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# Multiple cardiometabolic risk factors in the Southern Cone of Latin America: A population-based study in Argentina, Chile, and Uruguay ☆

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ABSTRACT

*Background:* Cardiovascular disease is a major cause of death, and its mortality is increasing in Latin America. However, population-based data on cardiovascular disease risk factors are sparse in these countries.
*Methods:* A total of 7524 men and women, aged 35 to 74 years old, were recruited between February 2010 and December 2011 from randomly selected samples in 4 cities (Bariloche and Marcos Paz, Argentina; Temuco, Chile; and Pando-Barros Blancos, Uruguay) in the Southern Cone of Latin America. Cardiovascular risk factors were measured using standard methods by trained and certified observers.
*Results:* Approximately 85.5% of adults ate less than five servings of fruit or vegetables per day, 35.2% engaged in low physical activity, and 29.7% currently smoked cigarettes. The prevalences of obesity, central obesity, hypertension, chronic kidney disease, dyslipidemia, diabetes, and metabolic syndrome were 35.7%, 52.9%, 40.8%, 2.0%, 58.4%, 12.4%, and 37.4%, respectively. The proportion of individuals with ≥3 cardiovascular risk factors, including low intake of fruit and vegetables, low physical activity, current cigarette smoking, obesity or central obesity, hypertension, chronic kidney disease, dyslipidemia, and diabetes, was 68.3%, and the proportion of individuals with ≥3 cardiometabolic risk factors, including obesity or central obesity, hypertension, chronic kidney disease, dyslipidemia, and diabetes, was 22.9%.
*Conclusions:* Cardiovascular disease risk factors are highly prevalent in the general population in the Southern Cone of Latin America. These data suggest that national efforts on the prevention, treatment, and control of cardiovascular risk factors should be a public health priority in the Southern Cone of Latin America.


## 1. Introduction

Coronary heart disease (CHD) and stroke are the leading causes of deaths worldwide, collectively killing 12.9 million people in 2010, or one in four deaths [1]. Low- and middle-income countries (LMIC) are disproportionally affected: over 80% of cardiovascular disease (CVD) deaths occur in LMIC, and almost half of CVD deaths are in people younger than 70 years in these countries [2]. It is estimated that the number of CVD deaths in Latin America will increase by more than 60% between 2000 and 2020 while CVD deaths will increase by only 5% in high-income countries during the same period [3]. In a case–control study of 1237 CHD patients and 1888 controls in South America, abdominal obesity, dyslipidemia, cigarette smoking, and hypertension were associated with high population-attributable risks of **48.5%, 40.8%, 38.4%, and 32.9%**, respectively [4]. These risk factors jointly accounted for 88% of the population-attributable risk. However, population-based data on the prevalence of these risk factors are sparse in Argentina, Chile and Uruguay. Furthermore, the limited available information on CVD risk factors in these populations was predominantly from studies based on self-reported data [5,6] or conducted in small convenience samples

*Abbreviations:* BMI, body-mass index; BP, blood pressure; CESCAS, Centro de Excelencia en Salud Cardiovascular para el Cono Sur; CHD, coronary heart disease; CKD, chronic kidney disease; CVD, cardiovascular disease; HDL, high-density lipoprotein; LDL, low-density lipoprotein; LMIC, low- and middle-income countries; MET, metabolic equivalent.

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[7]. Self-reported CVD risk factors do not provide reliable estimates of disease burden because they are influenced by access to healthcare and other factors [8].

The CESCAS (Centro de Excelencia en Salud Cardiovascular para el Cono Sur) I study is a population-based study aimed to examine CVD and risk factors in the general population from four representative cities in the Southern Cone of Latin America [9]. Specifically, the objectives of the present analysis are to provide current and reliable data on population levels of behavioral and metabolic risk factors for CVD and to assess the distribution of multiple CVD risk factors in the general adult population in the Southern Cone of Latin America.

## 2. Methods

### 2.1. Study participants

The details of study design and sampling method of the CESCAS I study have been published earlier [9]. Briefly, 7524 women and men, aged 35 to 74 years old, were recruited between February 2010 and December 2011 from randomly selected samples in 4 small to mid-sized cities in the Southern Cone of Latin America: two cities located in Argentina (Bariloche and Marcos Paz), one in Chile (Temuco), and one in Uruguay (Pando-Barros Blancos). Marcos Paz and Pando-Barros Blancos are small cities with 54,000 and 58,000 residents, respectively, according to the latest census data. Both urban and rural participants were recruited from these sites. Bariloche (Argentina) and Temuco (Chile) are larger cities with 134,000 and 245,000 residents, respectively, according to the latest census data. These study locations were selected based on population characteristics reflecting country averages. In addition, all four locations have demonstrated stable populations with migration rates below 10% over the past 10 years.

A 4-stage stratified sampling method was used to select a representative sample of the general population of the Southern Cone of Latin America [10]. In the first stage, census radii were randomly selected from each of the four locations, stratified by socio-economic level. In the second stage, a number of blocks proportional to the radius size were randomly selected. In the third stage, households within each block were selected by systematic random sampling. All members between 35–74 years in the selected households were listed to create the study sampling frame. In the final stage of sampling, one listed member per household was randomly selected to be included in the study.

Of the 10,254 individuals randomly selected, 550 were never found at their homes and 1394 refused to participate. Of those 8310 who completed the home surveys, 855 did not attend the clinical examination. Thus, the final sample for this analysis includes 7524 participants (3165 men and 4359 women). The overall response rate was 73.4% and the response rates were similar in men and women and across different locations.

The study complies with the Declaration of Helsinki. The study protocol has been approved by IRBs in all participating institutes in Argentina, Chile, Uruguay and the US. The written informed consent has been obtained from all study participants.

### 2.2. Data collection

Study data were collected at a home visit and a clinical visit. During the home survey, information on demographic characteristics, including age, sex, education, occupation, household income, and healthcare access; personal history of CVD and risk factors, including CHD, stroke, hypertension, diabetes, and dyslipidemia; treatment of hypertension, diabetes, and dyslipidemia; lifestyle risk factors, including cigarette smoking, alcohol consumption, and physical activity; and diet was obtained using a standard questionnaire. Leisure time physical activity, domestic and gardening activities, work-related physical activity, and transport-related physical activity were obtained using the International Physical Activity Questionnaire—Short Form [11]. The recorded activities were converted into metabolic equivalent (MET) and low activity was defined as <600 MET-minutes/week of total physical activity [12]. Nutrition information was collected using a semi-quantitative, self-administered food frequency questionnaire adapted from the NCI Dietary History Questionnaire and validated in Argentina, Chile, and Uruguay [13,14]. Specifically, the list of foods and beverages was modified to include those frequently consumed in Argentina, Chile and Uruguay according to data obtained from national surveys or food lists included in other food frequency questionnaires already validated in these countries [15–19]. Low fruit and vegetable intake was defined as <5 servings per day.

During the clinical examination, blood pressure (BP) and anthropometric measurements were obtained by trained and certified observers using standard protocols and techniques [20]. Three BP measurements were obtained with the participant in the seated position after 5 min of rest using a standard mercury or aneroid sphygmomanometer, and the mean of three readings was used for analysis. Participants were advised to avoid cigarette smoking, alcohol, caffeinated beverages, and exercise for at least 30 min before their BP measurement. Body weight, height, and waist circumference were measured twice during the examination. Weight was measured in light indoor clothing without shoes in kilograms to one decimal place, using standing scales supported on a steady surface. Height was measured without shoes in centimeters to one decimal place with a stadiometer. Waist circumference was measured at 1 cm above the navel at minimal respiration in centimeters to one decimal place.

Overnight fasting blood specimens were obtained for measurement of lipids, creatinine, and glucose. The fasting time was verified before the blood specimen was taken. Participants who had not fasted for at least 10 h did not have their blood drawn. Blood specimens were processed at the examination center and shipped to a central clinical laboratory in Buenos Aires where the specimens were stored at −80 °C until laboratory assays could be done. Blood glucose, total cholesterol, HDL-cholesterol, triglycerides, and creatinine were measured using standard methods with commercially available reagents. LDL-cholesterol was calculated using the Friedewald equation for participants with triglycerides <400 mg/dL [21].

Hypertension was defined as mean systolic BP ≥ 140 mm Hg, and/or diastolic BP ≥90 mm Hg, and/or current use of antihypertensive medications. Obesity was defined as a body-mass index (BMI) ≥30 kg/m$^2$ and overweight as BMI ≥25 and <30 kg/m$^2$. Central obesity was defined as waist circumference ≥102 cm for men or ≥88 cm for women [22]. Dyslipidemia was defined as total cholesterol ≥240 mg/dL and/or LDL-cholesterol ≥160 mg/dL and/or HDL-cholesterol <40 mg/dL and/or triglyceride ≥200 mg/dL and/or use of lipid-lowering medication. Diabetes was defined as fasting glucose ≥126 mg/dL or self- reported history of diabetes [23]. Metabolic syndrome was defined as 3 or more metabolic risk factors: waist circumference ≥102 cm in men and 88 cm in women, triglyceride ≥150 mg/dL, HDL-cholesterol <40 mg/dL in men and <50 mg/dL in women, blood pressure ≥135/85 mm Hg or use of antihypertensive medications, and fasting glucose ≥110 mg/dL or antidiabetic therapy [22].

### 2.3. Statistical analysis

The CESCAS I study was designed to provide precise estimates of the prevalence of CVD risk factors by sex and region (Marcos Paz and Bariloche, Argentina; Temuco, Chile; and Pando-Barros Blancos, Uruguay) in four age groups: 35–44, 45–54, 55–64 and 65–74 years old. Sample sizes were estimated to meet generally recommended requirements for precision in a complex survey [24]. All calculations were weighted to represent the general adult population aged 35–74 years in the study sites. Weights were calculated on the basis of data from the 2010 Population Census and the CESCAS I study sampling scheme, and took into account several features of the survey, including oversampling for specific age groups, non-response, and other demographic differences between the sample and the total population.