ORIGINAL RESEARCH

Distribution of Short-Term and Lifetime Predicted Risks of Cardiovascular Diseases in Peruvian Adults

Renato Quispe, MD; Juan Carlos Bazo-Alvarez, BA; Melissa S. Burroughs Peña, MD, MS; Julio A. Poterico, MD; Robert H. Gilman, MD; William Checkley, MD, PhD; Antonio Bernabé-Ortiz, MD, MPH; Mark D. Huffman, MD, MPH; J. Jaime Miranda, MD, MSc, PhD; PERU MIGRANT Study;* CRONICAS Cohort Study Group*

***Background*—**Short-term risk assessment tools for prediction of cardiovascular disease events are widely recommended in clinical practice and are used largely for single time-point estimations; however, persons with low predicted short-term risk may have higher risks across longer time horizons.

***Methods and Results*—**We estimated short-term and lifetime cardiovascular disease risk in a pooled population from 2 studies of Peruvian populations. Short-term risk was estimated using the atherosclerotic cardiovascular disease Pooled Cohort Risk Equations. Lifetime risk was evaluated using the algorithm derived from the Framingham Heart Study cohort. Using previously published thresholds, participants were classified into 3 categories: *low short-term and low lifetime risk, low short-term and high lifetime risk*, and *high short-term predicted risk*. We also compared the distribution of these risk profiles across educational level, wealth index, and place of residence. We included 2844 participants (50% men, mean age 55.9 years [SD 10.2 years]) in the analysis. Approximately 1 of every 3 participants (34% [95% CI 33 to 36]) had a high short-term estimated cardiovascular disease risk. Among those with a low short-term predicted risk, more than half (54% [95% CI 52 to 56]) had a high lifetime predicted risk. Short-term and lifetime predicted risks were higher for participants with lower versus higher wealth indexes and educational levels and for those living in urban versus rural areas ($P<0.01$). These results were consistent by sex.

***Conclusions*—**These findings highlight potential shortcomings of using short-term risk tools for primary prevention strategies because a substantial proportion of Peruvian adults were classified as low short-term risk but high lifetime risk. Vulnerable adults, such as those from low socioeconomic status and those living in urban areas, may need greater attention regarding cardiovascular preventive strategies. **(*J Am Heart Assoc*. 2015;4:e002112 doi: 10.1161/JAHA.115.002112)**

Key Words: cardiovascular risk • lifetime cardiovascular risk • Pooled Cohort Risk Equations • risk estimation tools • short-term cardiovascular risk

Although the incidence of cardiovascular disease (CVD) has decreased in many high-income countries, the burden of CVD in low- and middle-income countries remains high.[1,2] Intensive primary and secondary prevention efforts are important to reduce the burden of CVD in low- and middle-income countries because CVD has large economic and public health effects.[3] In this context, the identification and treatment of persons with high risk of a cardiovascular event in the future are key components of CVD prevention.[4] Many risk assessment tools have been developed to stratify asymptomatic persons, especially for short-term risk (eg, 10 years).[5–8] Nonetheless, a large proportion of those who are considered to be at low risk for CVD in the short term may have clinical characteristics that place them at risk for a CVD event long term[9] and thus may represent an important concern for public health planning.

From the CRONICAS Center of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru (R.Q., J.C.B.-A., M.B., J.A.P., A.B.-O., J.J.M.); Duke University Research Institute, Duke University, Durham, NC (M.B.); Asociación Benéfica PRISMA, Lima, Peru (R.H.G.); Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD (R.H.G., W.C.); Division of Pulmonary and Critical Care, School of Medicine, Johns Hopkins University, Baltimore, MD (W.C.); Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL (M.D.H.); Department of Medicine, School of Medicine, Universidad Peruana Cayetano Heredia, Lima, Peru (J.J.M.).

*A list of investigators for the PERU MIGRANT study and the CRONICAS cohort study group has been provided in the Appendix.

Correspondence to: J. Jaime Miranda, MD, MSc, PhD, CRONICAS Centro de Excelencia en Enfermedades Crónicas, Universidad Peruana Cayetano Heredia, Armendáriz 497, Miraflores, Lima, Peru. E-mail: Jaime.Miranda@upch.pe

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Current guidelines recommend stratifying asymptomatic persons based on their short-term and lifetime predicted CVD risk.[10,11] This approach to CVD risk stratification has been evaluated in China[12] and India[9] and in US South Asian participants[13] but has been limited in Central and South America.[14–16] Previous studies in populations from low- and middle-income countries used the ATP III risk assessment tool,[9,17] which includes only coronary heart disease as an outcome.[18] The clinical guidelines developed by the American Heart Association (AHA) and the American College of Cardiology (ACC) recommend the use of the atherosclerotic CVD Pooled Cohort Risk Equations, which predict risk for fatal and nonfatal ischemic heart disease and stroke events.[19]

The objective of this study is to estimate short-term and lifetime predicted CVD risk using baseline participant information from 2 population-based longitudinal studies in Peru and to compare short-term and lifetime CVD risk across socioeconomic status (SES), assessed by education, wealth index, and place of residence.

Methods

Study Participants

We identified eligible participants in 2 Peruvian longitudinal population-based studies: the CRONICAS cohort study (n=3619, baseline conducted in 2010–2011) and the PERU MIGRANT study (n=989, baseline conducted in 2007–2008). The CRONICAS cohort study aimed to assess the prevalence and incidence of cardiometabolic and pulmonary diseases among populations living in distinct urban or rural patterns in 3 Peruvian settings: Lima, Tumbes, and Puno. All participants were aged ≥35 years and were full-time residents of the area. The PERU MIGRANT study was designed to investigate the differences in CVD risk factors between rural-to-urban migrant and nonmigrant groups. This study was performed in participants aged ≥30 years from the rural site of Ayacucho or the urban site of Lima and rural-to-urban migrants from Ayacucho residing in Lima. In both studies, participants were sex and age stratified, single-stage random sampling was used, and only 1 participant per household was enrolled. Study design, fieldwork, and laboratory details of both studies have been described previously.[20,21]

We excluded participants with past history of ischemic heart disease, defined as self-reported diagnosis of myocardial infarction, unstable angina, or stable angina by the Rose angina questionnaire,[22] and those with past history of stroke.

Risk Factor Definitions

Hypertension was defined as systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg, diagnosis by a physician, or use of antihypertensive medications. Dyslipidemia was defined as total cholesterol level ≥200 mg/dL or as low high-density lipoprotein cholesterol <50 mg/dL in women and <40 mg/dL in men.[18] Diabetes was defined as fasting glucose ≥126 mg/dL or use of diabetes medication.[23] Current tobacco use was self-reported and defined as having smoked at least 1 cigarette in the previous 30 days.

Short-Term and Lifetime Predicted Risk Stratification

Short-term predicted risk was defined as the 10-year calculated risk of having a first atherosclerotic CVD event, which consisted of a nonfatal myocardial infarction, a fatal or nonfatal stroke, or a coronary heart disease–related death. This was estimated for all participants using coefficients of the Pooled Cohort Risk Equations, defined in the 2013 ACC/AHA Guideline on the Assessment of Cardiovascular Risk, which included age, total cholesterol level, high-density lipoprotein cholesterol, systolic blood pressure, use of antihypertensive medication, current smoking status, and presence of diabetes mellitus for each sex.[19] High short-term risk was defined as a 10-year predicted risk for an atherosclerotic CVD event of ≥7.5%, as recommended by 2013 ACC/AHA guidelines. Participants with low short-term predicted risk (<7.5%) were assigned to categories of lifetime risk based on risk-factor profiles using the existing algorithm developed from the Framingham Heart Study cohort.[24] Low predicted lifetime risk was defined as having all optimal risk factors or ≥1 nonoptimal risk factor, whereas high lifetime predicted risk was defined as having ≥1 elevated or ≥1 major risk factor (Table 1). This definition is based on clinical relevance because those with at least 1 elevated risk factor

Table 1. Risk Factors Stratification and Predicted Lifetime Risks[24]

CVD Risk Factors	Optimal	Nonoptimal	Elevated	Major
Blood pressure, mm Hg	<120/80	120 to 139/80 to 89	140 to 159/90 to 99	≥160/≥100 (or treated)
Total cholesterol, mg/dL	<180	180 to 199	200 to 239	≥240 (or treated)
Diabetes mellitus	No	No	No	Yes
Smoking	No	No	No	Yes

CVD indicates cardiovascular disease.

Table 2. Characteristics of the Pooled Population From the CRONICAS cohort study and PERU MIGRANT study (n=2844)

Variables	Low Short-Term/Low Lifetime Risk (n*=858, 353, 505)	Low Short-Term/High Lifetime Risk (n*=1007, 356, 651)	High Short-Term Risk (n*=979, 713, 266)
Age, y, mean (SD)	50.9 (7.7)	51.0 (6.9)	65.3 (8.4)
Men	49.6 (6.3)	47.2 (5.0)	63.4 (8.5)
Women	51.8 (8.4)	53.0 (6.9)	70.3 (5.6)
SBP, mm Hg, mean (SD)	109.7 (11.7)	116.8 (16.6)	130.1 (20.6)
Men	114.4 (10.0)	120.9 (15.1)	128.8 (19.5)
Women	106.5 (11.7)	114.5 (16.9)	133.6 (22.9)
DBP, mm Hg, mean (SD)	69.6 (8.0)	73.9 (10.8)	77.2 (12.0)
Men	71.7 (7.7)	76.7 (10.2)	77.8 (11.7)
Women	68.1 (8.0)	72.4 (10.8)	75.7 (12.4)
BMI, kg/m^2, mean (SD)	26.4 (4.4)	28.9 (4.9)	27.2 (4.4)
Men	25.5 (3.5)	27.3 (3.8)	27.1 (4.1)
Women	27.1 (4.8)	29.7 (5.3)	27.6 (4.9)
Waist circumference, cm, mean (SD)	87.2 (11.2)	93.1 (10.9)	93.0 (11.1)
Men	88.6 (9.7)	93.1 (9.4)	94.0 (10.5)
Women	86.3 (12.0)	93.1 (11.6)	90.5 (12.2)
Total cholesterol, mg/dL, mean (SD)	169.1 (22.5)	220.9 (35.6)	202.9 (41.0)
Men	166.3 (23.0)	210.6 (34.7)	201.2 (40.6)
Women	171.0 (21.9)	226.4 (34.8)	207.5 (41.7)
HDL-C, mg/dL, mean (SD)	41.5 (11.2)	43.5 (11.6)	40.5 (11.2)
Men	40.3 (11.1)	42.5 (11.9)	39.5 (10.5)
Women	42.4 (11.2)	44.1 (11.5)	43.2 (12.4)
Triglycerides, mg/dL, mean (SD)	131.5 (71.2)	178.9 (104.1)	173.3 (111.1)
Men	134.7 (84.1)	175.9 (110.6)	171.8 (107.5)
Women	129.3 (60.7)	180.6 (100.4)	177.5 (120.4)
Total cholesterol/HDL, mean (SD)	4.1 (1.1)	5.0 (1.4)	5.0 (1.6)
Men	4.0 (1.1)	4.7 (1.5)	5.1 (1.5)
Women	4.1 (1.1)	5.1 (1.4)	4.7 (2.2)
Current tobacco use, n (%)	0 (0.0)	123 (12.2)	163 (16.7)
Men	0 (0.0)	88 (24.7)	151 (21.2)
Women	0 (0.0)	35 (5.4)	12 (4.5)
Diabetes, n (%)	0 (0.0)	84 (8.3)	136 (13.9)
Men	0 (0.0)	13 (3.7)	88 (12.3)
Women	0 (0.0)	71 (10.9)	48 (18.1)
Hypertension, n (%)	0 (0.0)	233 (19.9)	309 (37.9)
Men	0 (0.0)	96 (18.9)	179 (31.9)
Women	0 (0.0)	137 (20.7)	130 (51.2)
Dyslipidemia, n (%)	576 (67.1)	924 (91.8)	814 (83.2)
Men	185 (52.4)	297 (83.4)	574 (80.5)
Women	391 (77.4)	627 (96.3)	240 (90.2)
Antihypertensive therapy, n (%)	0 (0.0)	77 (7.7)	164 (16.8)
Men	0 (0.0)	7 (2.0)	72 (10.1)
Women	0 (0.0)	70 (10.8)	92 (34.6)

Continued

Table 2. Continued

Variables	Low Short-Term/Low Lifetime Risk (n*=858, 353, 505)	Low Short-Term/High Lifetime Risk (n*=1007, 356, 651)	High Short-Term Risk (n*=979, 713, 266)
Pooled Cohort Risk Equations, % (mean, SD)	2.4 (1.9)	3.4 (1.9)	17.0 (9.7)
Men	3.3 (2.0)	4.3 (1.8)	17.6 (10.1)
Women	1.8 (1.6)	2.9 (1.8)	15.5 (8.1)

Dyslipidemia: TC ≥200 mg/dL or HDL-C <50 mg/dL (women), HDL-C <40 mg/dL (men). Hypertension: SBP ≥140 mm Hg, or DBP ≥90 mm Hg, or diagnosed by physician or taking antihypertensive medications. Diabetes: fasting glucose ≥126 mg/dL or taking diabetes medication. BMI indicates body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol.
*n for total, men, and women.

have a calculated lifetime risk for CVD ≥39%.[25] Participants were then classified, using these 2 risk assessment tools, into 3 groups: *low short-term and low lifetime risk, low short-term and high lifetime risk*, and *high short-term predicted risk*.[18]

Excluded Patients

Due to the specifications of Pooled Cohort Risk Equations, we included only participants in the age range of 40 to 79 years without past history of ischemic heart disease or stroke. Participants with missing values for age, systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, history of antihypertensive treatment, or current tobacco use were also excluded from the analysis.

Statistical Analysis

We used summary statistics to describe each predicted risk group by their demographic characteristics. The proportions of participants in each predicted risk group and the corresponding 95% CIs were estimated independently for men and women. The differences in proportion of participants within each predicted risk group were compared across age range, level of education (highest level reached), possessions weighted asset index (in tertiles), and place of residence (urban or rural).

Multiple parameters could be used to assess SES, including educational status and wealth index based on asset possessions.[26] All sites included in the CRONICAS and PERU MIGRANT studies were located in low-SES areas; however, levels of poverty varied across and within sites, allowing for individual participants to be properly grouped in context by wealth index and educational attainment.

To compare the distribution of CVD risk strata across level of education and wealth index, as measures of SES, and by place of residence, we used logistic regression—separately for each CVD risk stratum—adjusted by each variable (highest educational level, wealth index tertiles, or location, respectively) and by age. Binary outcomes were presence or absence of each CVD risk stratum. We used Stata version 12 (StataCorp LP) for all analyses.

This study was approved by the institutional review committee at Universidad Peruana Cayetano Heredia. All study participants gave informed consent.

Results

Overall, 4608 individuals were enrolled in both baseline surveys of the CRONICAS cohort study and the PERU MIGRANT study. Of the total 4608 participants in the 2 cohorts, 788 were excluded due to age, 526 due to past history of ischemic heart disease or stroke, and 389 due to missing data. Data from 61 subjects who were participants in both studies were included in this pooled cohort only once to avoid duplicate information. A total of 2844 participants were included in the analysis. Participants had a mean age of 55.9 years (SD 10.2 years), and 50% were men (Table 2).

In the aggregate population, the prevalence of participants classified as high short-term risk was 34.4% (95% CI 32.7 to 36.2), with a prevalence of 50.1% (95% CI 47.5 to 52.8) in men and 18.7% (95% CI 16.7 to 20.8) in women (Figure). Among participants classified as low short-term risk, 54.0% (95% CI 51.7 to 56.3) were in the high lifetime CVD risk category. Most CVD risk factors were most prevalent in the high short-term predicted risk group, although dyslipidemia was most prevalent in the low short-term and high lifetime risk group (92%).

Only 23.1% (95% CI 20.5 to 25.9) and 1.2% (95% CI 0.3 to 3.0) of participants in the youngest (40 to 49 years) and oldest (70 to 79 years) age groups, respectively, had all optimal risk factors. Prevalence of the optimal risk profile was significantly higher among participants with the lowest (14.9%) compared with the highest educational level (12.9%). Prevalence was similarly higher among those in the lowest (17.3%) compared with highest (12.1%) wealth index tertile and among rural (24.2%) compared with urban counterparts (12.0%) ($P<0.01$).

With regard to participants with low short-term and high lifetime predicted risk, 25.1% (95% CI 22.4 to 28.0) and 2.7% (95% CI 1.8 to 4.0) in the youngest age subgroup had ≥1

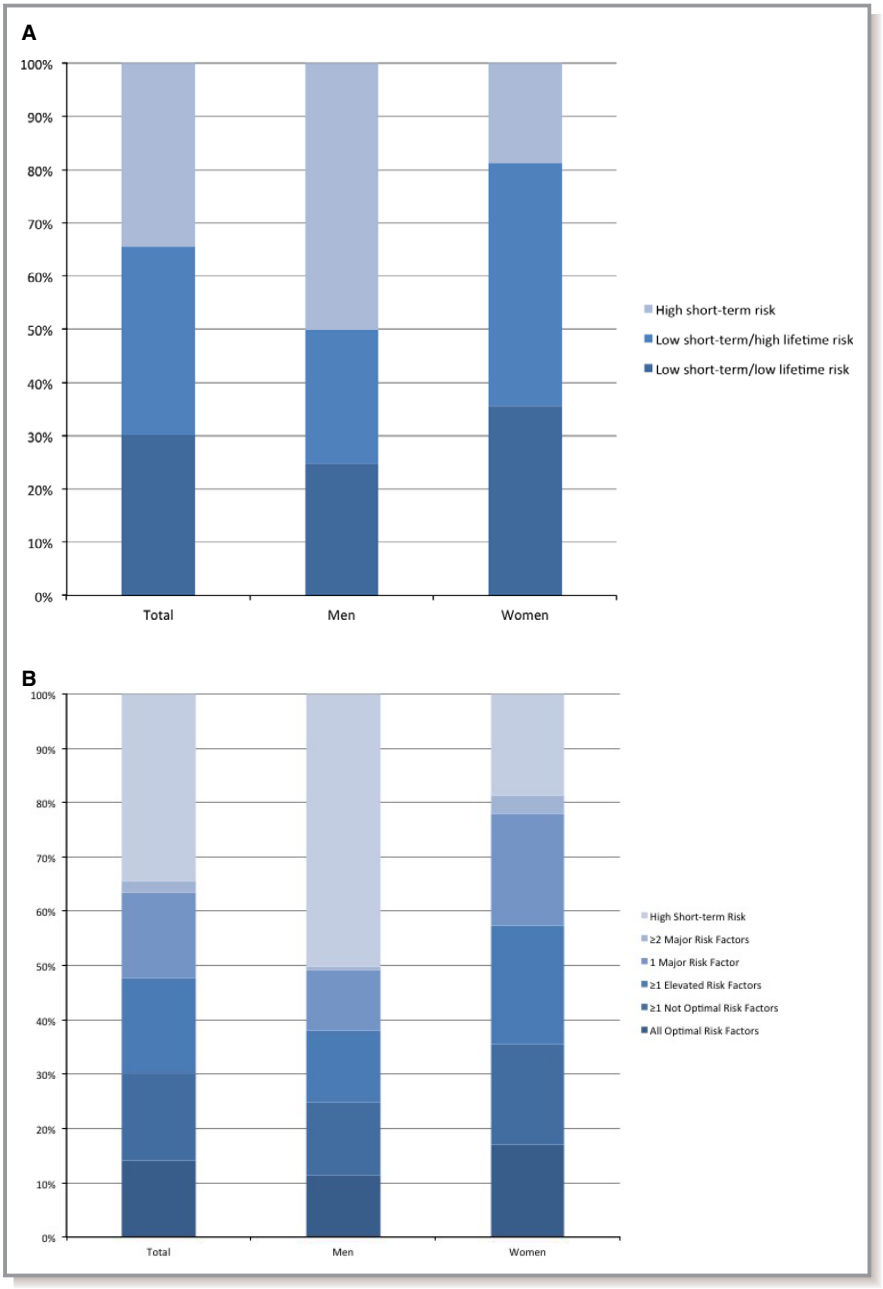

Figure. Distribution of risk in CRONICAS and PERU MIGRANT studies. A, Short-term and lifetime risk. B, Risk strata. For both panels, distribution was significantly different by sex ($P<0.001$).

elevated and ≥2 major risk factors, respectively, whereas none of the participants in the oldest age subgroup had these risk profiles. Participants within the lowest wealth index and from rural areas had significantly lower prevalence of these risk profiles compared with the highest wealth index and urban counterparts, respectively ($P<0.01$).

In contrast, almost all participants in the oldest age group (96.5% [95% CI 96.2 to 99.3]) were classified as high short-term risk. This risk profile was found to be significantly higher in the lowest (40.9%) versus the highest (30.5%) educational groups, in the lowest (37.2%) versus the highest (34.9%) wealth index tertiles, and among urban (35.3%) versus rural (30.4%) participants ($P<0.01$) (Table 3). Results were generally consistent by sex (Table 4).

Discussion

We found a relatively high proportion of participants classified as high short-term and high lifetime risk in a Peruvian population-based sample. A major finding of our study suggests that short-term and lifetime risks are not necessarily interdependent; specifically, the latter can be high even if the

Table 3. Distribution of Combined 10-Year (Short-Term) and Lifetime Cardiovascular Risk in the Pooled Population

	Low Short-Term/Low Lifetime Risk		Low Short-Term/High Lifetime Risk				N=2844
Variables	All Optimal	≥1 Not Optimal	≥1 Elevated	1 Major	≥2 Major	High Short-Term Risk	*P* Value
Total, n (%)	403 (14.2)	455 (16.0)	500 (17.6)	447 (15.7)	60 (2.1)	979 (34.4)	
Age, n (%)							
40 to 49	219 (23.1)	204 (21.5)	238 (25.1)	217 (22.9)	26 (2.7)	44 (4.6)	
50 to 59	119 (12.5)	201 (21.0)	200 (20.9)	180 (18.8)	30 (3.1)	226 (23.6)	
60 to 69	61 (10.1)	48 (8.0)	62 (10.3)	50 (8.3)	4 (0.7)	378 (62.7)	
70 to 79	4 (1.2)	2 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	331 (98.2)	
Location, n (%)							
Urban	278 (12.0)	344 (14.8)	430 (18.5)	395 (17.0)	58 (2.5)	822 (35.3)	<0.01*,†,‡
Rural	125 (24.2)	111 (21.5)	70 (13.5)	52 (10.1)	2 (0.4)	157 (30.4)	
Highest educational level, n (%)							
Primary school or less	206 (14.9)	207 (15.0)	206 (14.9)	170 (12.3)	29 (2.1)	565 (40.9)	<0.01*,‡
Secondary school	135 (13.8)	172 (17.5)	204 (20.8)	182 (18.5)	21 (2.1)	268 (27.3)	
Superior level	62 (12.9)	76 (15.9)	90 (18.8)	95 (19.8)	10 (2.1)	146 (30.5)	
Wealth index, n (%)							
Lowest	154 (17.3)	150 (16.9)	139 (15.6)	106 (11.9)	9 (1.0)	331 (37.2)	<0.01*,‡,§,¶,**
Middle	130 (13.4)	171 (17.6)	187 (19.3)	155 (16.0)	23 (2.4)	305 (31.4)	
Highest	119 (12.1)	134 (13.6)	174 (17.7)	186 (18.9)	28 (2.9)	343 (34.9)	

P values are for the comparison between row variables (highest level of education, wealth index tertiles, or location) and cardiovascular disease risk strata, separately, and adjusted by age.
*All optimal risk factors.
†≥1 elevated risk factor.
‡High short-term risk.
§≥1 nonoptimal risk factor.
¶1 major risk factor.
**≥2 major risk factors.

former is low. The chief implication of this finding is that approaches to prevention need to be global and target specific.

More than one-third of participants in our study were classified as high short-term CVD risk; more than half of those participants classified as low short-term predicted CVD risk, who would not likely be candidates for pharmacotherapy based on current guidelines, were classified as high lifetime CVD risk. Moreover, a higher proportion of participants were classified as high short-term and lifetime risk in low SES and urban settings, compared with high SES and rural settings, respectively. These overall findings are consistent with results from India and the United States.[9,27] In addition, a relatively small proportion of participants had all optimal risk factors (12.7%), which are far from optimal for population CVD prevention efforts. In fact, only 23.1% had this optimal risk profile in our youngest age subgroup (40 to 49 years). These findings suggest potential to identify targets for future public health intervention because maintaining a healthy lifestyle throughout young adulthood has been shown to be associated with a low CVD risk profile in middle age.[28]

Distribution of Risk by Socioeconomic Status: Education and Wealth Index

We found that levels of education and wealth index had inverse relationships to short-term risk but direct relationships to lifetime risk. A study in India found a similar association between educational level and short-term risk.[9] The relationship between SES and CVD incidence and risk factors has been well established,[29–34] and it is recognized that wealthy, educated, and urban people are most affected. Several risk factors, however, such as unhealthy food and tobacco use have become more available for mass consumption, leading to a transition in which all social classes are affected. Based on our findings, we may hypothesize that in Peru, this transition may have started by having a greater initial impact on short-term rather than lifetime risk.

Although CVD-related mortality has declined steadily over past decades, socioeconomic disparities have not. Similar to developed countries, developing countries had CVD risk factors more frequently in persons with high socioeconomic status in the past.[35] With social and economic development

Table 4. Distribution of Combined 10-Year (Short-Term) and Lifetime Cardiovascular Risk in the Pooled Population by Sex

	Low Short-Term/Low Lifetime Risk		Low Short-Term/High Lifetime Risk				N=2844
Variables	All Optimal	≥1 Not Optimal	≥1 Elevated	1 Major	≥2 Major	High Short-Term Risk	*P* Value
Total, n (%)	403 (14.2)	455 (16.0)	500 (17.6)	447 (15.7)	60 (2.1)	979 (34.4)	
Age range, men, n (%)							
40 to 49	89 (18.7)	95 (19.9)	113 (23.7)	127 (26.6)	9 (1.9)	44 (9.2)	
50 to 59	57 (12.3)	93 (20.0)	72 (15.5)	30 (6.5)	2 (0.4)	211 (45.4)	
60 to 69	15 (4.9)	4 (1.3)	3 (1.0)	0 (0.0)	0 (0.0)	282 (92.8)	
70 to 79	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	176 (100.0)	
Age range, women, n (%)							
40 to 49	130 (27.6)	109 (23.1)	125 (26.5)	90 (19.1)	17 (3.6)	0 (0.0)	
50 to 59	62 (12.6)	108 (22.0)	128 (26.1)	150 (30.6)	28 (5.7)	15 (3.1)	
60 to 69	46 (15.4)	44 (14.7)	59 (19.7)	50 (16.7)	4 (1.3)	96 (32.1)	
70 to 79	4 (2.5)	2 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	155 (96.3)	
Location, men, n (%)							
Urban	115 (9.8)	145 (12.4)	158 (13.5)	137 (11.7)	11 (0.9)	604 (51.6)	<0.01*,†,‡
Rural	46 (18.3)	47 (18.7)	30 (11.9)	20 (7.9)	0 (0.0)	109 (43.3)	
Location, women, n (%)							
Urban	163 (14.1)	199 (17.2)	272 (23.5)	258 (22.3)	47 (4.1)	218 (18.8)	<0.01*,†,§,¶,**
Rural	79 (29.8)	64 (24.2)	40 (15.1)	32 (12.1)	2 (0.8)	48 (18.1)	
Highest level of education, men, n (%)							
Primary school or less	54 (10.3)	56 (10.7)	42 (8.0)	31 (5.9)	4 (0.8)	339 (64.5)	>0.01
Secondary school	76 (12.7)	93 (15.5)	101 (16.8)	87 (14.5)	5 (0.8)	239 (39.8)	
Superior level	31 (10.5)	43 (14.6)	45 (15.3)	39 (13.2)	2 (0.7)	135 (45.8)	
Highest level of education, women, n (%)							
Primary school or less	152 (17.7)	151 (17.6)	164 (19.1)	139 (16.2)	25 (2.9)	226 (26.4)	<0.01*,¶
Secondary school	59 (15.5)	79 (20.7)	103 (27.0)	95 (24.9)	16 (4.2)	29 (7.6)	
Superior level	31 (16.9)	33 (17.9)	45 (24.5)	56 (30.4)	8 (4.4)	11 (6.0)	
Wealth index, men, n (%)							
Lowest	44 (11.43)	49 (12.73)	44 (11.4)	40 (10.4)	1 (0.3)	207 (53.8)	<0.01‡
Middle	65 (13.1)	72 (14.5)	78 (15.7)	54 (10.9)	5 (1.0)	222 (44.8)	
Highest	52 (9.6)	71 (13.1)	66 (12.2)	63 (11.7)	5 (0.9)	284 (52.5)	
Wealth index, women, n (%)							
Lowest	110 (21.8)	101 (20.0)	95 (18.9)	66 (13.1)	8 (1.6)	124 (24.6)	<0.01*,†,‡,¶,**
Middle	65 (13.7)	99 (20.8)	109 (23.0)	101 (21.3)	18 (3.8)	83 (17.5)	
Highest	67 (15.1)	63 (14.2)	108 (24.4)	123 (27.8)	23 (5.2)	59 (13.3)	

P values are for the comparison between row variables (highest level of education, wealth index tertiles, or location) and cardiovascular disease risk strata, adjusted by age.
*All optimal risk factors.
†≥1 not optimal risk factors.
‡≥1 elevated risk factor.
§1 major risk factor.
¶≥2 major risk factors.
**high short-term risk.

and ongoing epidemiological transition in these countries, these risk factors have become more prevalent among persons with lower SES.[35] Our findings suggest that in Central and South America, there is a need to direct CVD prevention efforts to communities and persons with low SES.

Distribution of Risk by Place of Residence

We found a higher proportion of participants classified as high short-term risk among urban versus rural counterparts and a lower proportion of participants with all optimal risk factors. Similar results were found in other low- and middle-income countries.[9,36,37] Using the INTERHEART risk score, Yusuf et al found that in low- and middle-income countries, the predicted cardiovascular risk was higher in urban areas.[38] Similar to demographic trends throughout Central and South America, the Peruvian urban population has increased from 12.2 million to 23.2 million between 1983 and 2012[39,40] and is predicted to increase.[41] Consequently, an increasing proportion of the population will likely face increased CVD risk.

Clinical Implications

The cutoff point for high short-term risk definition has been lowered from 10% (ATP III) to 7.5% (Pooled Cohort Risk Equations),[19] thereby increasing the proportion of persons with predicted high short-term risk. Despite this decrease in the number of persons classified as low short-term risk, a great proportion among them are at high lifetime risk. Exposure to high levels of risk factors over a lifetime promotes the development and progression of atherosclerosis.[42] Those with low short-term but high lifetime predicted risk have been found to have greater subclinical disease compared with those with low short-term and lifetime risk.[25] This suggests a potential benefit from aggressive prevention efforts in patients with this risk profile; however, this approach has yet to be rigorously tested.

Therapeutic strategies based on lifetime risk can be troublesome because of the uncertainty of safety and efficacy of use of statins for ≥10 years and the lack of data on long-term follow-up of randomized clinical trials >15 years or treatment of persons aged <40 years.[10] Nonetheless, reliance on only short-term risk estimates, as recommended by previous ATP III guidelines, may be limited because any single risk factor can produce significant cumulative damage if left untreated for many years. Consequently, lifetime risk assessment is particularly relevant for young patients, in whom attention to only short-term risk—very often found to be low—may discourage initiation of or adherence to lifestyle modification and treatment.[24]

Strengths and Limitations

This study uses diverse geographical settings at both low and high altitudes. In addition, this report may well be one of the earliest in Central and South American populations to use the recently published Pooled Cohort Risk Equations and one of the first to combine evaluations of short-term and predicted lifetime CVD risk in the region. Similar to the lifetime risk estimation tool, the Pooled Cohort Risk Equations assess total CVD as an outcome, which has been demonstrated to be more clinically relevant than only coronary heart disease events.[43] In addition, the lifetime risk algorithm used in this study yields a better remaining lifetime risk for CVD in comparison to Kaplan–Meier cumulative incidence.[24]

This study also has important limitations. Scarce evidence exists to support the validity of cardiovascular prediction tools in Central and South America.[16] In fact, Pooled Cohort Risk Equations have been shown to overestimate risk in non-US populations.[44] Neither short-term nor lifetime risk algorithms have been validated or calibrated for Peruvian populations. Moreover, risk assessment tools are thought to overestimate risk in Central and South American populations,[16] and there are not yet Peruvian, or general Central and South American, cohort studies with 10 years of follow-up to validate and recalibrate risk assessment tools.

Conclusions

In 2 Peruvian populations, about 1 in 3 persons has a high estimated risk of developing an atherosclerotic CVD event in the next 10 years. Among the low short-term risk group, which would not otherwise be considered for pharmacological therapy, a substantial proportion of participants were classified as high lifetime predicted CVD risk, suggesting that the profiles of short-term and lifetime risks are not necessarily interdependent. The chief implication of this finding is that approaches to prevention need to be global and target specific. Vulnerable persons, particularly those from low-SES and urban areas, are more likely to be classified as high short-term CVD risk. These findings demonstrate the need for comprehensive strategies for CVD prevention in Central and South America that target low-income communities.

Appendix

CRONICAS Cohort Study Group

Cardiovascular Disease: Antonio Bernabé-Ortiz, Juan P. Casas, George Davey Smith, Shah Ebrahim, Héctor H. García, Robert H. Gilman, Luis Huicho, Germán Málaga, J. Jaime Miranda, Víctor M. Montori, Liam Smeeth; Chronic Obstructive Pulmonary Disease: William Checkley, Gregory B. Diette, Robert H. Gilman, Luis Huicho, Fabiola León-Velarde, María Rivera, Robert A. Wise; Training and Capacity Building: William Checkley, Héctor H. García, Robert H. Gilman, J. Jaime Miranda, Katherine Sacksteder.

PERU MIGRANT Study Investigators

Antonio Bernabé-Ortiz, Lilia Cabrera, Héctor H. García, Robert H. Gilman, J. Jaime Miranda, Julio A. Poterico, Renato Quispe, Candice Romero, Juan F. Sánchez, Liam Smeeth.

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