American Journal of Therapeutics 17, 159–166 (2010)

Cardiovascular Risk Awareness, Treatment, and Control in Urban Latin America

Honorio Silva, MD,[1]* Rafael Hernandez-Hernandez, MD,[2] Raul Vinueza, MD,[3] Manuel Velasco, MD,[4] Carlos Pablo Boissonnet, MD,[5] Jorge Escobedo, MD,[6] H. Elif Silva, MD,[7] Palmira Pramparo, MD,[8] and Elinor Wilson, PhD[9] on behalf of the CARMELA Study Investigators

Effective prevention and treatment of cardiovascular diseases require regular screening for risk factors, high awareness of the condition, effective treatment of the identified risk factors, and adherence to the prescribed treatment. The Cardiovascular Risk Factor Multiple Evaluation in Latin America study was a cross-sectional, population-based, observational study of major cardiovascular risk factors—including hypertension, diabetes, and hypercholesterolemia—in 7 Latin American cities. This report presents data on assessment, diagnosis, extent, and effectiveness of treatment, adherence to treatment, and reasons for nonadherence. Data were collected through household questionnaire-based interviews administered to 5383 men and 6167 women, 25–64 years of age, living in the following cities: Barquisimeto, Venezuela; Bogota, Colombia; Buenos Aires, Argentina; Lima, Peru; Mexico City, Mexico; Quito, Ecuador; and Santiago, Chile. Participants also completed a clinic visit for anthromorphometric and laboratory assessments. Rates of prior diagnosis of hypertension and diabetes were high (64% and 78% of affected individuals, respectively) but relatively low for hypercholesterolemia (41%). The majority of affected individuals (hypercholesterolemia 88%, diabetes 67%, and hypertension 53%) were untreated. Among individuals who were receiving pharmacologic treatment, targets for control of hypertension, diabetes, and hypercholesterolemia were achieved by 51%, 16%, and 52%, respectively. Adherence to treatment was observed in 69% of individuals with hypertension, 63% with diabetes, and 66% with hypercholesterolemia. Forgetfulness was the major cause of nonadherence for all 3 conditions. There is a substantial need for increasing patient education, diagnosis, treatment, adherence, and control of cardiovascular risk factors in the 7 Latin American cities.

Keywords: adherence, awareness, blood pressure, cardiovascular risk factors, diabetes, hypercholesterolemia, hypertension, treatment control

CLINICAL SIGNIFICANCE

(1) Although a majority of individuals knew they had hypertension or diabetes, only 41% were aware of hypercholesterolemia.

(2) Forty-seven percent of hypertensive, 33% of diabetic, and 12% of hypercholesterolemic individuals were receiving pharmacological treatment, yet control of these conditions was low.

[1]*Project Globe Consortium for Continued Professional Development, New York, NY;* [2]*Clinical Pharmacology Unit and Hypertension Clinic, School of Medicine, Universidad Centroccidental "Lisandro Alvarado," Decanato de Medicina, Barquisimeto, Venezuela;* [3]*Worldwide Development Operations, Pfizer, Inc., New York, NY;* [4]*Clinical Pharmacology Unit, Vargas Medical School, Central University of Venezuela, Caracas, Venezuela;* [5]*Coronary Care Unit, Centro de Educación Médica e Investigaciones Clínicas "Norberto Quirno," Buenos Aires, Argentina;* [6]*Medical Research Unit on Clinical Epidemiology, Mexican Social Security Institute, Mexico City, Mexico;* [7]*InterAmerican Foundation for Clinical Research, New York, NY;* [8]*InterAmerican Heart Foundation, Buenos Aires, Argentina; and* [9]*Inter American Heart Foundation, Dallas, TX*

The CARMELA Study was funded by Pfizer, Inc.

**Address for correspondence: Project Globe for CPD, 708 Third Avenue, 6th Floor. New York, NY 10017. E-mail: honorio.silva@globecpd.org*

1075–2765

(3) The relatively high prevalence of these risk factors and their ineffective management reveal an alarming inadequacy of cardiovascular disease prevention and call for urgent patient and physician education.

INTRODUCTION

Latin American countries are undergoing an epidemiologic transition that will increase the prevalence of cardiovascular disease.[1] Changes in lifestyle and dietary and exercise habits, consistent with urbanization, foster this transition.[2] Advances in healthcare have decreased death rates due to infectious diseases, and hence increased life expectancy, which also increases the prevalence of age-related chronic conditions.[2,3] Healthcare systems must evolve with the changing needs of populations and take into account the value of prevention and treatment measures. This strategy requires that the epidemiologic status of the population be assessed periodically for awareness of whether individuals carry risk factors, acceptance of treatment, and adherence to the prescribed treatments. Then prevention and treatment strategies appropriate to the local epidemiology and environment can be developed and contextual education provided to physicians and the population.

Levels of awareness of cardiovascular risk factors, treatment, and adherence vary across the world and information available for Latin America is limited.[4–7] Therefore, population-specific data are required for Latin American healthcare systems to operate efficiently. The Cardiovascular Risk Factor Multiple Evaluation in Latin America (CARMELA) study evaluated the prevalence and distribution of cardiovascular risk factors in 11,550 subjects in 7 major cities, and found several trends unique to these populations.[8] In this report; we present data from CARMELA pertaining to awareness, control, and adherence to treatment for hypertension, diabetes, and hypercholesterolemia.

METHODS

CARMELA was a cross-sectional, population-based observational study conducted between September 2003 and August 2005 of 11,550 subjects (25–64 years of age) in 7 Latin American cities: Barquisimeto, Venezuela; Bogota, Colombia; Buenos Aires, Argentina; Lima, Peru; Mexico City, Mexico; Quito, Ecuador; and Santiago, Chile.[8] The distribution of subjects was approximately 1600 participants in every city, of whom 400 subjects (200 men and 200 women) were in each of the four 10-year age groups. This study was complied with the Declaration of Helsinki, Guidelines for Good Clinical Practice, and local bioethics regulations and laws in the participating countries. Subjects provided informed written consent.

Sampling, survey, clinical measurements, and statistical analysis were performed as described earlier.[8] Data were collected on the prevalence of hypertension, diabetes, and hypercholesterolemia; extent of previously and newly diagnosed cases; proportion of affected individuals who were receiving pharmacologic and/or nonpharmacologic treatment at the time of the study; proportion of those who achieved treatment control; extent of adherence to treatment; and reasons for nonadherence. Prevalence data are adjusted for the age and sex distribution of each city.

To assess awareness (prior diagnosis), subjects were asked if they were ever informed by a health professional that they carry the risk factor. To assess treatment, subjects were asked if they were currently prescribed any medication for the condition and if the medication was taken as prescribed (ie, adherence). Subjects who replied in the negative were asked to indicate reasons for nonadherence. Subjects were asked if they used nonpharmacologic lifestyle changes (diet, exercise, weight control, and ''other'') to control hypertension, diabetes, or hypercholesterolemia.

Hypertension was defined as blood pressure $\geq$140/90 mm Hg or taking antihypertensive medication; diabetes and hypercholesterolemia were defined as previous diagnosis of the condition or fasting plasma glucose $\geq$126 mg/dL and total cholesterol $\geq$240 mmol/L, respectively. A blood pressure $<$140/90 mm Hg in previously diagnosed or currently treated hypertensive subjects was designated as controlled hypertension. Diabetes was considered controlled if fasting plasma glucose levels were $<$110 mg/dL. For hypercholesterolemia, Framingham risk scores determined low density lipoprotein cholesterol (LDL-C) cutoffs for control; high risk ($>$20% 10-year risk), intermediate risk (10%–20% 10-year risk), and low risk ($<$10% 10-year risk) cutoffs were LDL-C $<$100, $<$130, and $<$160 mg/dL, respectively.[9]

RESULTS

Levels of awareness of disease, current prevalence, and treatment and control of hypertension (Table 1), diabetes (Table 2), and hypercholesterolemia (Table 3) varied across cities. In the overall population, the prevalence of hypertension (16%) and hypercholesterolemia (14%) was about twice that of diabetes (7%). In the case of hypertension, 90% of the overall population had been previously screened for blood pressure; in contrast, only 50% of the overall population had been previously screened for hypercholesterolemia and 58% had been screened previously for diabetes. Lima had

Table 1. Levels of assessment, awareness, treatment, and control of hypertension.

	Barquisimeto	Bogota	Buenos Aires	Lima	Mexico City	Quito	Santiago	Overall
Percentage of general population (overall N = 11,550)								
n	1,848	1,553	1,482	1,652	1,722	1,638	1,655	11,550
Blood pressure ever measured	95.6 (94.4–96.8)	93.3 (91.2–95.4)	97.5 (96.5–98.4)	73.4 (70.3–76.6)	97.5 (96.3–98.6)	87.9 (85.5–90.4)	88.7 (86.7–90.7)	89.5 (88.3–90.8)
Hypertension prevalence*	24.7 (22.7–26.8)	13.4 (11.5–15.2)	29.0 (26.9–31.1)	12.6 (11.1–14.0)	11.7 (10.3–13.1)	8.6 (7.3–10.0)	23.8 (21.2–26.1)	16.3 (15.4–17.2)
Percentage of population with hypertension* (overall N = 2631)								
n	610	309	481	260	282	211	478	2,631
Prior diagnosis†	72.0 (67.8–76.2)	68.8 (62.2–75.5)	64.1 (59.9–68.2)	53.1 (46.5–59.6)	75.7 (70.1–81.2)	67.6 (60.2–74.9)	60.1 (55.4–64.7)	64.4 (62.0–66.9)
Newly diagnosed‡	28.0 (23.7–32.2)	31.2 (24.5–37.8)	35.9 (31.8–40.1)	46.9 (40.4–53.5)	24.3 (18.8–29.9)	32.4 (25.1–39.8)	39.9 (35.3–44.6)	34.3 (31.9–36.8)
Using nonpharmacologic therapy§	41.3 (36.0–46.5)	76.7 (70.4–83.0)	70.9 (66.0–75.9)	61.0 (51.5–70.5)	88.9 (84.7–93.2)	56.4 (46.3–66.5)	65.6 (60.0–71.1)	71.1 (68.3–73.9)
Medication currently prescribed	48.9 (44.2–53.5)	55.0 (48.2–61.8)	41.6 (37.5–45.8)	28.8 (24.0–33.5)	65.7 (60.4–70.9)	51.8 (43.9–59.8)	43.0 (38.8–47.7)	46.7 (44.1–49.4)
Treated with medication and controlled‖	20.7 (17.4–24.0)	30.6 (25.8–25.5)	18.0 (14.8–21.2)	12.0 (8.4–15.7)	41.0 (36.2–45.8)	28.0 (19.9–36.1)	20.3 (16.4–24.2)	24.0 (21.8–26.1)
Treated with medication but not controlled	28.2 (23.8–32.6)	24.3 (19.1–29.6)	23.6 (19.2–28.0)	16.7 (12.6–20.9)	24.7 (20.5–28.8)	23.8 (17.3–30.3)	22.7 (18.8–26.6)	22.8 (20.9–24.6)

Data are presented as a percentage (and 95% CI) of the overall population or of the population with hypertension.
*Blood pressure ≥140/90 mm Hg or receiving pharmacologic treatment for hypertension.
†Individuals reporting they had been told they were hypertensive.
‡Individuals first diagnosed with hypertension at the time of the CARMELA assessment.
§Nonpharmacologic treatments included diet, exercise, weight control, and other methods.
‖Control defined as blood pressure <140/90 mmHg.

consistently low screening rates relative to other cities, and Buenos Aires had the highest screening rates.

The proportion of individuals with hypertension, diabetes, or hypercholesterolemia who reported prior diagnosis (awareness) of the risk factor varied across cities. Of the 3 risk factors, the level of awareness was greatest for diabetes (78%), less for hypertension (64%), and lowest for hypercholesterolemia (41%). Consistent with the relatively low screening rates, Lima had the lowest levels of awareness for all 3 conditions.

Few people with hypercholesterolemia were receiving pharmacologic treatment (12%); levels of treatment were higher among the populations with hypertension (47%) and diabetes (33%). Attainment of therapeutic goals for blood pressure, glucose, and cholesterol levels shown in this study was far from desirable in all 3 conditions (24% for hypertension, 5% for diabetes, and 6% for hypercholesterolemia) among the overall affected population.

Pharmacologic treatment of hypertension, diabetes, and hypercholesterolemia

Among the treated hypertensive population, 51% had controlled blood pressure (<140/90 mm Hg). The use of monotherapy (78%) was more common than combination therapy (19%, 3%, and 0.3% for 2-, 3-, and 4-drug combinations, respectively, Figure 1A); this trend was consistent for both men and women in every city. Angiotensin-converting enzyme (ACE) inhibitors were the most commonly reported drugs, followed by beta-blockers and calcium channel blockers. Combinations of ACE inhibitors with either a diuretic or a calcium channel blocker accounted for 28% and 21% of all combinations used.

Only 16% of the subjects treated for diabetes were controlled (fasting plasma glucose <110 mg/dL). The predominant means of managing diabetes was through the use of oral drugs alone, which far exceeded the use of insulin alone and combined treatment with oral drugs and insulin (Figure 1B); this pattern was consistent in most cities and for both sexes. Among those on oral drugs, monotherapy was more common (76%) than 2-drug therapy (24%).

Among the pharmacologically treated hypercholesterolemic population, 52% had attained therapeutic LDL-C goals. Statins were the most commonly prescribed medication (52%), followed by fibrates (20%). Nicotinic acid and derivatives, bile acid sequestrants, and other drugs were used by 28% of treated subjects. This trend was consistent across most cities—the exceptions were

Table 2. Levels of assessment, awareness, treatment, and control of diabetes.

	Barquisimeto	Bogota	Buenos Aires	Lima	Mexico City	Quito	Santiago	Overall
Percentage of general population (overall N = 11,550)								
n	1,848	1,553	1,482	1,652	1,722	1,638	1,655	11,550
Blood glucose ever measured	67.8 (64.6–71.1)	56.8 (52.9–60.7)	75.9 (73.1–78.6)	37.3 (34.1–40.4)	76.8 (73.3–80.1)	35.5 (32.0–39.1)	52.9 (50.2–55.6)	57.8 (55.6–60.0)
Diabetes prevalence*	6.0 (5.0–7.0)	8.1 (6.9–9.5)	6.2 (4.8–7.7)	4.4 (3.4–5.4)	8.9 (7.7–10.2)	5.9 (4.8–7.1)	7.2 (5.9–8.6)	7.0 (6.5–7.6)
Percentage of population with diabetes* (overall N = 971)								
n	153	162	103	84	203	117	149	971
Prior diagnosis†	82.5 (75.9–89.1)	87.5 (81.9–93.1)	87.1 (79.9–94.4)	61.7 (49.6–73.7)	73.2 (66.7–79.7)	80.8 (71.3–90.3)	78.0 (70.9–85.1)	78.0 (74.7–81.2)
Newly diagnosed‡	17.5 (10.9–24.1)	12.5 (6.9–18.1)	12.9 (5.6–20.1)	38.3 (26.3–50.4)	26.8 (20.3–33.3)	19.2 (9.7–28.7)	22.0 (14.9–29.1)	21.2 (18.0–24.3)
Using nonpharmacologic therapy§	47.9 (36.9–59.0)	70.8 (61.8–79.8)	67.3 (59.0–75.7)	73.6 (59.9–87.3)	87.5 (80.4–94.7)	53.3 (41.0–65.5)	65.5 (55.9–75.1)	73.0 (68.6–77.4)
Medication currently prescribed	43.2 (33.7–52.6)	20.5 (14.9–26.1)	22.1 (13.4–30.8)	20.7 (11.6–29.7)	51.0 (44.3–57.7)	23.3 (15.7–30.9)	37.0 (28.5–45.5)	32.8 (29.1–36.6)
Treated with medication and controlled‖	10.2 (4.2–16.3)	3.1 (0.5–5.7)	2.1 (0.0–5.1)	4.0 (0.0–9.0)	6.8 (3.1–10.5)	5.5 (3.1–10.5)	8.3 (3.4–13.3)	5.4 (3.7–7.0)
Treated with medication but not controlled	32.9 (24.6–41.3)	17.4 (12.6–22.3)	20.0 (11.4–28.5)	16.7 (8.4–24.9)	44.2 (37.8–50.7)	17.8 (11.1–24.4)	28.7 (21.0–36.4)	27.5 (24.0–31.0)

Data are presented as a percentage (and 95% CI) of the overall population or of the population with diabetes.
*Previously diagnosed diabetes or fasting plasma glucose >126 mg/dL.
†Individuals reporting they had been told they were diabetic.
‡Individuals first diagnosed with diabetes at the time of the CARMELA assessment.
§Nonpharmacologic treatments included diet, exercise, weight control, and other methods.
‖Control defined as fasting plasma glucose <110 mg/dL.

Mexico City, where fibrates were the most commonly used drugs (41%), and Quito, where drugs other than statins or fibrates accounted for 52% of drugs used.

Adherence and nonadherence to pharmacologic treatment

Among those reporting that they currently took medication, the mean proportion reporting use as prescribed was 69% for hypertension (city range: 56%–77%), 63% for diabetes (city range: 26%–91%), and 66% for hypercholesterolemia (city range: 37%–76%), with wide variation between cities and risk factors. Women tended to report better treatment adherence than men. Forgetfulness was the main cause of nonadherence reported for all 3 conditions (51% for hypertension, 54% for diabetes, 42% for hypercholesterolemia), and financial reasons were not cited as the major limiting factor in these populations (18% for hypertension, 13% for diabetes, 25% for hypercholesterolemia).

Nonpharmacologic management of cardiovascular risk

Although most subjects (hypertension, 53%; diabetes, 67%; or hypercholesterolemia, 88%) were not receiving pharmacologic treatment at the time of the study, the majority of individuals with hypertension (60%), diabetes (73%), and hypercholesterolemia (66%) did report using nonpharmacologic means (eg, diet, weight control, regular exercise) to manage their condition. As seen in Table 4, among individuals reporting the use of some nonpharmacologic means to manage hypertension, diabetes, or hypercholesterolemia, diet was nearly always used in attempts to manage the risk factor, whereas weight control and exercise were reported by only approximately one-third of these patient populations.

DISCUSSION

Awareness of hypertension in the CARMELA cities (64%) was higher than the awareness values reported for many countries in the world and comparable to that of the United States (66%).[10] Awareness of hypercholesterolemia in the CARMELA cities (41%) fell between developed and developing countries (ranging from 0% to 33% among 32 populations from 19 countries on 3 continents),[6] whereas in the United States, awareness of hypercholesterolemia is 48%.[10] Nonetheless, CARMELA contributed to an overall new diagnosis in 34% of the population with hypertension, 21% of the population with diabetes, and 54% of those

Table 3. Levels of assessment, awareness, treatment, and control of hypercholesterolemia.

	Barquisimeto	Bogota	Buenos Aires	Lima	Mexico City	Quito	Santiago	Overall
Percentage of general population (Overall N = 11,550)								
n	1,848	1,553	1,482	1,652	1,722	1,638	1,655	11,550
Total cholesterol ever measured	68.7 (65.6–71.7)	51.6 (47.8–55.5)	81.2 (78.7–83.6)	35.5 (32.5–38.5)	46.1 (43.6–48.7)	40.3 (35.9–44.6)	51.0 (48.0–53.9)	49.9 (48.2–51.5)
Hypercholesterolemia prevalence*	5.7 (4.7–6.7)	11.7 (10.2–13.2)	18.7 (16.7–20.7)	11.6 (10.1–13.1)	16.4 (14.2–18.7)	20.2 (18.0–22.3)	15.3 (13.4–17.2)	14.2 (13.5–15.0)
Percentage of population with hypercholesterolemia* (overall N = 2057)								
n	155	259	341	240	356	386	320	2,057
Prior diagnosis†	46.1 (36.9–55.4)	31.5 (24.2–38.8)	58.2 (51.9–64.5)	33.7 (27.0–40.3)	41.9 (36.7–47.2)	32.1 (25.4–38.8)	43.7 (37.8–49.6)	40.5 (37.7–43.2)
Newly diagnosed‡	53.9 (44.6–63.1)	68.5 (61.2–75.8)	41.8 (35.5–48.1)	66.3 (59.7–73.0)	58.1 (52.8–63.3)	67.9 (61.2–74.6)	56.3 (50.4–62.2)	59.5 (56.8–62.3)
Using nonpharmacologic therapy§	45.4 (30.4–60.4)	68.2 (58.0–78.4)	69.4 (63.0–75.7)	66.9 (57.9–75.8)	85.5 (78.8–92.3)	51.0 (40.6–61.4)	54.3 (44.8–63.7)	68.9 (64.9–72.8)
Medication currently prescribed	13.2 (7.4–19.0)	13.0 (8.3–17.6)	19.2 (14.5–23.8)	9.4 (5.2–13.5)	10.7 (7.3–14.1)	4.4 (2.2–6.5)	12.9 (9.3–16.6)	12.1 (10.5–13.8)
Treated and controlled‖	9.5 (4.0–15.0)	7.1 (3.9–10.3)	10.4 (6.9–14.0)	3.8 (1.4–6.2)	5.9 (3.3–8.5)	2.1 (0.4–3.9)	6.4 (3.7–9.1)	6.3 (5.1–7.5)
Treated but not controlled	3.7 (1.0–6.5)	5.9 (2.8–9.0)	8.7 (5.6–11.8)	5.6 (2.8–8.4)	4.8 (2.3–7.3)	2.2 (0.7–3.7)	6.5 (4.0–9.0)	5.8 (4.7–6.9)

Data are presented as a percentage (and 95% CI) of the overall population or of the population with diabetes.
*Previously diagnosed hypercholesterolemia or total cholesterol ≥240 mg/dL.
†Individuals reporting they had been told they were hypercholesterolemic.
‡Individuals first diagnosed with hypercholesterolemia at the time of the CARMELA assessment.
§Nonpharmacologic treatments included diet, exercise, weight control, and other methods.
‖Control defined by Framingham risk score LDL-C cutoffs for control: high risk (>20% 10-year risk), intermediate risk (10%–20% 10-year risk), and the low risk (<10% 10-year risk) cutoffs were LDL-C <100, <130, and <160 mg/dL, respectively.

with hypercholesterolemia, indicating the need for and the intrinsic value of detection and awareness campaigns in these countries.

About half of the individuals with hypertension (47%) and 33% of those with diabetes were prescribed medication for their condition at the time of CARMELA, whereas only 12% of individuals with hypercholesterolemia were treated. The lower likelihood of treatment for persons with hypercholesterolemia was consistent with the low rates of screening and diagnosis. By comparison, in the United States, half of the cases of hypertension and diabetes, and 20% of individuals with dyslipidemia are currently being treated.[10] In the CARMELA study, monotherapy was more common than combination therapy for each of the 3 conditions. For hypertension, ACE inhibitors were the most commonly prescribed drug. Among medications for diabetes, oral drugs were much more commonly used than insulin. For hypercholesterolemia, statins were the most commonly used medication, although a relatively high percentage of the population (28%) reported using nicotinic acid and derivatives, bile acid sequestrants, or other drugs. This reflects the availability of modern medicines in these cities.

Roughly, half of the treated population with hypertension or hypercholesterolemia achieved control of their condition, but only 1 in 6 patients treated for diabetes had a fasting plasma glucose <110 mg/dL. The percentage of treated individuals attaining therapeutic goals (blood pressure <140/90 mm Hg, fasting plasma glucose <110 mg/dL, or LDL-C level cutoffs appropriate to Framingham risk) were 51%, 16%, and 52%, respectively; by comparison, recent National Health and Nutrition Examination Survey data show United States' attainment of these treatment goals at 65%, 34%, and 46%, respectively.[10] A single-city study in Cuba with a design similar to CARMELA found hypertension prevalence of 20%, but higher levels of treatment and control than most CARMELA cities[11]—only Mexico City had comparable levels. The results in Cienfuegos, Cuba, and Mexico City would suggest that good blood pressure control is possible even in resource-constrained societies if an appropriate system providing medical assistance and medicines with a focus on long-term chronic care is in place.

Taking medication entirely in accordance with the prescription is an important aspect of achieving the desired clinical outcome.[12–15] In the CARMELA study,

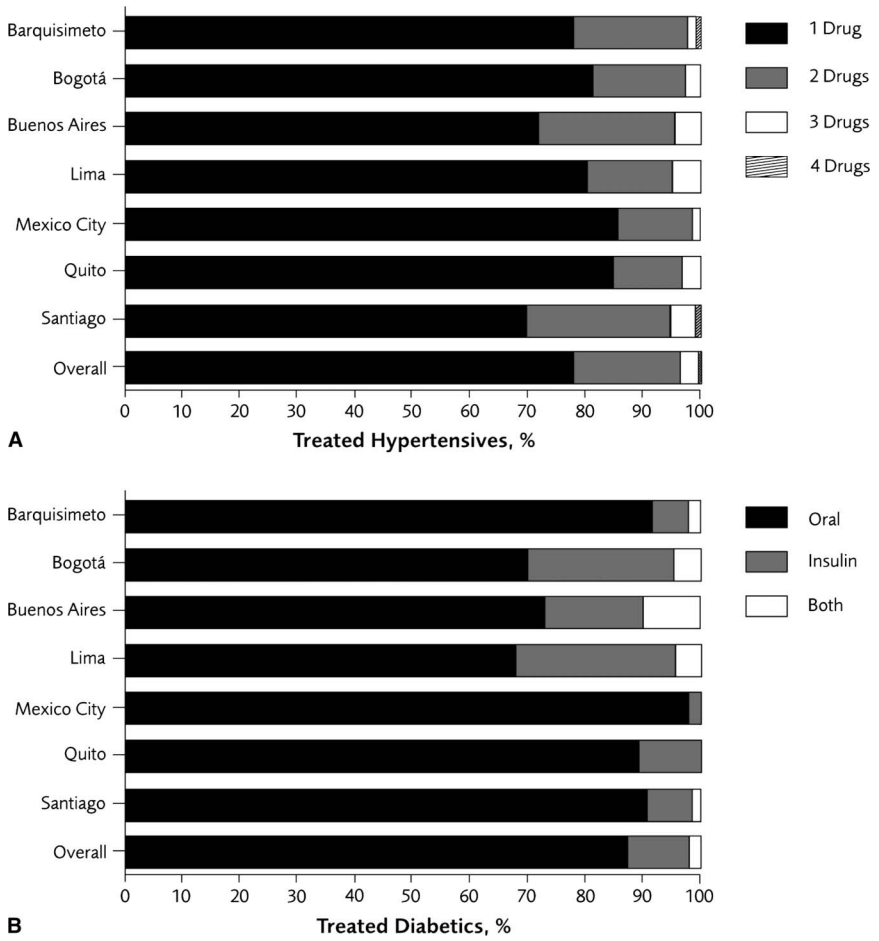

FIGURE 1. Most subjects reported receiving only 1 drug for antihypertensive therapy (A) and for antidiabetic therapy (B).

the percentage of patients currently taking medications and reporting adherence to medication as prescribed was relatively high for individuals with hypercholesterolemia (66%), diabetes (63%), and hypertension (69%), and this is comparable with the adherence rates found for treatment of cardiovascular disease (77%) and diabetes (68%) in a large meta-analysis of adherence studies.[16] For hypertension, levels of

Table 4. Types and numbers of treatments utilized among individuals reporting the use of some nonpharmacologic means to manage hypertension, diabetes, or hypercholesterolemia.

	Percentage of patients utilizing nonpharmacologic treatments		
	Hypertension, n = 1805	Diabetes, n = 770	Hypercholesterolemia, n = 834
Types of nonpharmacologic treatments			
Diet	86.1 (83.8–88.3)	92.8 (90.4–95.2)	90.5 (88.8–92.3)
Exercise	25.1 (22.0–28.2)	19 (15.2–22.9)	22.7 (19.9–25.5)
Weight control	33.3 (30.1–37.7)	36 (30.0–42.0)	29.5 (25.6–33.3)
Other types	3.4 (2.2–4.6)	3.6 (1.9–5.3)	2.5 (1.6–3.5)
Number of nonpharmacologic treatments utilized			
1	62.6 (59.2–66.4)	58.7 (52.6–64.8)	64.5 (60.7–68.4)
2	26.3 (23.1–29.5)	32.1 (26.9–37.3)	25.7 (22.0–29.4)
3	10.5 (8.5–12.6)	8.3 (5.6–10.9)	9.7 (7.9–11.6)
4	0.4 (0.0–0.8)	0.9 (0.0–2.1)	0 (0.0–0.1)

adherence observed in CARMELA seem to exceed those reported from other developing countries (43% for China, 27% for Gambia, and 26% for Seychelles), and even those in the United States (51%).[4]

The leading cause of nonadherence to treatment reported in the CARMELA cities was forgetfulness, cited by roughly half of the individuals currently using medication for the 3 risk factors examined—financial reasons were not the major cause of nonadherence. Although self-reported adherence is not an objective assessment, it is a valid measurement that may actually underreport the degree of adherence compared with objective measures such as pill counts.[16] A limitation of this study is that the survey asked questions on adherence only of those individuals reporting that they currently took medication for their condition—those who had been diagnosed but were not currently taking medication were not questioned on why they were not. Thus, we do not have a full assessment of the patients' access to medicines and other factors influencing adherence. Nonetheless, the reasons for nonadherence in CARMELA cities closely parallel reasons found in another study where forgetfulness was the major cause of nonadherence (30% of subjects).[17] If we accept that forgetfulness and lack of interest are significant factors impacting adherence to treatment, these causes can be addressed with better patient education to increase awareness of the need to take medication as prescribed to achieve the best cardiopreventive effects.

CONCLUSION

Although many individuals in the CARMELA cities knew they had hypertension or diabetes, only 41% were aware of having hypercholesterolemia. However, few of them received treatment, and even fewer achieved control of their condition. The relatively high prevalence of these 3 risk factors and the low rates of treatment and achievement of therapeutic goals (especially for hypercholesterolemia) constitute alarming trends with regard to cardiovascular disease prevention. There is a tremendous need for medical and patient education directed toward more aggressive diagnosis and proper management for both primary and secondary prevention to avert substantial healthcare costs in these cities. Furthermore, the levels of previously undiagnosed hypertension (36%), hypercholesterolemia (60%), and diabetes (21%) underscore the need for and value of mounting screening campaigns. Although many individuals reported lifestyle modifications to manage their risk, the low numbers with healthy blood pressure, plasma glucose, or lipid levels indicate a need for patient and physician education on appropriate dietary changes and types and quantities of exercise. Because these data are derived exclusively from urban areas, where individuals might be expected to have better access to health screening and medical care, the findings reported here are a call to action for all Latin American physicians, public health organizations, and citizens.

ACKNOWLEDGMENTS

The authors would like to thank The CARMELA Study institutions-investigators were: Asociación Cardiovascular Centro Occidental–Lic. Elizabeth Infante, Luis Rocha; Pontificia Universidad Javeriana de Bogotá–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 Falconí; Pontificia Universidad Católica de Santiago de Chile–Ximena Berrios-Carrasola, Beatriz Guzmán, Mónica Acevedo. Marta Torres for compiling clinical lab analysis; Héctor Rosso for database design and administration; Fabio Pellegrini, MSc and Alejandro Macchia, MD of Mario Negri Institute for statistical support; Javier Valenzuela administrative and communication assistance. Editorial support was provided by Beth Young, PhD and Lynn Rudich, MD at Envision Pharma and was funded by Pfizer Inc.

Conflicts of interest: Raul Vinueza, MD is a permanent employee of Pfizer, Inc., makers of a cholesterol-regulating drug, and has shares in the company. Honorio Silva, MD was an employee of Pfizer, Inc. during the conduct of the study (now retired). H. Elif Silva is a current employee of Eisai Inc (New Jersey, with no involvement in cardiovascular drugs), and was not affiliated to any pharmaceutical company during the study period. All other authors declare no conflict of interest.

REFERENCES

1. Schargrodsky H, Escobar MC, Escobar E. Cardiovascular disease prevention: a challenge for Latin America. *Circulation*. 1998;98:2103–2104.
2. Yusuf S, Reddy S, Ounpuu S, et al. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation*. 2001;104:2746–2753.

3. Murray C, Lopez A, eds. *The Global Burden of Disease. A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020*. Cambridge, MA: Harvard University Press; 1996.
4. World Health Organization. *Adherence to Long-Term Therapies: Evidence for Action*. Geneva: World Health Organization; 2003.
5. Yusuf S, Reddy S, Ounpuu S, et al. Global burden of cardiovascular diseases: part II: variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. *Circulation*. 2001;104: 2855–2864.
6. Tolonen H, Keil U, Ferrario M, et al. WHO MONICA Project. Prevalence, awareness and treatment of hypercholesterolemia in 32 populations: results from the WHO MONICA Project. *Int J Epidemiol*. 2005;34:181–192.
7. Silva H, Kleinstiver S, Sungar E, et al. Trends, challenges and promotion of clinical and cardiovascular research in Latin America and the Caribbean. *Prev Contr*. 2006;2: 129–135.
8. Schargrodsky H, Hernandez-Hernandez R, Champagne BM, et al. CARMELA Study Investigators. CARMELA: assessment of cardiovascular risk in seven Latin American cities. *Am J Med*. 2008;121:58–65.
9. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA*. 2001;285:2486–2497.
10. Hertz RP, McDonald M, Unger AN, et al. Racial and ethnic disparities in the prevalence and management of cardiovascular risk factors in the United States workforce. *J Occup Environ Med*. 2007;49:1165–1175.
11. Ordunez-Garcia P, Munoz JL, Pedraza D, et al. Success in control of hypertension in a low-resource setting: the Cuban experience. *J Hypertens*. 2006;24:845–849.
12. Bramley TJ, Gerbino PP, Nightengale BS, et al. Relationship of blood pressure control to adherence with antihypertensive monotherapy in 13 managed care organizations. *J Manag Care Pharm*. 2006;12:239–245.
13. Goldman DP, Joyce GF, Karaca-Mandic P. Varying pharmacy benefits with clinical status: the case of cholesterol-lowering therapy. *Am J Manag Care*. 2006;12:21–28.
14. Ho PM, Rumsfeld JS, Masoudi FA, et al. Effect of medication nonadherence on hospitalization and mortality among patients with diabetes mellitus. *Arch Intern Med*. 2006;166:1836–1841.
15. Wei L, Wang J, Thompson P, et al. Adherence to statin treatment and readmission of patients after myocardial infarction: a six year follow up study. *Heart*. 2002;88:229–233.
16. DiMatteo MR. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Med Care*. 2004;42:200–209.
17. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353:487–497.