldwide including Latin America. Epidemiological information on the prevalence of cardiovascular risk factors in this region, and especially in women, has been difficult to assess, because of differences in data collection and processing [1]. Some improvements have occurred in the region with respect to life expectancy and infant mortality. Despite these improvements, many challenges remain in the region regarding diabetes, obesity and hypertension, [2] as well as tobacco addiction. The influence of gender and sex hormones on cardiovascular risk factors has been studied in recent years [3]. However, there is limited information about this topic in women in Latin America.

Using the database of the Carmela study, [4] we analyzed cardiovascular risk factors in the female population, in relation to age as well as time from menopause in seven Latin American cities: Barquisimeto, Venezuela; Bogota, Colombia; Buenos Aires, Argentina; Lima, Peru; Mexico City, Mexico; Quito, Ecuador; and Santiago, Chile.

Methods

The CARMELA study was designed to assess and compare the prevalence of cardiovascular risk factors, socioeconomic aspects, and common carotid artery intimal medial thickness in seven Latin American cities. The methodology and main results have been published recently [4]. Briefly, it was a cross-sectional, population-based, observational study with probabilistic sampling, which enrolled approximately 1600 participants from each city. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. The sampling design distributed the participants stratified by sex and by age (into four 10 years age groups). A customized questionnaire was used to collect information on demographics and cardiovascular risk factors. Participants visited designated healthcare institutions for standardized clinical measurements, obtained by health personnel trained, certified, and supervised by CARMELA investigators. These measures were standardized across all centers. Of a total of 6167 women, 48 women were excluded from the analysis because of pregnancy, therefore cardiovascular risk factors in relation to age and time since menopause were analyzed in 6119 women.

Clinical definitions

Hypertension was defined according to The Seventh Report of the Joint National Committee [5]. Dyslipidemia was defined in accordance with the National Cholesterol Education Program Adult Treatment Panel III [6]. Diabetes was defined as a fasting blood glucose level $\geqslant$1.26 mg/dl [7] or as self reported diabetes. Metabolic syndrome was defined in accordance with the National Cholesterol Education Program Adult Treatment Panel III. [6] Overweight included a body mass index (BMI) $\geqslant 25\ kg/m^2$ to $< 30\ kg/m^2$ and Obesity a BMI $\geqslant 30\ kg/m^2$. Current (regular) smoking included daily or occasional consumption of cigarettes, cigars, or pipe. Menopausal status was defined as 12 months of amenorrhea following the final menstrual period [8].

Statistical analysis

Overall characteristics of the sample are reported as mean ± standard deviation or frequencies and percentages. Statistical processing addressed the non-equal probability character of the sample and the structure of the design to generate weighted data adjusted for the age and sex distribution of the population of each city. Means and prevalence rates along with their 95% confidence intervals were estimated by survey analysis procedures (SAS Software, Release 9.1, and Cary, North Carolina, USA), taking into account the multistage stratified sampling design via CLUSTER and STRATA statements.

Results

Table 1 shows the distribution of the 6167 female participants in the CARMELA study by city, mean age, menopausal status and type of menopause (natural or surgical).

Table 2 shows the prevalence and 95% CI of cardiovascular risk factors by city and according to 10-year age group. The highest prevalence of hypertension was seen in Barquisimeto, Buenos Aires and Santiago. Interestingly, after age 35 significant increases were seen in Barquisimeto and Mexico City. Santiago and Buenos Aires had a high prevalence of tobacco addiction even in young women of reproductive age. Diabetes showed an overall prevalence of more than 7% in Mexico City, Bogota, Quito and Santiago. The prevalence of diabetes increased with age in all cities, however, in Mexico City and Bogotá a sharp increase was observed after the age of 45 years. The prevalence of metabolic syndrome ranged from 12.3% in Buenos Aires to 28% in Mexico City, but increases were found after age 35 years in Barquisimeto, Lima and Santiago. The prevalence of overweight ranged from 27.5% to 40.8%, with the lowest rate in Buenos Aires. However, notable increases were seen in Bogota and Buenos Aires after the age of 35 years. The lowest prevalence of obesity was also found in Buenos Aires (16.8%) and the highest in Mexico City (30.4%). Increments in obesity prevalence, after age 35 years, were seen in Lima and Quito. As shown in Fig. 1, the greatest mean value of waist circumference, 88 cm (35 in.) or more, was found in Mexico City and Santiago.

Table 3 shows lipid profiles by city and age group. Women from Barquisimeto had the lowest mean total cholesterol and the highest values were seen in Quito and Mexico City. Notably, women from Mexico City and Quito in the 35—44 age range had mean total cholesterol values over 200 mg/dL. In all cities, except Quito, a significant increment in the cholesterol value occurred after 35—44 years of age. In Buenos Aires, Mexico City, Quito and Santiago, the mean HDL-C value was greater than 50 mg/dL and statistically non-significant changes were seen with age.

Table 4 presents the weighted mean prevalence and 95% CI of cardiovascular risk factors in relation to time since menopause (< or >10 years), adjusted by age. Ten years after menopause, the prevalence of hypertension presented a sharp increase in Barquisimeto, Buenos Aires and Mexico City. Diabetes and metabolic syndrome did not show any differences in relation to time since menopause. Also, HDL-C did not change according to the time since menopause, while LDL-C only showed an increase in Barquisimeto.

Table 1 Total population of women, age and menopausal status by city

City	Total sample $N = 6167$ number and (%) of women in each city	Age (years) mean age ± SD 44.59 ± 11.36	Menopausal status number and prevalence (95% CI) $n = 2439$	Age and type of menopause weighted mean age and (95% CI) $N = 2433$[a]	
				Natural $n = 1820$	Surgical $n = 613$
Barquisimeto	1135(61.42)	45.1 ± 11.3	466 25(22.4—27.5)	46.6(46.0—47.2)	41.8(40.7—42.9)
Bogotá	815(52.48)	45.1 ± 11.3	323 22.3(19.1—25.4)	48(47.2—48.7)	42.7(40.7—44.8)
Buenos Aires	748(50.47)	44.6 ± 11.7	292 34.4(30.9—38.0)	48.6(48.0—49.1)	41.4(39.4—43.3)
Lima	883(53.45)	43.6 ± 11.6	358 29(25.9—32.1)	46.5(45.8—47.1)	40.4(38.8—42.1)
México DF	889(51.63)	44.5 ± 11.3	350 26.9(23.4—30.4)	47.3(46.7—48.0)	40(38.7—41.3)
Quito	825(50.37)	44.4 ± 11.2	322 22.9(19.5—26.3)	47.1(46.6—47.7)	41.5(39.5—43.5)
Santiago	872(52.69)	44.8 ± 11.2	328 26.4(23.3—29.5)	47.6(46.8—48.5)	42.3(40.8—43.7)

[a] Six women did not know their type of menopause and were excluded.

Table 2 Weighted prevalence and 95%CI of cardiovascular risk factors, by city and age group

Risk Factor	Barquisimeto	Bogotá	Buenos Aires	Lima	Mexico City	Quito	Santiago
Hypertension[a] *n* = 6119 total prevalence	23.3(21.0–25.6)	12.5(10.2–14.8)	21.9(19.2–24.6)	10.8(8.9–12.7)	12.1(9.9–14.3)	10.3(8.1–12.6)	20.9(18.0–23.7)
Age group							
25–34	6(3.0–9.0)	1.7(0.0–3.4)	6.1(2.3–9.9)	2.1(0.3–4.0)	1.4(0.0–3.1)	1.7(0.0–3.6)	5.5(1.9–9.2)
35–44	18.2(13.9–22.5)	4.51(1.8–7.2)	13.4(8.4–18.5)	5.3(2.5–8.1)	7.3(4.2–10.4)	3.7(1.1–6.3)	12.9(8.4–17.5)
45–54	38(32.1–44.0)	24.1(17.7–30.6)	23.7(17.1–30.3)	17(12.5–21.4)	21.1(15.8–26.4)	21.9(17.0–26.8)	29.4(23.4–35.4)
55–64	59.9(53.9–66.0)	45(37.9–52.1)	50.8(44.0–57.5)	34.8(28.6–41.0)	38(31.0–45.1)	34.4(27.2–41.5)	55(49.0–61.0)
Tobacco[b] *n* = 6119 total prevalence	15.2(12.9–17.4)	15.1(11.2–19.0)	38(34.3–41.6)	15.6(12.8–18.4)	21.1(18.9–23.2)	10.7(8.0–13.4)	43.5(39.9–47.1)
Age group							
25–34	9.3(5.5–13.1)	13.3(7.5–19.0)	41.7(33.6–49.8)	16.7(11.1–22.4)	20.3(14.6–26.0)	10.1(5.9–14.2)	50.8(43.4–58.1)
35–44	23.2(18.5–28.0)	19(12.3–25.7)	38.7(32.4–45.0)	15.8(11.0–20.6)	24.7(19.3–30.0)	12.2(7.1–17.2)	42.4(36.2–48.6)
45–54	15.3(11.3–19.3)	14.7(9.7–19.6)	41.2(33.2–49.2)	17.4(12.7–22.1)	21.5(17.2–25.8)	12.4(7.9–16.8)	46(38.6–53.3)
55–64	9.4(6.1–12.7)	10.5(5.6–15.4)	28.1(20.9–35.4)	9.8(5.8–13.8)	14.6(10.4–18.9)	6.2(2.8–9.5)	28.1(21.6–34.7)
Diabetes[c] *n* = 6119 total prevalence	6.4(5.1–7.7)	8.7(6.8–10.6)	4.7(3.2–6.3)	4.6(3.2–6.0)	9.7(7.8–11.7)	7.2(5.6–8.9)	7.7(5.7–9.7)
Age group							
25–34	2.3(0.1–4.6)	6.1(2.3–9.9)	2.8(0.4–5.1)	2.1(0.3–4.0)	4.2(1.8–6.7)	3.9(0.7–7.1)	3.5(0.6–6.5)
35–44	5.7(3.1–8.4)	4.5(1.3–7.7)	2.7(0.0–5.5)	5.7(3.0–8.5)	7.8(4.2–11.3)	6.3(3.0–9.7)	5.8(2.7–8.9)
45–54	8(5.2–10.8)	12.9(8.7–17.1)	2.8(0.0–5.7)	5.7(2.8–8.5)	16.3(11.9–20.8)	10(5.8–14.1)	10.9(6.5–15.3)
55–64	16.8(12.5–21.1)	20.5(14.8–26.2)	12.1(7.0–17.1)	7.4(3.8–10.9)	19(13.6–24.4)	14.9(10.2–19.5)	15.2(10.1–20.2)
Metabolic syndrome[d] *n* = 6119 total prevalence	25.6(22.9–28.3)	21.7(19.0–24.4)	12.3(9.6–15.1)	20(17.3–22.8)	28(24.4–31.6)	20.1(16.9–23.4)	23(20.0–26.0)
Age group							
25–34	11.6(7.2–16.0)	8.3(4.6–11.9)	3.3(0.8–5.9)	6.4(3.2–9.7)	16.5(11.9–21.1)	7.8(3.6–12.1)	11.6(7.3–15.9)
35–44	23.9(19.2–28.6)	16.8(10.8–22.7)	7.5(3.6–11.4)	18.7(12.9–24.4)	27.4(20.3–34.5)	18(11.8–24.2)	22.3(16.0–28.6)
45–54	37.7(32.3–43.1)	36.2(30.2–42.3)	16.9(10.4–23.5)	34.8(28.8–40.7)	35.5(30.0–40.9)	35.5(29.3–41.6)	26.1(20.4–31.7)
55–64	47.8(41.8–53.8)	48.6(41.8–55.5)	24.6(17.8–31.4)	36.8(29.5–44.0)	49.3(42.4–56.1)	37.4(31.1–43.7)	42.4(36.4–48.5)
Overweight[e] *n* = 6119 total prevalence	33.8(30.7–36.9)	37.5(33.4–41.7)	27.5(24.1–30.9)	40.8(37.2–44.3)	40.2(37.0–43.3)	40.8(37.3–44.3)	36.7(33.4–40.1)
Age group							
25–34	28.7(22.0–35.4)	28.2(21.9–34.4)	16.1(10.2–22.1)	39.1(32.8–45.3)	35.8(30.1–41.6)	34.1(26.7–41.4)	30.2(23.9–36.5)
35–44	33.7(28.6–38.8)	42.5(35.6–49.3)	31.2(24.1–38.2)	41.1(35.0–47.3)	39.3(34.1–44.4)	41.3(34.1–48.5)	41.1(34.5–47.6)
45–54	38(32.5–43.5)	42.2(35.8–48.7)	28.8(21.1–36.5)	39.6(32.5–46.6)	45.4(38.6–52.2)	45.8(39.1–52.5)	39.8(32.7–47.0)
55–64	40.7(35.3–46.1)	43.2(36.1–50.2)	37.2(30.5–43.8)	46.1(39.1–53.1)	45.9(38.5–53.3)	51.8(45.0–58.6)	36.8(30.7–42.9)
Obesity[f] *n* = 6119 total prevalence	26.1(22.6–29.6)	22(19.0–25.0)	16.8(13.8–19.8)	23.4(20.5–26.4)	30.4(27.1–33.7)	22.4(18.7–26.0)	29.4(26.0–32.9)
Age group							
25–34	20.8(14.5–27.2)	12.2(7.9–16.4)	8.9(4.9–12.9)	14.2(9.7–18.6)	23.1(17.5–28.7)	12.3(7.5–17.1)	24.1(18.5–29.7)
35–44	25.9(20.7–31.2)	21.8(15.8–27.8)	14(8.6–19.3)	26.3(20.0–32.6)	32(25.1–38.8)	26.5(19.5–33.4)	27.2(20.9–33.6)
45–54	31.9(27.1–36.8)	31(25.1–37.0)	19.8(12.4–27.2)	30.9(24.1–37.6)	35.5(28.5–42.4)	30.3(23.4–37.1)	31.8(26.0–37.6)
55–64	30.6(25.3–36.0)	35.5(28.6–42.3)	27.1(20.0–34.2)	31.4(24.2–38.6)	39(32.6–45.5)	29.2(22.9–35.6)	41.1(34.4–47.9)

[a] Hypertension: defined as ⩾140/90 mmHg or use of antihypertensive drugs.

[b] Current (regular) smoking: daily or occasional, consumption of cigarettes, cigars, or pipe tobacco.

[c] Diabetes, fasting blood glucose level >126 mg/dL or self reported diabetes.

[d] Metabolic syndrome: presence of ⩾3 of the following: abdominal obesity (waist circumference >88 cm in women); blood pressure ⩾130/85 mm Hg; triglycerides ⩾150 mg/dL; fasting glycemia >110 mg/dL or self-reported diabetes.

[e] Overweight: BMI > 25 kg/m^2 and <29.9 kg/m^2.

[f] Obesity: BMI ⩾ 30 kg/m^2.

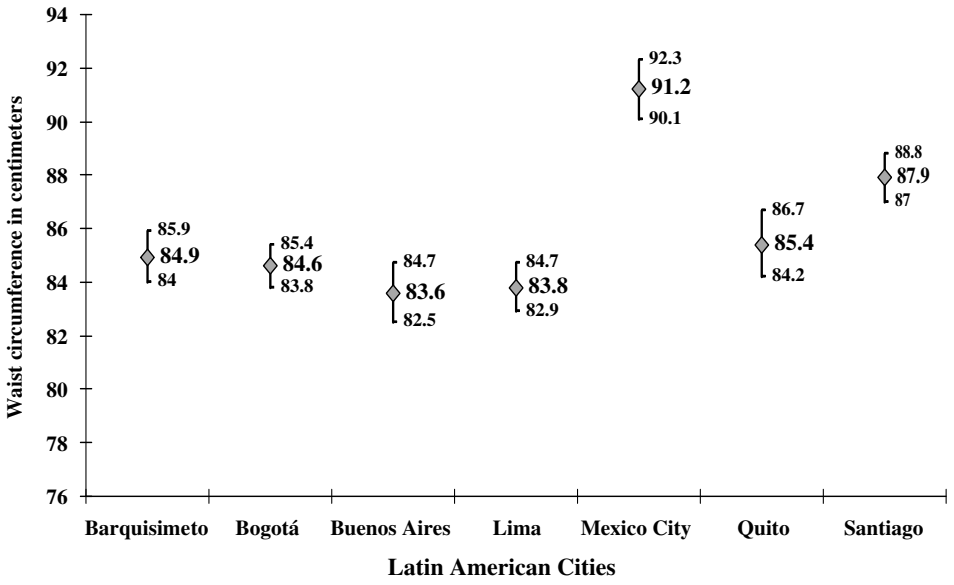

Figure 1 Weighted mean and 95%CI of waist circumference in centimeters, by city.

Discussion

This paper is the first to present different prevalence rates of cardiovascular risk factors in women in 7 Latin American cities. The prevalence of cardiovascular risk factors is distributed heterogeneously across the cities and in some cities an increased prevalence was found at young ages.

The onset of the occurrence of cardiovascular risk factors in women has been attributed to different circumstances. It has been shown that estrogen deficiency following menopause might increase cardiovascular risk [9]. The clustering of risk factors, particularly obesity, hypertension and dyslipidemia, is commonly seen in postmenopausal women, which has been related to increased cardiovascular risk [10]. However, the contribution of age and menopausal status to the development of heart disease remains unclear [11]. Age and type of menopause have also been related to subsequent cardiovascular morbidity and mortality [9,11]. In our sample, the time from menopause did not show the same impact on risk factors among the seven cities.

Reports from USA, estimate the prevalence of hypertension as 28% in white women and 27% in Mexican-American women [12]. Our study showed a lower prevalence of hypertension. A study in postmenopausal women found an overall prevalence of hypertension of 37.8% [13]. We observed a prevalence of hypertension above 38% in the subgroup of women 55 years and older in Barquisimeto, Bogotá, Buenos Aires, Mexico City and Santiago. The impact of the time since menopause on the prevalence of hypertension, adjusted by age, showed an increase in Barquisimeto, Buenos Aires and Mexico City. In most cities, increases in the prevalence of hypertension were seen at earlier ages, and well before the onset of menopause.

Cigarette smoking remains the leading preventable cause of coronary heart disease in women. In published Latin-American data, for women, the attributable risk of smoking for acute myocardial infarction was 25.7 (95% CI: 18.2—35.1) [14]. Latin American and Caribbean countries are in the second stage of an epidemic where the prevalence of female smokers is just beginning to increase [15]. The World Health Organization (WHO) reported for the year 2003, a total prevalence of female tobacco use of 36.8% in Chile, 15% in Mexico and 7% in Ecuador [16]. Our study showed a greater prevalence than that reported by WHO, with wide differences among cities. In general, and compared to men, Latin American women smoke less. The exceptions were Buenos Aires and Santiago, where the prevalence of tobacco use was similar in both genders [4]. In all cities, independently of the total prevalence, high prevalence rates were found in women up to age 44 years. Decreases in the prevalence rates were observed only in women older than 55 years.

Diabetes has been increasing disproportionately especially among minority groups in the United States [17]. In the CARMELA study, women across all ages in Mexico City had the highest prevalence of diabetes. High prevalence rates were also found in Bogotá, Quito and Santiago, where in the 45—54 year age group, it was almost double that in other

Table 3 Lipids as weighted mean and 95%CI by city and age group

Lipid: $n = 6119$	Barquisimeto	Bogotá	Buenos Aires	Lima	Mexico City	Quito	Santiago
Cholesterol (mg/dL)	175.5(172.6–178.4)	192.2(189.3–195.2)	197.4(194.1–200.7)	189.2(185.9–192.4)	201.6(198.3–205.0)	203.5(200.1–206.9)	198.7(195.8–201.7)
Age group							
25–34	158.1(154.0–162.1)	177(172.2–181.7)	173.2(168.3–178.1)	168.7(164.1–173.3)	182.5(177.9–187.1)	190.9(185.3–196.6)	181.3(176.1–186.5)
35–44	173.9(169.4–178.4)	189.2(183.8–194.6)	186.8(182.1–191.4)	186(180.5–191.5)	204.8(199.2–210.3)	202.5(195.8–209.2)	193.1(188.7–197.6)
45–54	192.2(187.7–196.6)	207.1(202.1–212.0)	212.3(204.8–219.8)	208.9(203.6–214.2)	215.6(208.8–222.5)	215.4(209.6–221.1)	217.2(210.9-–223.5)
55–64	199.3(194.7–203.9)	218.5(213.5–223.6)	225(219.3–230.6)	219.8(212.6–227.0)	225.9(219.4–232.5)	224.5(219.0–230.1)	218.2(212.5–224.0)
HDL–C (mg/dL)	42.8(42.0–43.7)	44.6(43.7–45.4)	57.4(56.4–58.4)	41.2(40.3–42.0)	53.7(52.6–54.7)	51.1(50.2–52.0)	52.7(51.7–53.6)
Age group							
25–34	43.3(41.8–44.7)	44.5(42.9–46.0)	56.6(54.8–58.3)	41.1(39.9–42.2)	53.4(51.2–55.6)	52.3(50.6–54.0)	52.8(51.2–54.5)
35–44	42.2(40.9–43.5)	44.2(42.5–45.8)	55.5(53.6–57.3)	40.1(38.8–41.4)	52.4(50.6–54.1)	50.5(48.9–52.1)	50.6(49.0–52.2)
45–54	43.3(42.0–44.6)	44.9(43.4–46.4)	58.6(56.3–60.8)	41.7(40.4–43.0)	55.1(53.6–56.6)	50.1(48.8–51.4)	54.5(52.7–56.3)
55–64	42.4(40.9–43.8)	45.3(43.8–46.8)	59.4(57.4–61.4)	42.5(41.1–44.0)	54.9(53.0–56.8)	50.8(49.0–52.6)	53.9(52.1–55.6)

Table 4 Age-adjusted weighted prevalence or mean and 95%CI of cardiovascular risk factors by city and time since menopause

Risk factor $n = 2438$	Time since menopause (years)	Barquisimeto	Bogotá	Buenos Aires	Lima	Mexico City	Quito	Santiago
Hypertension%	<10	44.3(37.5–51.2)	33.5(25.2–41.9)	32.6(26.1–39.0)	22.3(16.7–27.9)	20.8(16.1–25.4)	20.8(15.1–26.5)	44.4(37.3–51.5)
	⩾10	59.1(51.5–66.7)	40.2(31.0–49.4)	54.1(44.4–63.7)	34.8(27.0–42.6)	38.6(31.6–45.5)	30.6(22.9–38.3)	49.5(41.9–57.2)
Diabetes%	<10	9.7(6.3–13.1)	15.5(8.8–22.1)	8.4(3.8–13.1)	7.5(3.6–11.4)	17.3(12.0–22.6)	10.3(6.0–14.6)	14(8.1–19.9)
	⩾10	15.1(9.8–20.4)	17.7(12.1–23.2)	10.3(4.8–15.8)	8.5(3.9–13.2)	17.5(11.6–23.3)	13.3(8.2–18.4)	15.8(9.2–22.4)
Metabolic syndrome%	<10	43(36.4–49.7)	46(39.2–52.7)	20.9(13.7–28.1)	38.9(32.0–45.7)	37.9(29.6–46.1)	40.2(32.1–48.4)	36.4(29.4–43.5)
	⩾10	51.5(43.8–59.1)	46.1(38.1–54.1)	24.3(15.6–33.0)	38.6(30.3–46.9)	42.7(35.7–49.6)	33.7(25.5–42.0)	39(30.6–47.3)
Mean LDL–C (mg/dL)	<10	116.4(112.8–119.9)	137.3(131.8–142.9)	142.3(136.2–148.5)	141.6(135.9–147.2)	131.1(125.4–136.9)	138.6(132.6–144.6)	132.2(127.6–136.9)
	⩾10	127.3(121.6–133.0)	137.6(132.5–142.7)	138.8(131.7–145.9)	142.7(136.2–149.2)	130.7(125.0–136.4)	139.4(134.6–144.1)	134.4(128.1–140.7)
Mean HDL–C (mg/dL)	<10	43.2(41.5–44.8)	44.5(42.4–46.6)	59.4(57.2–61.6)	41.5(39.9–43.2)	54.6(52.4–56.8)	50.4(48.7–52.1)	53.4(51.3–55.6)
	⩾10	41.9(40.3–43.5)	45.3(43.5–47.0)	58.6(56.3–60.8)	42.6(40.9–44.3)	55.9(54.1–57.7)	50.8(48.8–52.7)	54(51.4–56.7)

cities. The time since menopause did not impact the prevalence of diabetes in the CARMELA study. It is likely that other factors, such as overweight, obesity and metabolic syndrome, present in younger women in these cities, thereby contributed to the development of diabetes at an early age.

The prevalence of metabolic syndrome in Mexican American women is 27.2%, one of the highest in the American population [12]. We found similar values in Mexico City, even in the 35—44 year old age group, and a prevalence rate >20%, in Barquisimeto and Santiago for the same age group. Women from Buenos Aires had less prevalence of metabolic syndrome than men, and inversely, women in Quito had a higher prevalence than men [4].

It is well established that obesity is increasing worldwide [2,18]. Based on USA data, 54.5% of Hispanic women are overweight or obese [12]. We found a combined prevalence of overweight plus obesity over 50% in all CARMELA cities, with an alarming 70% in Mexico City. This high prevalence in women after 35 years of age was comparable to data from developed countries [2,18]. When compared to men, women from Buenos Aires showed less obesity whereas in Bogotá and Quito more obesity [4].

Enlargement of waist circumference in menopausal women is associated with increased cardiovascular risk [19,20]. Differences exist among cities in the mean values of waist circumference, but the highest values, according to the American Heart Association (AHA) criteria [3], were found in Santiago and Mexico City.

For women, it has been published that the mean total cholesterol concentrations increase with age, with a peak among 55 to 64 year olds [21]. A mean cholesterol value of 196.4 mg/d was reported for American women, with a mean HDL-C value not significantly different between non-Hispanic whites and Mexican Americans (mean HDL-C in both groups of 52.9 mg/d) [22,23]. In the CARMELA study we found a wide range of mean total cholesterol. In most cities, the mean values were less than the USA data with the exception of Mexico City and Quito where the values were similar. In general, the total cholesterol mean values increased with age in all cities, but except for Quito, significant increases were found after ages 35—44 years. We observed the lowest mean cholesterol values in Barquisimeto, Bogotá and Lima. However, these cities also had the lowest mean HDL-C values according to ATPIII [6] and AHA guidelines [3].

Better lipid profiles (lower LDL-C and higher HDL-C) in women compared to men have been attributed to the protective effect of estrogen [24]. Randomized trials of estrogen use on primary and secondary cardiovascular prevention, failed to demonstrate a benefit [25,26]. It has been published that HDL-C values change following menopause [27,28]. Women in most cities in the CARMELA study did not demonstrate significant changes in HDL-C with the time from menopause, nor with aging. LDL-C did not show any change with the time from menopause, except for women in Barquisimeto city.

Limitations of the CARMELA study include: the cross-sectional rather than longitudinal approach, exclusion of marginal areas which may have affected the socioeconomic balance of the sample, as well as the exclusion of non-urban populations.

In conclusion, the CARMELA study is the largest study done in Latin America that included an important number of women from the general population, to evaluate the prevalence of cardiovascular risk factor in different age groups, simultaneously in seven Latin American cities. We found that the prevalence of cardiovascular risk factors in women is different among cities, and that, some risk factors are present at earlier ages than historically expected. Population-wide strategies are needed in Latin America to combat cardiovascular disease in women.

CARMELA study committee members and investigators

Steering committee

Elinor Wilson (Chair); Herman E Schargrodsky, Rafael Hernández-Hernández, Beatriz Marcet Champagne, Honorio Silva.

Scientific committee

Herman E. Schargrodsky (Chair); Francisco Benítez, Ximena Berríos-Carrasola, Carlos Pablo Boissonnet, Jorge Escobedo, Raúl Gamboa-Aboado, Alvaro Ruiz-Morales, Palmira Pramparo, Manuel Velasco, Raúl Vinueza.

Participating institutions, coordinators and investigators

Asociación Cardiovascular Centro Occidental- Lic. Elizabeth Infante, Luis Rocha; Pontificia Universidad Javeriana de Bogota-Álvaro Ruíz Morales, Esperanza Peña, Felipe Uriza; Centro de Educación Medica e Investigaciones Clinicas"Norberto Quirno"-Carlos Boissonnet, Juan Fuselli, Víctor Torres;Universidad Cayetano Heredia-Raúl Gamboa-Aboado, Carlos Kiyán, Mario Vargas; Instituto

Mexicano de Seguridad Social-Jorge Escobedo, Luisa Buitrón, Jesús Ramírez-Martínez; Hospital Metropolitano de Quito- Francisco Benítez, María Velasco, Luis Falcóni; Pontificia Universidad Católica de Santiago de Chile-Ximena Berrios-Carrasola, Beatriz Guzmán, Mónica Acevedo.

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Contribution of the authors

Palmira Pramparo: CARMELA study, scientific committee member, data interpretation and responsibility to write this paper. Herman Schargrodsky: principal investigator of the CARMELA study, steering committee member, study design, and data collection. Carlos Boissonnet: principal investigator for Argentina, scientific committee member, data interpretation, and data collection. Beatriz Marcet Champagne: executive director of the InterAmerican Heart Foundation, steering committee member, and data interpretation. Honorio Silva: data interpretation, and writing the report. Monica Acevedo: investigator for Chile, data interpretation and data collection. Elinor Wilson: CARMELA study, chair scientific committee, study design and data interpretation.

Conflict of interest

Drs. Palmira Pramparo, Herman Schargrodsky, Carlos Boissonnet, Beatriz Champagne, Monica Acevedo and Elinor Wilson declare no conflict of interest. Dr. Honorio Silva was VP Science and Medical Professional Development, a non product-related position at Pfizer, New York, USA for the period 2004—2007. Since 2008 Dr. Silva has been at the Center for Experimental Pharmacology and Therapeutics. Harvard/MIT Division of Health Sciences and Technology, Boston, USA, and Director/Treasurer for Project Globe for Continued Professional Development, a non profit organization.

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