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Original article

# Do all components of the metabolic syndrome cluster together in U.S. Hispanics/Latinos? Results from the Hispanic Community Health study/Study of Latinos

Maria M. Llabre PhD [a,*], William Arguelles PhD [a], Neil Schneiderman PhD [a], Linda C. Gallo PhD [b], Martha L. Daviglus MD, PhD [c], Earle C. Chambers PhD [d], Daniela Sotres-Alvarez DrPH [e], Diana A. Chirinos MS [a], Gregory A. Talavera MD, MPH [f], Sheila F. Castaneda PhD [g], Scott C. Roesch PhD [b], Gerardo Heiss PhD [h]

[a] Department of Psychology, University of Miami, Coral Gables, FL
[b] Department of Psychology, San Diego State University, San Diego, CA
[c] Institute for Minority Health Research, College of Medicine, University of Illinois, Chicago, IL
[d] Department of Family and Social Medicine, Albert Einstein College of Medicine, Bronx, NY
[e] Collaborative Studies Coordinating Center, Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC
[f] Department of Health Promotion/Behavioral Science, Graduate School of Public Health, San Diego State University, San Diego, CA
[g] Institute for Behavioral and Community Health, Graduate School of Public Health, San Diego State University, San Diego, CA
[h] Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

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ABSTRACT

*Purpose:* Metabolic syndrome (MetS), the clustering of several risk factors for cardiovascular disease, is highly prevalent in Hispanics/Latinos. We tested whether all components significantly loaded on the syndrome in Hispanics/Latinos and whether their contribution differed by sex and Hispanic ancestry. We also examined associations of MetS with prevalent diabetes and coronary heart disease in Hispanics/Latinos.
*Methods:* Data were obtained from a population-based cohort of $n = 15,823$ participants in the HCHS/SOL study who self-identified as being of Central American, Cuban, Dominican, Mexican American, Puerto Rican, or South American ancestry and were aged 18 to 74 years at screening.
*Results:* A latent variable model of waist circumference, systolic and diastolic blood pressure, triglycerides, high-density lipoprotein cholesterol (HDL-C), and fasting glucose fit the data in men and women, but the contribution of HDL-C was weak. No difference in the latent model of MetS was detected across Hispanic/Latino ancestry groups. MetS was significantly associated with diabetes and coronary heart disease.
*Conclusions:* Our results indicate that similar criteria for MetS may be applied across Hispanic/Latino ancestry groups but call into question the role of HDL-C in classifying the MetS in Hispanics/Latinos.


## Introduction

Metabolic syndrome (MetS) refers to the clustering of several risk factors that together confer increased risk for cardiovascular disease (CVD). The interrelated factors include obesity, hyperglycemia, dyslipidemia, and hypertension. According to a unified definition, the presence of three or more of the following risk factors results in a diagnosis of MetS: (1) waist circumference of 102 cm or greater in U.S. men and of 88 cm or greater in U.S. women; (2) systolic and diastolic blood pressures of 130 mm Hg or greater and of 85 mm Hg or greater or use of antihypertensive medication; (3) high-density lipoprotein cholesterol (HDL-C) levels less than 40 mg/dL in men and less than 50 mg/dL in women or use of cholesterol medication; (4) triglyceride (TG) levels of 150 mg/dL or higher or use of lipid-lowering medication; and (5) fasting glucose level of 100 mg/dL or higher or use of medication [1]. Presence of MetS increases the risk of CVD [1,2] and type II diabetes [3].

Data on the prevalence of MetS among U.S. Hispanics/Latinos, based primarily on Mexican Americans, indicate increased rates of MetS relative to whites or blacks [4]. Ancestry group comparisons

* Corresponding author. Department of Psychology, University of Miami, P O Box 248185 Coral Gables, FL 33124. Tel.: +1-305-284-6698; fax: +1-305-284-2522.
*E-mail address:* mllabre@miami.edu (M.M. Llabre).

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from the Multi-Ethnic Study of Atherosclerosis showed that Mexican Americans had a higher prevalence of MetS compared with Puerto Ricans and other ancestry groups in the United States, suggesting that Hispanics/Latinos do not represent a homogeneous group with respect to MetS prevalence.

Furthermore, the prevalence of some individual MetS components has been shown to be higher for Hispanics/Latinos than non-Hispanic whites, including overweight or obesity and dyslipidemia [4]. Hispanics tend to have lower levels of HDL-C cholesterol in comparison to blacks or non-Hispanic whites [5,6] and higher TGs [5]. Of interest, HDL-C has not been shown to reliably predict myocardial infarction (MI) in Hispanics/Latinos, as shown in non-Hispanic whites [7]. Prevalence of hypertension, on the other hand, has been reported to be lower in Hispanics/Latinos compared with non-Hispanic whites [4].

Similar to MetS, diabetes appears to be disproportionately prevalent among Hispanics/Latinos relative to among whites and blacks [4]. Paradoxically, prevalence of CVD is lower among U.S. Mexican Americans than among whites and blacks [4]. Researchers often refer to the unexpected lower CVD rates in a relatively more disadvantaged population as the "Hispanic paradox" [8,9].

The HCHS/SOL study provides a unique opportunity to examine the MetS in Hispanics/Latinos and address fundamental questions and methodologic shortcomings in the quantification of the MetS. Several methodologic criticisms related to MetS have been elucidated by Kahn et al [10], who point out that there is no empirical rationale for the inclusion (or exclusion) of specific indicators, nor for the cutoff values specified in existing MetS criteria, which appear arbitrary given that biological levels of the individual MetS components are continuous. It is possible that the risk factors and/or cutoff values do not apply in Hispanics/Latinos and their routine application contributes to the Hispanic paradox. To overcome these methodologic shortcomings, we specify a latent variable model using the current indicators of MetS.

In the most common latent variable measurement model, it is assumed that there is an underlying construct or mechanism that explains the covariation among a set of measures. Each measure or indicator is linearly related to its latent variable and is expected to contain some error or residual variation. The indicators are measured as continuous variables without the need to impose cutoffs. The model allows estimation of the contribution of each component to the underlying construct, the MetS.

We use this latent variable model approach, consistent with the notion of MetS, to address a fundamental question: Do all components of MetS cluster together in Hispanics/Latinos? A related question is whether there are differences in the contribution of each component to the MetS as a function of sex or Hispanic/Latino ancestry group? We will also assess whether MetS, assessed using continuous measures, is associated with prevalent diagnosis of diabetes and coronary heart disease (CHD) in Hispanics/Latinos.

## Methods

### *Participants*

The purpose, design, and methods of the HCHS/SOL have previously been reported [11,12]. Participants were recruited in four U.S. communities: the Bronx, NY, Chicago, IL; Miami, FL; and San Diego, CA. A two-stage stratified probability sampling plan was used and previously described [12]. The study protocol was approved by the Institutional Review Board at each site and informed consent was obtained from all participants. Of the 16,415 eligible participants aged between 18 and 74 years who were assessed at baseline between 2008 and 2011, $n = 15{,}823$, identified themselves as being of Central American, Cuban, Dominican, Mexican American, Puerto Rican, or South American ancestry. Those of mixed background or who identified as "other" were excluded from the current analyses. Two participants with missing data on all components of the MetS were also excluded from analysis; thus the analytic sample size was $n = 15{,}823$.

### *Measures*

#### *MetS components*

The indicators used in this study are those consistent with current definitions of MetS. Waist circumference was measured to the nearest 0.1 cm at the uppermost lateral border of the right ilium using a measuring tape. After 5 minutes in the seated position, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured three times at 1-minute intervals using an automatic sphygmomanometer (Omron model HEM-907 XL, Omron Healthcare Inc., Bannockburn, IL), and the average of the three readings was used. Measurements of HDL-C, TGs, and glucose were obtained from fasting blood samples.

#### *Prevalent CHD and diabetes*

Each participant received a standard digital 12-lead electrocardiogram (ECG; GEMSIT MAC 1200 portable electrocardiograph) and readings were electronically transmitted to a central ECG reading center (the Epidemiological Cardiology Research Center of Wake Forest University's School of Medicine). Guidelines to determine wave duration and voltage following the Minnesota Code were used to ascertain possible old MI. ECG classification criteria for MI by the Minnesota Code are detailed elsewhere [13]. Self-reported information on angina, heart attack, and coronary procedures (angioplasty, stent, or bypass surgery to the arteries of the heart) was collected via standard questionnaire and interview. Prevalent CHD was specified as a dichotomous variable that combined information from ECG reports of possible old MI as well as self-report of heart attack, coronary procedures, and angina.

Diabetes was also specified as a dichotomous variable based on the American Diabetes Association definition, taking into account serum glucose levels adjusted for fasting time and, if available, glucose level 2 hours after a 75-g glucose load, glycosylated hemoglobin A1c%, scanned or transcribed antiglycemic medication use, or self-report of diabetes.

#### *Covariates*

Standard questionnaires and interviews were used to collect information on age, sex, Hispanic/Latino ancestry group, current or previous smoking history, education, and total household income. Age was examined as a continuous variable. Sex was examined as a dichotomous variable. Use of lipid-lowering, diabetes, and hypertension medication was coded as a dichotomous variable. Hispanic/Latino ancestry group was dummy coded with five vectors for Puerto Rican, Cuban, Dominican, Central American, or South American, with Mexicans serving as the reference group.

### *Procedures*

#### *Statistical analysis*

We examined a latent variable model for MetS as most consistent with the notion of a common underlying pathophysiology using confirmatory factor analysis (CFA), where each indicator was assumed to be a manifestation of the syndrome. The commonality or common variance among the indicators is represented by a latent variable. We tested whether such a model represented good fit to the data. Initially, we assumed uncorrelated residuals except for SBP with DBP and HDL-C with TGs but relaxed the assumption based on modification indices suggesting added correlations between waist