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Social patterning of cardiovascular and metabolic risk in Colombian adults

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ABSTRACT

Objectives: To test for differences in cardiovascular and metabolic risk (CMR) by educational attainment and physical capital. To compare CMR among black, indigenous, and mixed populations, accounting for socioeconomic status (SES).

Design: We conducted multivariate analyses using cross-sectional data from a national survey of Colombian adults ($n = 10,814$) to examine the social patterning of CMR. In sex/gender-stratified models, a CMR index was regressed on educational attainment, physical capital, ethnicity/race, and age.

Results: Women with a primary education (OR = 1.64, 95% CI: 1.25, 2.15) had higher age- and ethnicity/race-adjusted odds of CMR than women with more than secondary education. Men with a primary education (OR = 0.67, 95% CI: 0.48, 0.92) had significantly lower adjusted odds of CMR than men with more than secondary education; these associations did not remain significant after adjustments for physical capital. Men in the first (OR = 0.45, 95% CI: 0.36, 0.57) and second (OR = 0.72, 95% CI: 0.57, 0.91) physical capital tertiles had significantly lower adjusted odds of CMR than those in the highest tertile. There was not a significant patterning of CMR by ethnicity/race for women or men, or by physical capital for women.

Conclusions: Findings suggest that for Colombian adults CMR is patterned by SES; these associations differ by sex/gender.

Introduction

Cardiovascular disease (CVD) and metabolic conditions are growing public health challenges in Latin American countries (LACs). Mortality from ischemic heart disease and cerebrovascular disease, two subsets of CVD, and the prevalence of diabetes are each expected to increase in LACs between 1990 and 2020 (Yusuf et al. 2001; Wild et al. 2004). Risk factors for CVD and metabolic disorders are not equally distributed within LACs (Tejero 2010). Understanding the social patterning of risk factors for CVD is essential to the development of effective strategies to reduce cardiovascular and metabolic risk (CMR) in LACs.

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A shift from infectious to chronic conditions as major causes of death, often called the epidemiologic transition, has been linked to changes in economic patterns, including urbanization, trade liberalization, and foreign investment (Pramparo et al. 2006; Quast and Gonzalez 2014; Goryakin et al. 2015). Economic transitions may differentially affect groups based on socioeconomic status (SES), ethnicity/race, and sex/gender (Tejero 2010). These differences may be reflected in the patterning of risk factors for CVD and metabolic conditions. Yet, relatively few empirical studies have examined social and economic differences in CMR in countries experiencing epidemiologic transitions. In this paper, we examine variations in CMR by SES, sex/gender, and ethnicity/race among adults in Colombia, a multiethnic middle–upper-income LAC that is in the midst of macroeconomic, social, and epidemiologic transformations.

In less economically developed regions of LACs there is generally a positive association between SES and indicators of CMR (Monteiro, Conde, and Popkin 2001; Fernald 2007). In contrast, in middle- to upper-income regions and countries this association tends to be reversed (Monteiro, Conde, and Popkin 2001; Fernald 2007; Fernald and Adler 2008). This shift from positive to inverse associations between SES and CMR may be associated with differential adoption of modifiable behaviors (Cois and Ehrlich 2014). For instance, after an initial increase in consumption of meats and processed food high in fats and sugar among high socioeconomic groups in middle- to upper-income countries, these groups tend to adopt healthier diets, while lower-SES groups tend to adopt and maintain less healthy diets (Colhoun, Hemingway, and Poulter 1998; Monteiro, Conde, and Popkin 2001). Thus, associations between SES and CMR begin to reverse, with higher SES linked to lower CMR over time.

Evidence from other middle-income LACs suggests that the association of SES with CMR also varies by sex/gender (Monteiro, Conde, and Popkin 2001; Boissonnet et al. 2011; Fleischer et al. 2011). In Brazil, one study found an inverse association between education and obesity among Brazilian women, irrespective of the income level within their region of residence (Monteiro, Conde, and Popkin 2001). Income was positively associated with obesity for women in less economically developed regions, but negatively associated in economically advantaged regions (Monteiro, Conde, and Popkin 2001). In contrast, for Brazilian men, the association between education and obesity varied according to the regional income level, while the association between household income and obesity was positive regardless of the regional income level. In Argentina, Fleischer and colleagues (2011) found variations in the relationship between level of regional economic development, educational attainment, and individual indicators of CMR by sex/gender (Fleischer et al. 2011). Among men living in urban areas, educational attainment was inversely associated with overweight or obesity, hypertension, and diabetes. In contrast, in rural areas men's educational attainment was positively associated with overweight or obesity and hypertension, and inversely associated with diabetes risk. Educational attainment was inversely associated with women's risk of overweight or obesity, hypertension, and diabetes, regardless of urbanicity. These findings suggest complex and dynamic associations between SES, sex/gender, and CMR in regions experiencing economic, social, and epidemiologic transitions.

Evidence suggests that marginalized ethnic/racial groups in the US are more likely to accumulate risk for chronic conditions such as CVD or diabetes than their white counterparts (Szanton, Gill, and Allen 2005; Geronimus et al. 2006). Black and indigenous communities in LACs have been similarly economically, socially, and politically marginalized

(Montenegro and Stephens 2006; Wade 2010). However, the social patterning of CMR by ethnicity/race in LACs has been under-examined (Perreira and Telles 2014). The few studies that have examined the social patterning of CMR by ethnicity/race in LACs report higher odds of hypertension for black women in comparison with their white and mixed-race counterparts (Sichieri, Oliveira, and Pereira 2001; Ordunez et al. 2013; Lucumi 2014). No studies identified in this literature review have reported ethnic/racial variations in CMR for men (Sichieri, Oliveira, and Pereira 2001; Ordunez et al. 2013; Lucumi 2014). Evidence regarding indigenous communities is inconclusive. Some studies report a lower prevalence of hypertension in indigenous communities (Guerrero-Romero et al. 2000; Tavares et al. 2003; Hollenberg et al. 2005), while others report similar prevalence to the rest of the population (Agostinho Gimeno et al. 2007; Oliveira et al. 2011), particularly in urban contexts (Hollenberg et al. 1997). In LACs few, if any, studies have examined sex/gender-specific patterns of cardiometabolic indicators by SES and ethnicity/race.

In LACs, current literature primarily includes studies that examine the social patterning of CMR using single indicators. These studies may underestimate the joint implications of chronic conditions, as they are often comorbidities (Bautista et al. 2006; Feliciano-Alfonso et al. 2010). The combination of these conditions may further enhance risk for premature mortality in this changing social and economic context. The use of a cumulative measure of CMR provides a more robust predictor of mortality relative to individual measures of CMR and better captures the biological impact of social and economic disadvantage (Seeman et al. 2004; Merkin et al. 2009). Thus, a cumulative or composite measure of CMR may be useful for monitoring and enhancing understanding of these health patterns in LACs.

Using data from a nationally representative survey, we examine two research questions regarding the social patterning of CMR in Colombia. First, we test for differences in CMR by educational attainment and physical capital. Second, we compare CMR among black, indigenous, and mixed populations, accounting for SES. We use sex/gender-stratified models to examine differences in the socioeconomic and ethnic/racial patterning of CMR.

Methods

Sample

Data for this study are from the 2007 Colombian National Survey of Health (CNSH), a cross-sectional study based on a probabilistic, multistage, stratified, and cluster sampling strategy designed to study the health status of the non-institutionalized civilian Colombian population aged 0–69 years (Rodríguez et al. 2009). Sampling weights in this survey were assigned to reflect the structure of the Colombian population based on the 2005 Census.

This study is restricted to a subsample of 13,301 men and women aged 18–69 who participated in the self-reported, clinical, and anthropometric components of the CNSH (Rodríguez et al. 2009). Self-reported measures, collected through face-to-face interviews administered by trained interviewers, included medication use for hypertension and diabetes, indicators of social position, and demographic characteristics. Systolic and diastolic blood pressures were measured once with a digital sphygmomanometer. Glucose, high-density lipoproteins, low-density lipoproteins, total cholesterol, and triglycerides were obtained from fasting blood draws using a portable analyzer. Participants' height (meters) and weight (kg) were recorded at the time of clinical measurements, with body mass index (BMI) calculated by dividing weight (kg) by height (meters) squared. The CNSH followed Colombian ethical regulations. This study was granted exemption by the University of Michigan Institutional Review Board.

Dependent variable

Our dependent variable was a measure of cumulative CMR based on previous work by Seeman et al. (2004). This study builds on existing evidence from high-income countries by examining a 9-point index of risk factors for CMR (Geronimus et al. 2006; Seeman et al. 2008; Schulz et al. 2012). We calculated cumulative CMR as the sum of the following indicators: systolic blood pressure =>140 mmHg; diastolic blood pressure =>90 mmHg; glucose >110 mg/dL; triglycerides >150 mm/dL; total cholesterol >240 mg/dL or total cholesterol <240 mg/dL and low-density lipoproteins >130 mg/dL; and high-density lipoproteins <40 mg/dL (men) or <50 mg/dL (women) (Schulz et al. 2012). For BMI, we differentiated between overweight (1 point if BMI ≥25–<30 kg/m^2) and obesity (2 points if BMI ≥30 kg/m^2). Consistent with previous research (Geronimus et al. 2006; Schulz et al. 2012), we assigned points to individuals who were taking antihypertensive or diabetes medication and whose blood pressure and glucose were below the respective cut points for risk. Overall, 10,814 participants had clinical data for all nine CMR indicators. Those with incomplete data were dropped from the analysis ($n = 2{,}487$). Relative to those with incomplete data, participants with complete data were more likely to be women and older. The mean of the CMR index was 2.56 (SE = 0.09; min = 0, max = 9). We defined a high CMR score as 3 or above. We selected this threshold based on previous literature indicating that cardiovascular and metabolic morbidity risk increases when three or more risk factors are present (Seeman et al. 1997). Additionally this cut-point is close to the sample mean, with a high score being conceptualized as having CMR above the sample mean (Kaestner et al. 2009).

Independent variables

SES was measured by educational attainment and physical capital. Educational attainment was assessed by the highest level of education completed, grouped into four categories according to the Colombian educational system: less than primary education (less than 5 years), primary education (up to 5 years); high school (11 years), and certificate, bachelor or higher (12 years or more). Physical capital was assessed by a summary measure of 15 household assets (e.g. refrigerator and car), 19 characteristics of housing quality (e.g. floor materials), and overcrowding (usual residents/number of rooms in dwelling), using a similar approach to a previous study in Colombia (Gonzalez et al. 2010). The composite measure of physical capital was the first component of a principal component analysis, divided into tertiles (Vyas and Kumaranayake 2006). In Colombia, ethnic and racial categories overlap both for analytical and practical purposes (Wade 2010). We grouped ethnicity/race into three categories: indigenous, black (collapsing blacks, mulattos, natives of San Andres and Providence Archipelago, and Palenqueros, which are the official categories for the Afrocolombian population used in the 2005 Census and in health surveys in Colombia), and mixed (those who did not self-identify with any ethnicity/race category). Thus, our use of these ethnic/racial categories is congruent with governmental measures of ethnicity/race and also reflects socially constructed categories of ethnicity/race in Colombia (DANE 2007). The gypsy population was not included due to the small size in the clinical subsample ($n = 15$). Age, in years, was a measured as a continuous variable.

Statistical analysis

Multivariate statistical regression techniques were used to test for associations. To examine the first research question, regarding the association between SES and CMR by sex/gender, we regressed CMR (CMR score >3) on the SES measure (educational attainment or physical capital) in sex/gender-stratified models adjusted for age. In each age-adjusted model we progressively included covariates. To test the second research question, regarding the association of ethnicity/race with CMR, we regressed ethnicity/race on CMR in sex/gender-stratified models. As with SES, we incrementally included covariates in the models. Analyses were conducted in SAS 9.3 (SAS Institute, Cary, NC) accounting for sampling weights, clustering, and stratification to obtain unbiased estimations of univariate population characteristics and regression analysis. Multivariate results are presented in terms of adjusted odds ratios (OR) and 95% confidence intervals (CI).

Results

Estimated population characteristics are presented in Table 1 for persons who had complete data for the dependent variable, CMR ($n = 10{,}814$). The mean age was 39.1 years for women and 39.6 years for men. More than half (57.1%) were women. A majority (83.9%) was mixed, 9.5% were black, and 6.4% were indigenous, similar to Census estimates in 2005 (DANE 2007). Fully 6.2% of participants had less than a primary education.

Table 1. Weighted descriptive statistics for restricted sample ($n = 10{,}814$).

	Total sample		Women ($n = 6529$)		Men ($n = 4285$)		
	Percent (%)	Mean (SE)	Percent (%)	Mean (SE)	Percent (%)	Mean (SE)	*p*-Value
Age		39.29 (0.20)		39.09 (0.25)		39.55 (0.32)	.25
Female (%)	57.1						
Ethnicity–race (%)							
Indigeneous	6.4		5.5		7.6		<.01
Black	9.5		8.6		10.7		.01
Mixed	83.9		85.7		81.6		<.01
Socioeconomic status							
Educational attainment (%)							
Less than primary	6.2		6.0		6.4		.52
Primary	34.2		34.0		34.5		.73
Secondary	47.4		47.2		47.7		.72
Beyond secondary	12.2		12.8		11.425		.15
Physical capital (%)							
Tertile 1	33.0		31.4		35.2		<.01
Tertile 2	33.9		34.9		32.6		.09
Tertile 3	33.0		33.7		32.2		.27
Cardiovascular and metabolic risk		2.6 (0.02)	2.5 (0.03)			2.6 (0.4)	.63
Cardiovascular and metabolic risk score > 3(%)	45.0		43.3		47.2		.01

Primary education was the highest level of educational attainment for 34.2% of the sample, 47.4% completed secondary education, and 12.2% had more than a secondary education. Compared to men, a significantly smaller proportion of women were indigenous ($P < .01$) or black ($P = .01$) and a larger proportion identified as mixed ($P < .01$). A smaller percent of women had physical capital in the lowest tertile relative to men ($P < .01$). Fewer women than men had a high cumulative CMR score ($P = .01$).

Educational attainment and CMR

As shown in Table 2, women with less than primary education and primary education had a 58% (OR: 1.58; 95% CI: 1.09, 2.30) and 64% (OR: 1.64; 95% CI: 1.25, 2.14) higher age-adjusted probability of having a high cumulative CMR score, respectively, when compared to women with more than a secondary education (Model 1). There was not a statistically significant difference in CMR between women with a secondary education (OR = 1.24, 95% CI: 0.95, 1.61; Model 1) and those with more than a secondary education. Trends were similar when adjusting for ethnicity/race (Model 2) and physical capital (Model 3).

In contrast, for men there was a direct gradient in the association between education and CMR. That is, men with lower educational attainment had significantly lower age-adjusted odds of high CMR compared to men with more than a secondary education (Model 1). This gradient remained when adjusting for ethnicity/race (Model 2), but the association between secondary education and CMR was not significant after accounting for physical capital (OR = 0.78, 95% CI: 0.56, 1.09; Model 3).

Physical capital and CMR

Women in the first (OR = 1.17, 95% CI: 0.96, 1.41) and second (OR = 1.18, 95% CI: 0.97, 1.45) physical capital tertiles trended toward higher age-adjusted odds of CMR compared to women in the highest tertile, though these differences were not statistically significant (Table 2, Model 4). Patterns were similar when accounting for ethnicity/race (Model 5) and educational attainment (Model 6).

Among men, those in the first (OR: 0.45, 95% CI: 0.35, 0.56) and second (OR: 0.72, 95% CI: 0.57, 0.91) physical capital tertiles had 55% and 28% lower, respectively, age-adjusted odds of high cumulative CMR compared to men in the highest physical capital tertile (Model 4). After accounting for ethnicity/race and educational attainment, these associations remained robust (Model 5 and 6, respectively).

Ethnicity/race and CMR

There was no difference in odds of high CMR for indigenous (OR = 1.19, 95% CI: 0.87, 1.63) or black (OR = 1.12, 95% CI: 0.85, 1.48) women relative to their mixed counterparts (Table 3, Model 1). There was also no difference in odds of high CMR for indigenous (OR = 0.83, 95% CI: 0.60, 1.15) or black (OR = 0.79, 95% CI: 0.59, 1.05) men compared to men of mixed ethnicity/race. Patterns remained similar after adjusting for education and physical capital (Models 2–4).

Table 2. Odds of CMR score of 3+, by educational attainment and physical capital.

	Women	Men	Women	Men	Women	Men
	Model 1[a]		Model 2[b]		Model 3[c]	
Education						
Less than primary	1.58* (1.09, 2.30)	0.34*** (0.21, 0.54)	1.58* (1.09, 2.30)	0.34*** (0.21, 0.55)	1.58* (1.07, 2.35)	0.54* (0.33, 0.87)
Primary	1.64*** (1.25, 2.14)	0.49*** (0.35, 0.69)	1.64*** (1.25, 2.15)	0.50*** (0.35, 0.70)	1.64** (1.22, 2.19)	0.68* (0.47, 0.97)
Secondary	1.24 (0.95, 1.61)	0.66* (0.48, 0.92)	1.25 (0.96, 1.62)	0.67* (0.48, 0.92)	1.24 (0.95, 1.62)	0.78 (0.56, 1.09)
Beyond secondary	Referent	Referent	Referent	Referent	Referent	Referent
	Model 4[a]		Model 5[b]		Model 6[b]	
Physical capital						
Tertile 1	1.17 (0.96, 1.41)	0.45*** (0.35, 0.56)	1.15 (0.95, 1.40)	0.45*** (0.36, 0.57)	0.98 (0.79, 1.21)	0.52*** (0.41, 0.67)
Tertile 2	1.18 (0.97, 1.45)	0.72** (0.57, 0.91)	1.18 (0.97, 1.44)	0.72** (0.57, 0.91)	1.08 (0.87, 1.32)	0.77* (0.61, 0.99)
Tertile 3	Referent	Referent	Referent	Referent	Referent	Referent

Notes: Analysis was weighted.
[a]Adjusts for age.
[b]Adjust for age and ethnicity/race.
[c]Adjusts for age, ethnicity/race, education, and physical capital.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.0001$.

Table 3. Odds of cardiovascular & metabolic risk score of 3+, by ethnicity/race.

	Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]	
	Women	Men	Women	Men	Women	Men	Women	Men
Indigeneous	1.19 (0.87, 1.63)	0.83 (0.60, 1.15)	1.17 (0.86, 1.59)	0.84 (0.61, 1.16)	1.17 (0.86, 1.61)	0.95 (0.69, 1.31)	1.18 (0.86, 1.61)	0.94 (0.68, 1.29)
Black	1.12 (0.85, 1.48)	0.79 (0.59, 1.05)	1.13 (0.86, 1.48)	0.80 (0.60, 1.06)	1.11 (0.84, 1.47)	0.85 (0.64, 1.12)	1.13 (0.86, 1.49)	0.84 (0.63, 1.11)
Mixed	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent

Notes: Analysis was weighted.
[a]Adjusts for age.
[b]Adjusts for age and educational attainment.
[c]Adjust for age and physical capital.
[d]Adjusts for age, education, and physical capital.

Discussion

There are three major findings from the analyses presented here. First, associations between educational attainment and CMR differed by sex/gender. A robust inverse association of education with cumulative CMR for women was apparent after accounting for other variables. In contrast, men with the lowest levels of education had lower odds of high CMR relative to men with more than a secondary education. Second, we found a positive association between physical capital and CMR among men but not women. These socioeconomic patterns by sex/gender held after accounting for covariates. Third, there were no significant differences in CMR for indigenous and black men and women compared with their mixed counterparts.

Our findings are consistent with results reported from studies in middle-income countries indicating that education is inversely associated with CMR for women (Monteiro, Conde, and Popkin 2001; McLaren 2007; Fernald and Adler 2008; Boissonnet et al. 2011; Cois and Ehrlich 2014). These findings join previous studies in Colombia suggesting that education is a valid marker of social stratification that is consistently patterned with health among women, with women with lower educational attainment having lower self-reported health status, health service utilization, and higher mortality than their higher-educated counterparts (Lucumí-Cuesta and Gomez Gutierrez 2004; Gonzalez et al. 2010; Lucumí, Grogan-Kaylor, and Espinosa 2013; Arroyave et al. 2014; Agudelo-Suárez et al. 2015; de Vries, Arroyave, and Pardo 2016). The mechanisms by which educational attainment may be patterned with favorable health outcomes for more highly educated Colombian women relative to women with lower levels of educational attainment are not well understood.

Educational attainment may be more strongly associated with access to material resources among women compared with men, and thus confer protections through access to material resources. Sex/gender differences in stressors associated with lower social position might also explain sex/gender differences in the association between education and CMR (Lucumi 2014). Furthermore, some evidence suggests sex/gender differences in the adoption of health behaviors and sense of control, two pathways by which education may be associated with health (Chandola et al. 2006; Cutler and Lleras-Muney 2006). In addition, some studies suggest that gender-based differences in the patterning of socioeconomic position with health reflect a greater salience of social, structural, and psychosocial determinants for women, and greater salience of behavioral factors for health outcomes among men (Moss 2002; Denton, Prus, and Walters 2004).

Future studies are needed that consider the mechanisms by which educational attainment may shape health, and differences by gender, particularly in the context of countries undergoing economic and epidemiologic transitions. Potential pathways linking education to health include, for example, access to improved employment opportunities, health care, healthful foods and opportunities for physical activity, and reduced stress. Examining these pathways will help to ascertain the specific mechanisms through which education may contribute to improved health among women. These findings suggest that education may provide a fruitful point of intervention to promote the health of women in rapidly emerging, middle-income contexts.

We found little association between physical capital and CMR among women, and for men, lower levels of physical capital were associated with lower levels of CMR, suggesting that increasing access to physical capital in this middle-income country is associated with increased CMR among men but not women. Monteiro, Conde, and Popkin (2001) report similar findings for income and obesity among Brazilian men. These findings suggest that as men experience greater access to material resources, they may encounter increased CMR, perhaps due to increased consumption of meats, processed foods higher in fats and sugar foods, and cigarettes, consistent with early trends in the epidemiologic transition in other countries (Rivera et al. 2004; Popkin 2006; Thow and Hawkes 2009). If men more readily accrue physical capital benefits from economic development than women, perhaps men who have not yet accrued those benefits lag behind in access to some of the less health-promoting aspects of economic development (e.g. high fat, high sugar foods). Men with fewer material resources may also have more physically demanding jobs compared to those with more resources, conferring some protection against adverse CMR.

These results join literature suggesting that associations between SES and CMR vary by sex/gender in countries that are undergoing economic and epidemiological transitions (Monteiro, Conde, and Popkin 2001; Fleischer et al. 2011). Findings indicate that the patterning of CMR is not homogeneous across SES or sex/gender for Colombian adults, with the distribution of risk for CVD and metabolic conditions patterned by social characteristics. Mechanisms by which the economic transition has unfolded in Colombia, and variations in the economic transition across regions within Colombia may contribute to these findings of an inverse association between SES and CMR by sex/gender. Given variation in the timing and effects of the economic transition on regions within countries by urbanicity and rurality (United Nations Human Settlements Programme 2012), research examining the social patterning of CMR by urbanicity is warranted (Fleischer et al. 2011). In addition, the differences we report may be associated with inconsistencies in SES measurements or sex/gender differences in factors such as stress associated with lower social position, lower social power, and greater vulnerability.

The odds of CMR did not vary significantly by ethnicity/race, including after accounting for SES, for either women or men. These findings differ from those reported in more developed contexts, such as the US, where relative to non-Latino whites, ethnic/racial minorities have greater odds of CMR when assessed using a composite index (Geronimus et al. 2006; Kaestner et al. 2009; King, Morenoff, and House 2011). Future research regarding variations in the association of ethnicity/race with CMR by geography and community-level SES is warranted. In addition, as the study of ethnic/racial variations in health in Colombia is understudied, future research should consider alternative measurements of ethnicity/race (Perreira and Telles 2014). The uneven distribution of poverty, income inequality, and ethnic/racial groups across Colombia also indicates a need to examine the patterning of CMR across regions.

This study has several limitations. First, the cross-sectional nature of the study limits causal interpretations. Second, this study utilizes a CMR index that encompasses cardiovascular and metabolic indicators, but does not include indicators of, for example, immune response (e.g. cortisol) that may be relevant (McEwen 2008; McEwen and Wingfield 2010; Seeman et al. 2010). Third, in the CNSH blood pressure was measured once. However, the potential systematic error introduced for the single measurement of blood pressure is unlikely to distort these findings because persons who have high blood pressure on an initial occasion have greater cardiovascular risk than those with normal blood pressure (Roccella 1985). Finally, epidemiologic transition is a dynamic process, and the results reported here are based on data that reflect a point in time in Colombia's epidemiologic transition. Thus, studies must consider social and behavioral factors in conjunction with economic indicators as these emerge and change over time to affect health (Chen et al. 2013).

There are three main public health implications from these findings. First, social interventions are needed to extend the health-promoting effects of education to Colombian women and to address the adverse health consequences of increased access to material resources among men. Second, as the social patterning of CMR among the Colombian population differs from that observed in high-income countries, public health authorities should monitor the implications of social inequalities and social and economic transitions for health inequities over time, to better understand their dynamic nature and shifts in these social patterns across various phases of an epidemiologic transition. Finally, as countries such as Colombia undergo economic as well as epidemiologic transitions, it is critical to understand the role of macro-economic and social processes in contributing to these transitions. These processes have important implications for health, and offer opportunities for intervention to promote health equity.

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At the time of writing this paper, Diego I. Lucumí was affiliated with the School of Medicine at the Universidad el Bosque in Bogotá.

Disclosure statement

No potential conflict of interest was reported by the authors.

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