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Total adult cardiovascular risk in Central America

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ABSTRACT

Objective. *To evaluate prevalence of cardiovascular risk among adults 40 years and older using population-based samples from six Central American countries.*
Methods. *Risk factors were derived from a multi-national cross-sectional survey implemented in 2003–2006, which included a sample of 4 202 participants aged 40 years and older. Charts produced by the World Health Organization and the International Society of Hypertension for the Region of the Americas sub-region B were used to predict risk on the basis of factors including age, sex, blood pressure, total serum cholesterol, smoking status, and diabetes status.*
Results. *Overall, 85.9% of the population was classified as having < 10% risk for cardiovascular events during the following ten years. The likelihood of being in this risk group decreased with age in both males and females. Four percent of respondents were identified as having > 20% risk. More than 75% of those with a 30–40% risk had previously been identified by health services, and an additional 23% were identified during the study, suggesting they could be diagnosed by opportunistic screening for diabetes, hypertension and hypercholesterolemia. Results of bivariate analysis showed that respondents who were male, older, obese and/or less educated had higher risk for cardiovascular events, but a multivariate analysis including education indicated highest risks for older, obese, and less educated females.*
Conclusions. *Measuring cardiovascular disease risk identifies most cases of (or at risk for) diabetes, hypertension and hypercholesterolemia among adults 40 years and older. This strategy can facilitate implementation of control programs and decrease disabilities and premature mortality.*

Key words Risk factors; cardiovascular diseases; population; obesity; diabetes mellitus; Central America.

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The increasing burdens imposed by obesity and diabetes are two of the most prominent threats to the health and well-being of populations of developed and developing countries alike (1). Central American countries have historically faced high morbidity from poverty-related conditions including parasitic and other infectious diseases and malnutrition. However, during the last decade it has become apparent that they also face the twin epidemics of obesity and diabetes. The Central America Diabetes Initiative (CAMDI) study indicated a prevalence of diabetes of from 5.4% to 12.9%, and a prevalence of obesity of from 11.5% to 18.8% in six countries of the region (2, 3). The World Health Organization (WHO) (4, 5) has proposed the use of Risk Prediction Charts to measure 10-year risks for fatal or non-fatal cardiovascular events (CVDR) such as coronary heart diseases and stroke. The present study evaluates the prevalence of different levels of CVDR among those 40 years of age or older in a population-based sample of six Central American countries.

MATERIALS AND METHODS

A multi-national cross-sectional survey implemented between 2003 and 2006 included a probabilistic stratified multi-stage sample of the adult non-institutionalized population of six Central American countries. The sampling frame was based on population censuses conducted in 1992 in El Salvador and Guatemala, 1993 in Nicaragua, 2000 in Belize and Costa Rica, and 2001 in Honduras. For Belize, the national electoral registry was used. Older census data, such as those in El Salvador, Guatemala, and Nicaragua, were updated for field work by visiting the selected sectors and houses. The survey sample represented the entire adult national population in Belize and the overall metropolitan adult populations in Costa Rica (San José), Honduras (Tegucigalpa), and Nicaragua (Managua), but was restricted to individual municipalities in El Salvador (Santa Tecla) and Guatemala (Villa Nueva). Residents of the survey areas aged 20 years or more were eligible, unless they: 1) were pregnant at the time of the interview; 2) had delivered a baby within the previous three months; or 3) had a severe mental disability that made it too difficult to communicate or respond to the questionnaire. Primary Sampling Units (PSUs) were clusters of independent households grouped into segments or blocks. All eligible individuals in the selected household were included in the sample. Overall, 10 822 individuals were interviewed and 7 243 underwent laboratory tests and anthropometric measurements. The overall response rates were 82% and 74% for the questionnaire and laboratory tests, respectively. This analysis used data from 4 202 participants aged 40 years and older with complete interview and laboratory tests (Table 1).

The survey questionnaire was adapted from the United States Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey (NHANES) (6) and Behavioral Risk Factor Surveillance System (BRFSS) (7) and modified to better suit urban environments in Central America. Data were entered, cleaned, and organized in each survey city, and subsequently revised and standardized at a central data center at the University of Nicaragua in León, Nicaragua.

Local interviewers, trained specifically for the study, recruited and interviewed participants. To ensure comparable methods across sites, interviewers were trained by the same trainer. Interviews took place in the selected homes. Except in San José, participants received an appointment during the interview to visit an examination center where anthropometric measurements and blood samples were taken. In San Jose, a mobile unit of laboratory technicians took blood samples in interviewee homes. The diagnosis of diabetes was based on the questionnaire, on a Fasting Blood Glucose (FBG) test administered after overnight fasting, and on a second glucose test two hours after a 75g glucose load (2h-Oral Glucose Tolerance Test, 2h-OGTT), except among participants from El Salvador, where only the FBG was measured. Diabetes was defined as an FBG ≥ 126 mg/dL or 2h-OGTT ≥ 200 mg/dL or a previous diagnosis of diabetes. Intermediate hyperglycemia was defined as impaired fasting glucose (IFG; FBG = 100–125 mg/dL) or impaired glucose tolerance (IGT; 2h-OGTT = 140–199 mg/dL).

TABLE 1. Sample size by country, weighted population, and sample proportion by population characteristics in the Central American Diabetes Initiative (CAMDI) study, 2003–2006[a]

	Male	Female	Total
Sampled Population (*n*)	1 591	2 611	4 202
Belize	406	626	1 032
Costa Rica	241	432	673
El Salvador	214	449	663
Guatemala	171	299	470
Honduras	201	351	552
Nicaragua	358	454	812
Weighted Population (*n*)	405 733	401 507	807 241
Age, years (mean) (*P* = 0.92)	55.12	55.12	55.12
40–49	39.1	39.0	39.0
50–59	29.6	29.7	29.6
> 60	31.2	31.4	31.3
Race/ethnicity (*P* = 0.19)			
Whites	8.3	10.9	9.6
Black/Mulatto	5.0	5.6	5.3
Native/Mestizo	84.8	81.7	83.3
Other	1.9	1.9	1.9
Education (*P* < 0.01)			
None	8.0	8.9	8.5
Primary	44.5	51.9	48.1
Secondary	28.5	27.7	28.1
University	19.0	11.5	15.3
Body mass index (mean) (*P* < 0.01)	27.3	29.1	28.2
< 18.5	1.7	1.1	1.4
18.5–24.9	29.1	23.6	26.4
25.0–29.9	44.3	36.9	40.6
30.0–34.9	20.1	23.6	21.8
35.0–39.9	2.9	10.7	6.8
> 40.0	1.9	4.2	3.0
Physical Activity (*P* = 0.52)			
Low	51.7	54.1	52.9
Moderate	32.2	31.2	31.7
High	16.1	14.8	15.4

Source: The CAMDI Study.
[a] All values are percentages unless otherwise noted in row heading.

Blood pressure was measured three times in resting position. If the difference between the second and the third measurement was less than 10 mm Hg, the average of these figures was reported. If this difference reached or exceeded 10 mm Hg, a fourth measurement was taken and the two closest values were averaged.

Hypertension was defined as a previous diagnosis, a systolic blood pressure (SBP) of ≥ 140 mm Hg or a diastolic blood pressure (DBP) of ≥ 90 mm Hg. Normal high blood pressure was defined as SBP = 120–139 mm Hg or DBP = 80–89 mm Hg.

The prevalence of previously diagnosed diabetes (or hypertension) was assessed by the question(s): "Has a doctor or nurse ever told you that you have [diabetes/high blood sugar/hypertension]?" To rule out gestational diabetes, female respondents were asked if they had been told they had diabetes only when pregnant.

Hypercholesterolemia or high cholesterol was defined as total blood cholesterol ≥ 240 mg/dl. Normal high cholesterol (borderline blood cholesterol) was defined as total blood cholesterol = 200–239 mg/dL.

Those with intermediate hyperglycemia, normal high blood pressure or normal high cholesterol were classified as having preconditions.

Body weight and height were measured by trained personnel in duplicate using standard techniques. Body weight was measured using a calibrated digital scale and recorded to the nearest 100 g with the subject wearing his/her usual clothes and without shoes. Height was measured to the nearest millimeter with the subject standing on bare feet, and head, shoulders, buttocks, and heels leaning against a metric scale at a 90° angle to the floor. If the difference between the two measurements was ≥ 0.5 kg for body weight or ≥ 0.5 cm for height, a third measurement was obtained, and the mean of the two closest measurements was used. Body mass index (BMI) was calculated as body weight (kg) divided by height squared (m^2). Obesity was defined as BMI ≥ 30 kg/m^2.

Local interviewers were trained to classify participants into different races. The indigenous population was identified by the use of traditional outfits and by exploring knowledge of native languages.

Physical activity was measured using a short version of the International Physical Activity Questionnaire (IPAQ) (8). Participants were classified into one of three categories of physical activity (active, moderate, or inactive) following the IPAQ protocol.

Sample survey weights were constructed based on selection probability, non-response rates at the various stages (i.e. sectors, compact segments, households, and individuals), and the age and sex composition of the population at the selected sites. A separate weight was calculated for those who provided blood samples and anthropometric measurements. Prevalence rates were age- and sex-standardized using direct methods, with the population of Central America as the reference (9). The relative weights used in standardization were: [males 40–49 years old] = 0.15; [males 50–59 years old] = 0.11; [males 60 years or older] = 0.07; [females 40–49 years old] = 0.32; [females 50–59 years old] = 0.22; [females 60 years or older] = 0.12.

WHO Risk Prediction Charts are based on standardized collection and assessment of data on risk factor prevalence and relative risk by sub-region (10). The WHO determined the absolute risk of cardiovascular events by scaling individual relative risk to population incidence rates of major CVDs, estimated from the Global Burden of Disease Study (11). This study used risk prediction charts produced by WHO/International Society of Hypertension (ISH) for the Region of the Americas sub-region B (12) using the following variables: age (measured in single years), sex (male or female), systolic blood pressure and diastolic blood pressure (in mm Hg), total serum cholesterol, current smoking status (smoker or non-smoker), and diabetes status (yes or no).

Predictive marginals were used to estimate the prevalence of 10-year CVDR > 20% by level of education while adjusting for age and sex (13). In addition, a multilevel logistic regression model was used to measure the independent associations of different categories of gender, age, level of education, physical activity, race and obesity with different levels of CVDR.

All results reported here account for the sample design and the unequal probability of selection. Analyses were performed using STATA version 12.0 (Stata Corp., College Station, United States of America) and SPSS version 20.0 (SPSS Inc., Chicago, USA). Results were considered significant where $P < 0.05$. The study protocol was approved by ethical committees in each participating country and at the Pan American Health Organization (PAHO). All participants signed an informed consent form that was read and explained by interviewers. All patients diagnosed with diabetes, hypertension, obesity or hyperlipidemia were referred to the corresponding health services for treatment.

RESULTS

Overall, 4 202 adults aged 40 years and older from sites in six countries were included in the analysis, representing a population of 807 241 people (Table 1). Most participants of both genders had BMIs from 25.0–29.9 kg/m^2 (overweight), but females were significantly ($P < 0.01$) overrepresented relative to males in all categories of obesity (i.e. 30.0–34.9; 35.0–39.9; or 40.0+ kg/m^2). Almost half of participants reported moderate/high levels of physical activity.

Using the WHO/ISH Risk Prediction Chart (Table 2), 85.9% of the population was classified as having CVDR < 10% during the following ten years. The prevalence of the CVDR < 10% category decreased with age in both males and females (Table 2). Overall, 10.2% and 4% of participants were found to have CVDR of 10–20% and > 20%, respectively. Males were more likely than females to be in the CVDR 10–20% category in all age groups with or without diabetes ($P < 0.01$). Females with diabetes were more likely than males with diabetes to be in the CVDR > 20% category in all age groups ($P < 0.01$).

Overall, 3.9% of participants (representing more than 29 000 adults) had a 10-year risk >20% for cardiovascular events in the following ten years (Table 3). A clear pattern was observed with respect to education, with the less educated having the highest prevalence in this high-risk category among both males (4.0%, $P < 0.01$) and females (4.4%, $P = 0.02$).

Figure 1 presents predictive marginals for the CVDR > 20% category by age, level of education and gender. Risk among males and females was comparable at 40 years of age irrespective of the level of education attained. The prevalence of the CVDR > 20% category increased with increasing age among both less educated males and less educated females. From ages 40 to 50 there was little increase in prevalence of CVDR > 20% among educated males or females. At age 50, risk was highest among uneducated males ($P < 0.001$) while at age 60+ the highest risk was observed for less-educated females ($P < 0.001$). Among educated individuals at age 60+, the prevalence of CVDR > 20% was much lower among females than males.

Odds ratios for different levels of CVDR are presented in Table 4. Those 60 years or older are significantly more likely to experience CVDR at each level than those 40–59 years of age. Those with no or only primary education had higher odds of experiencing CVDR than those with secondary or more, but the odds are highest at CVDR = 30% among both males (odds ratio, OR = 3.9, 95% confidence interval, CI: 1.3–11.3) and females (OR = 9.2, 95% CI: 1.7–49.6). Obesity increases the risk of experiencing CVDR

TABLE 2. Age- and sex- standardized distribution (%, standard error) of population by age, sex, diabetes status and 10-year cardiovascular risk (CVDR) in the Central American Diabetes Initative (CAMDI) study, 2003–2006

Gender/ Diabetes mellitus status	CVDR (%)	Age (years)			
		40–49	50–59	> 60	Total[a]
All respondents					
Both genders	< 10	97.2 (0.5)	90.3 (1.2)	59.7 (2.3)	85.9 (0.9)
	10–20	1.9 (0.4)	7.0 (1.1)	31.4 (2.0)	10.2 (0.8)
	> 20	1.0 (0.3)	2.7 (0.7)	8.9 (1.4)	4.0 (0.6)
Males	< 10	97.0 (1.0)	89.1 (2.1)	54.4 (3.0)	83.5 (1.2)
	10–20	2.4 (0.9)	8.4 (1.9)	36.9 (2.6)	13.2 (1.0)
	> 20	0.7 (0.4)	2.4 (0.9)	8.7 (1.4)	3.3 (0.5)
Females	< 10	97.5 (0.7)	91.5 (1.4)	65.2 (2.8)	86.4 (1.1)
	10–20	1.3 (0.4)	5.5 (1.1)	25.7 (2.7)	9.6 (0.9)
	> 20	1.2 (0.5)	3.0 (0.9)	9.1 (2.3)	4.0 (0.7)
With diabetes					
Both genders	< 10	91.4 (2.6)	82.6 (3.9)	29.6 (4.2)	72.5 (2.1)
	10–20	4.7 (1.8)	13.0 (3.7)	51.5 (3.9)	18.1 (2.0)
	> 20	3.8 (2.1)	4.4 (1.4)	18.8 (3.3)	9.5 (1.8)
Males	< 10	91.5 (3.7)	82.6 (6.2)	23.5 (5.1)	71.1 (3.0)
	10–20	6.1 (3.4)	16.2 (6.1)	59.0 (5.9)	22.9 (2.9)
	> 20	2.4 (1.7)	1.6 (0.9)	17.5 (4.9)	6.1 (1.5)
Females	< 10	91.4 (4.3)	82.9 (4.7)	35.2 (5.8)	72.7 (2.5)
	10–20	3.3 (1.4)	9.9 (3.9)	44.8 (5.9)	17.2 (2.3)
	> 20	5.3 (4.2)	7.2 (2.8)	20.0 (4.4)	10.1 (2.1)
Without diabetes					
Both genders	< 10	97.7 (0.5)	92.1 (1.5)	69.6 (2.4)	89.7 (0.9)
	10–20	1.6 (0.5)	5.6 (1.2)	24.8 (1.8)	7.8 (0.7)
	> 20	0.7 (0.3)	2.3 (0.8)	5.6 (1.5)	2.5 (0.6)
Males	< 10	97.5 (1.0)	90.7 (2.3)	63.7 (3.4)	86.7 (1.2)
	10–20	2.0 (0.9)	6.7 (2.0)	30.2 (2.9)	10.7 (1.0)
	> 20	0.5 (0.4)	2.6 (1.1)	6.1 (1.2)	2.6 (0.5)
Females	< 10	98.0 (0.6)	93.5 (1.4)	75.9 (2.8)	90.3 (1.1)
	10–20	1.1 (0.4)	4.5 (1.2)	19.0 (2.5)	7.3 (0.8)
	> 20	0.9 (0.4)	2.0 (0.9)	5.2 (2.2)	2.4 (0.7)

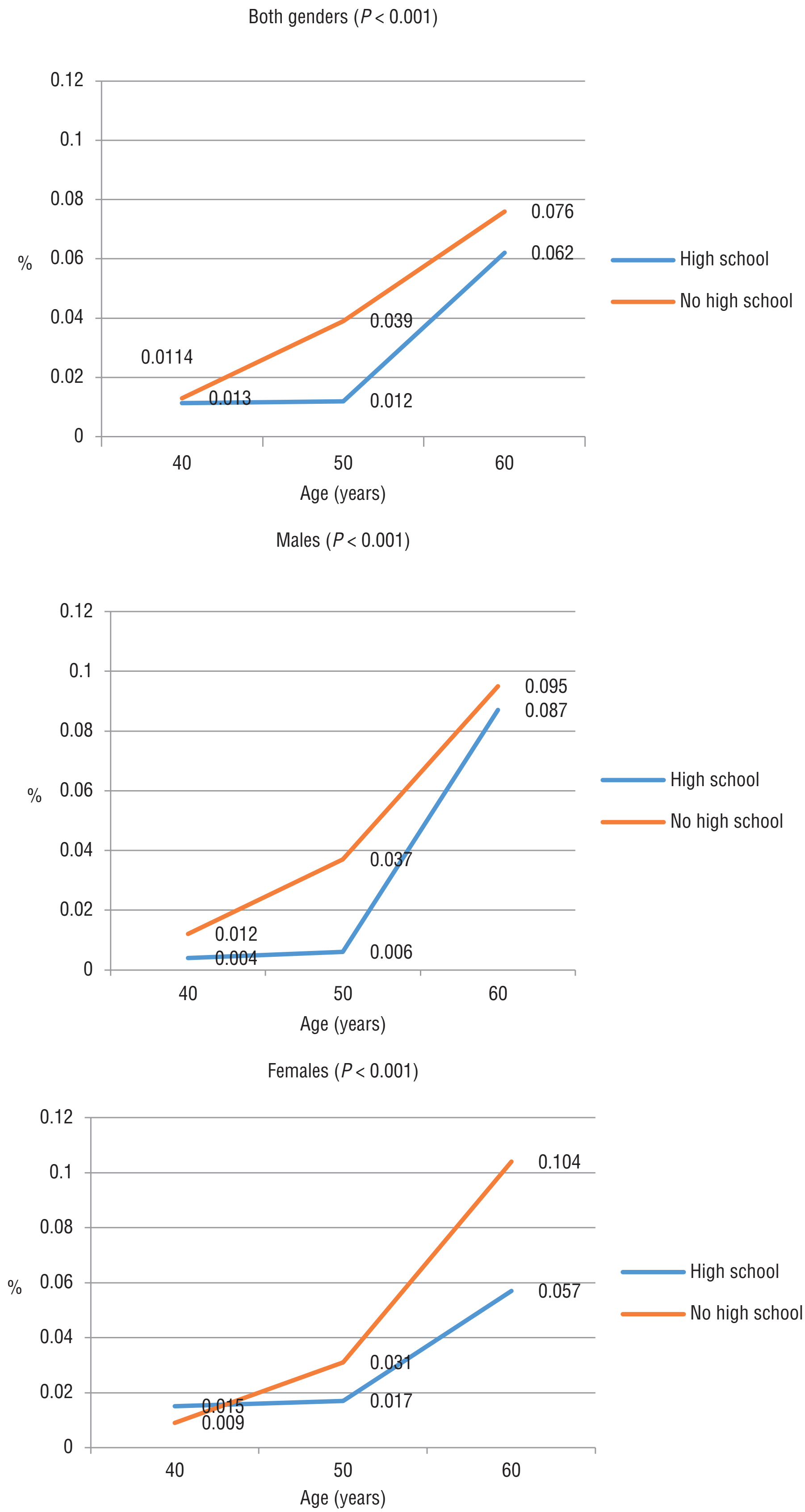
Source: The CAMDI Study.
[a] Adjusted using direct methods, with the 2008 Central American population as reference.

TABLE 3. Age- and sex- standardized prevalence (%, 95% confidence interval) of cardiovascular risk >20% by age, race, education, obesity and physical activity level in the Central American Diabetes Initiative (CAMDI) study, 2003–2006

	Male	Female	Total
Total	3.7 (2.8–5.0)	4.2 (2.9–6.1)	3.9 (2.9–5.3)
Age (years)			
40–49	0.7 (0.2–2.0)	1.2 (0.5–2.9)	1.0 (0.5–1.9)
50–59	2.4 (1.1–5.1)	3.0 (1.7–5.4)	2.7 (1.7–4.4)
> 60	8.7 (6.3–12.0)	9.1 (5.5–14.7)	8.9 (6.4–12.2)
P-value	< 0.01	< 0.01	< 0.01
Race/ethnicity			
Whites	2.6 (1.0–7.0)	6.6 (2.9–14.6)	6.0 (2.8–12.6)
Black/Mulatto	3.7 (1.8–7.6)	3.7 (1.8–7.4)	3.7 (2.0–6.9)
Native/Mestizo	4.0 (2.9–5.5)	5.1 (3.3–7.9)	5.0 (3.3–7.3)
P-value	0.30	0.18	0.14
Education			
None/Primary	4.0 (2.8–5.8)	4.4 (3.0–6.4)	4.4 (3.1–6.2)
Secondary/more	2.4 (1.3–4.2)	2.4 (1.2–4.3)	2.4 (1.4–4.0)
P-value	< 0.01	0.02	0.01
Obesity[a]			
Yes	3.5 (2.5–5.1)	3.3 (1.9–5.5)	3.5 (2.1–5.3)
No	1.6 (0.7–3.3)	6.4 (4.1–10.0)	5.6 (3.7–8.6)
P-value	0.05	0.07	0.09
Physical Activity			
Low	3.3 (2.3–4.8)	4.3 (2.8–6.4)	4.1 (2.9–5.8)
Moderate/High	3.3 (2.0–5.4)	3.5 (2.3–5.3)	3.4 (2.4–5.0)
P-value	0.54	0.11	0.07

Source: The CAMDI Study.
[a] Body mass index (BMI) > 30.

FIGURE 1. Predicted marginals for cardiovascular risk > 20% by level of education, age and gender in the Central American Diabetes Initative (CAMDI) study, 2003–2006



Source: The CAMDI Study.

at almost all levels among females alone and both genders in combination.

Table 5 presents chronic disease (i.e. diabetes, hypertension and hypercholesterolemia) status at specified levels of CVDR, stratified by gender. Overall, 11.5% (95% CI: 10.0–13.2%) of the studied population had not been diagnosed with diabetes, hypertension or hypercholesterolemia and had normal blood FBG, OGT, blood pressure and blood cholesterol, while 37.6% (95% CI: 35.3–39.9%) and 22.7% (95% CI: 20.6–24.7%), respectively, were classified as having diagnosed or undiagnosed conditions. The remaining 28.3% (95% CI: 25.5–31.3%) were found to have intermediate hyperglycemia, normal high blood pressure and/or normal high cholesterol. The proportion of participants who had been diagnosed with a chronic disease generally tended to increase with increasing CVDR among both males and females. Overall, 77% of participants with CVDR = 30–40% had been previously diagnosed with diabetes, hypertension or hypercholesterolemia. This proportion was higher among females (88%) than males (64%). Screening for diabetes, hypertension and hypercholesterolemia revealed undiagnosed disease among the remainder of those with CVDR = 30–40%.

DISCUSSION

Mortality in Central American populations has shifted dramatically from infectious to non-communicable causes in recent decades. This has been reflected in an increase in life expectancy and a one-third reduction in communicable disease mortality between 1980 and 2011 (14).

The present analysis confirms that there is a substantial risk of obesity-related chronic diseases in Central American populations, and consequently risk to their economic prospects. The applicability of risk charts has been validated by previous studies (15, 16). Applying global CVDR prediction charts to this Central American population indicates that 4% of those aged 40 years or older had a CVD/stroke risk of 20% or more during the following 10 years. The proportion of the population observed here in the CVDR > 20% category is on average 4% lower than that predicted by WHO for the Region of the Americas Group B (17). In this study most participants (85.9%) had 10-year CVDR < 10%.

TABLE 4. Odds ratios (and 95% confidence intervals) for different levels of cardiovascular risk (CVDR) by gender, age, level of education, physical activity level, race and obesity in the Central American Diabetes Initiative (CAMDI) study, 2003–2006

Factor	Category	CVDR (%)	Males	Females	Both
Gender	Females vs. males	10	-	-	1.8 (1.3–2.7)
		20	-	-	2.1 (1.1–3.8)
		30	-	-	0.8 (0.3–2.2)
		40	-	-	1.1 (0.6–1.9)
		P-value			0.01
Age (years)	> 60 vs. 40–59	10	14.8 (8.3–26.6)	9.1 (5.8–14.4)	12.2 (8.2–18.4)
		20	11.8 (5.2–26.9)	4.9 (2.2–10.7)	8.5 (5.1–14.2)
		30	8.8 (2.8–27.5)	6.9 (2.4–19.2)	7.8 (3.5–17.4
		40	7.7 (3.4–17.7)	6.6 (2.8–15.5)	7.1 (3.9–12.9)
		P-value	< 0.01	< 0.01	< 0.01
Education	None/primary vs. secondary or more	10	1.3 (0.6–2.5)	1.7 (0.9–3.5)	1.4 (0.9–2.4)
		20	1.0 (0.5–2.3)	1.8 (0.8–3.8)	1.3 (0.7–2.3)
		30	3.9 (1.3–11.3)	9.2 (1.7–49.6)	5.5 (2.3–12.8)
		40	2.4 (0.7–8.0)	1.4 (0.6–4.1)	1.8 (0.8–4.4)
		P-value	0.07	0.03	< 0.01
Physical Activity	Inactive vs. active/moderate	10	0.6 (0.4–1.2)	2.1 (1.1–4.0)	1.0 (0.6–1.7)
		20	0.5 (0.2–1.2)	1.4 (0.4–5.1)	0.8 (0.4–1.5)
		30	1.4 (0.4–4.7)	2.5 (0.8–8.2)	1.9 (0.9–4.1)
		40	0.8 (0.4–1.9)	0.8 (0.4–1.6)	0.8 (0.5–1.4)
		P-value	0.42	0.22	0.21
Race	White vs. indigenous	10	0.5 (0.2–1.3)	1.0 (0.3–3.2)	0.7 (0.3–1.5)
		20	1.7 (0.4–8.0)	0.5 (0.1–5.5)	1.2 (0.3–4.8)
		30	0.4 (0.1–3.8)	0.6 (0.1–2.9)	0.5 (0.1–1.9)
		40	0.8 (0.2–2.8)	1.6 (0.4–6.7)	1.2 (0.5–3.2)
	Black vs. indigenous	10	0.5 (0.2–1.2)	1.9 (0.5–7.3)	1.1 (0.4–3.2)
		20	1.0 (0.3–3.3)	2.0 (0.9–4.4)	1.5 (0.6–3.3)
		30	1.3 (0.4–4.7)	0.8 (0.2–3.6)	1.0 (0.4–2.7)
		40	0.6 (0.2–1.8)	0.5 (0.2–1.5)	0.5 (0.2–1.4)
		P-value	0.59	0.75	0.09
Obesity[a]	Yes vs. no	10	1.0 (0.5–2.1)	1.3 (0.8–2.1)	1.2 (0.8–1.7)
		20	1.2 (0.5–2.9)	1.1 (0.1–1.3)	1.2 (0.7–2.2)
		30	0.7 (0.2–2.7)	0.4 (0.1–1.3)	0.5 (0.2–1.2)
		40	0.4 (0.1–1.4)	5.3 (2.5–11.0)	2.0 (1.3–3.3)
		P-value	0.50	< 0.01	< 0.01

Data Source: The CAMDI study.
[a] Body mass index (BMI) > 30.

This proportion is lower than similar figures reported from other developing countries in Asia and the Americas (18, 19). Marma et al. reported a prevalence of CVDR < 10% of 82% for the US population, somewhat lower than that presented here, possibly due to a difference in their definition of low risk (which excluded subjects with diabetes) (20).

Several limitations apply to this analysis. The cross-sectional design of the study prevents cause-effect analysis. The multi-center nature of the study made it difficult to fully control general conditions of the study, such as observer biases and laboratory standards although attempts were made to reduce these biases by providing cross-site standardized training and by following a standard protocol. Because the survey was conducted in selected, mostly urban, areas in most of the countries, the results cannot be generalized to the entire countries or to the Central American region as a whole. Furthermore, the inclusion of individuals in this analysis was conditional on their willingness to provide blood samples and anthropometric measures. The distribution of age and gender of non-respondents and respondents were similar, as has been described elsewhere (3). These selection modalities were accounted for in the weighting process to limit their impact on results.

Cardiovascular risk is heavily influenced by lifestyle choices such as patterns of smoking, healthy diet, and physical activity. Health behavior is heavily influenced by social and economic determinants. Social and economic inequalities have been deemed to play a role in the emergence of non-communicable diseases and particularly cardiovascular diseases globally. This study observed higher risk for cardiovascular events among those with lower education among both males and females, but the analysis demonstrated a larger gap between more- and less-educated females than for males, highlighting worse results for older females. Low education has previously been shown to be a good predictor of cardiovascular risk (21, 22). Educational inequality, in particular, was identified as a key factor for mortality related to diabetes and smoking (23), two of the factors evaluated in the current analysis. These data suggest that risk for cardiovascular events increases with age and male gender, especially among the elderly, but incorporating education into the analysis reveals that females with less-than-secondary education exhibit the poorest outcomes. Obesity was also independently associated with increased CVDR within this population, most markedly among females. The relation observed here between obesity and three of the main

Table 5. Prevalence (%, 95% confidence intervals) of chronic diseases and precursors, by gender, at specified levels of cardiovascular risk (CVDR) from the Central American Diabetes Initiative (CAMDI) study, 2003–2006

CVDR (%)	No disease[a]	Previously diagnosed[b]	Undiagnosed[b]	Pre-conditions[c]
Both genders				
0	13.7 (11.9–15.6)	32.2 (29.6–34.8)	20.3 (17.9–22.9)	33.9 (30.3–37.6)
10	1.0 (0.2–3.8)	60.0 (53.3–66.2)	37.9 (31.8–44.5)	1.2 (0.4–3.5)
20		63.6 (49.2–75.9)	36.4 (24.2–50.8)	
30		72.7 (52.3–86.6)	27.3 (13.4–47.7)	
40		78.5 (64.8–87.9)	21.5 (12.1–35.2)	
Total	11.5 (10.0–13.2)	37.6 (35.3–39.9)	22.6(20.6–24.7)	28.3 (25.5–31.3)
Men				
0	13.1 (10.2–16.6)	27.5 (24.3–30.8)	21.4 (17.6–25.7)	38.1 (32.0–44.6)
10	16.0 (0.4–6.3)	53.8 (43.1–64.1)	42.8 (32.9–53.4)	1.8 (0.5–5.7)
20		59.3 (40.7–75.5)	40.7 (24.5–59.3)	
30		48.3 (26.0–71.4)	51.7 (28.6–74.0)	
40		69.2 (50.8–83.0)	30.8 (17.0–49.2)	
Total	10.8 (8.4–13.7)	33.0 (30.0–36.0)	25.1 (22.0–28.4)	31.2 (26.3–36.4)
Women				
0	14.3 (12.4–16.3)	36.7 (33.6–40.0)	19.2 (16.8–21.9)	29.8 (26.9–32.8)
10		69.1 (59.8–77.0)	30.7 (22.8–40.0)	0.2 (0…-1.6)
20		70.4 (54.1–82.8)	29.6 (17.2–45.9)	
30		88.3 (65.1–96.8)	11.7 (3.2–34.9)	
40		88.2 (71.3–95.7)	11.8 (4.3–28.7)	
Total	12.2 (10.6–14.0)	42.2 (39.2–45.3)	20.1 (17.7–22.6)	25.5 (22.9–28.2)

Data source: The CAMDI Study.
[a] No diagnosis of diabetes, hypertension or hypercholesterolemia, and normal blood fasting blood glucose, oral glucose tolerance blood pressure and blood cholesterol.
[b] Previously-diagnosed or current presentation with diabetes, hypertension or hypercholesterolemia.
[c] Presentation with intermediate hyperglycemia, normal high blood pressure or normal high cholesterol.

components of CVDR (diabetes, hypertension and hypercholesterolemia) is well-known and is consistent with previous results.

More than 75% of respondents with CVDR of 30–40% had been diagnosed by health services as having diabetes, hypertension or hypercholesterolemia. Screening for those diseases revealed undiagnosed disease among the remainder of those with 30–40% CVDR. Results suggest that screening would benefit more males than females, since males had a higher proportion of undiagnosed diseases than females.

In conclusion, 4% of adults 40 or older in the studied populations were identified as having CVDR > 20%. Three-quarters of those with CVDR of 30–40% were previously identified by health services. The rest of those with a CVDR of 30–40% were identified during the study and therefore could be diagnosed by opportunistic screening of diabetes, hypertension or hypercholesterolemia. Males, the older, the obese and the less-educated had higher CVDR, but the highest risk was among females who were older, obese, and less educated. Prevention programs targeting the less-educated, especially females, may help to reduce the burden of cardiovascular risk in Central America.

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RESUMEN

Riesgo cardiovascular total en adultos en América Central

Objetivo. Evaluar la prevalencia del riesgo de padecer enfermedades cardiovasculares en adultos de 40 años de edad o mayores mediante el uso de muestras poblacionales obtenidas de seis países de América Central.

Métodos. Se tomaron los factores de riesgo de una encuesta transversal multinacional realizada entre 2003 y 2006, que incluyó una muestra de 4 202 participantes de 40 años de edad o mayores. Se usaron gráficos producidos por la Organización Mundial de la Salud y la Sociedad Internacional para la Hipertensión de la Región de las Américas, subregión B, para predecir el riesgo sobre la base de factores como la edad, el sexo, la presión arterial, las concentraciones totales de colesterol sérico, y la situación con respecto al tabaquismo y la diabetes.

Resultados. En términos generales, 85,9% de la población quedó clasificada en el grupo con un riesgo menor de 10% de sufrir episodios cardiovasculares en el transcurso de los 10 años siguientes. La probabilidad de pertenecer a este grupo de riesgo disminuyó con la edad, tanto en los hombres como en las mujeres. Se determinó que 4% de los encuestados tenían un riesgo mayor de 20%. Más de 75% de los que tenían un riesgo de 30% a 40% ya habían sido identificados por los servicios de salud y otro 23% fue identificado durante el estudio, lo cual indica que los diagnósticos pueden hacerse mediante un tamizaje oportunista para la detección de diabetes, hipertensión e hipercolesterolemia. Según los resultados del análisis bivariado, los entrevistados de sexo masculino, de edad más avanzada, obesos o con poca escolaridad tenían un mayor riesgo de sufrir episodios cardiovasculares, pero un análisis multivariado que abarcó el nivel educativo reveló que los riesgos más altos los tienen las mujeres mayores, obesas y con poca instrucción.

Conclusiones. El cálculo del riesgo cardiovascular permite identificar la mayoría de los casos (o personas con riesgo de presentar) diabetes, hipertensión e hipercolesterolemia en adultos de 40 años de edad o mayores. Esta estrategia puede facilitar la puesta en práctica de los programas de control, así como reducir la discapacidad y la mortalidad prematura.

Palabras clave Factores de riesgo; enfermedades cardiovasculares; población; obesidad; diabetes mellitus; América Central.