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Original Article

Patterns of SES Health Disparities Among Older Adults in Three Upper Middle- and Two High-Income Countries

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Abstract

Objectives: To examine the socioeconomic status (SES) health gradient for obesity, diabetes, and hypertension within a diverse group of health outcomes and behaviors among older adults (60+) in upper middle-income countries benchmarked with high-income countries.

Method: We used data from three upper middle-income settings (Colombia-SABE-Bogotá, Mexico-SAGE, and South Africa-SAGE) and two high-income countries (England-ELSA and US-HRS) to estimate logistic regression models using age, gender, and education to predict health and health behaviors.

Results: The sharpest gradients appear in middle-income settings but follow expected patterns found in high-income countries for poor self-reported health, functionality, cognitive impairment, and depression. However, weaker gradients appear for obesity, hypertension, diabetes, and other chronic conditions in Colombia and Mexico and the gradient reverses in South Africa. Strong disparities exist in risky health behaviors and in early nutritional status in the middle-income settings.

Discussion: Rapid demographic and nutritional transitions, urbanization, poor early life conditions, social mobility, negative health behavior, and unique country circumstances provide a useful framework for understanding the SES health gradient in middle-income settings. In contrast with high-income countries, the increasing prevalence of obesity, an important risk factor for chronic conditions and other aspects of health, may ultimately change the SES gradient for diseases in the future.

Keywords: Diabetes, Health disparities, Hypertension, Middle-income countries, Obesity, Socioeconomic status

Cross-national studies provide additional insight into the understanding of the socioeconomic status (SES) health gradient but there have been only a few cross-national studies of middle- and high-income countries that focus on the SES health gradient for older adults (Beltrán-Sánchez, Palloni, Riosmena, & Wong, 2016; Goldman, Turra, Rosero-Bixby, Weird, & Crimmins, 2011; Payne, Gómez-Olivé, Kahn, & Berkman, 2017). Although health is comprised of physical, mental, and social dimensions, few cross-national studies of middle- and high-income countries examine the SES gradient for older adults across a broad group of dimensions.

The relationship between SES and health is complex (Davey Smith & Lynch, 2004), making international comparisons challenging. Most studies in the developed world show a strong positive relationship between poor health and lower SES status. However, one of the more intriguing questions facing social science researchers is the degree to which this relationship holds true in developing economies. Middle-income countries are particularly of interest given that they

are experiencing large increases in diet-related conditions—obesity, diabetes, and heart disease—among a growing population of adults over the age of 60 (He, Goodkind, & Kowal, 2016; World Health Organization, 2000).

Existing evidence from middle-income settings shows mixed results in regards to the SES health gradient, in particular for obesity (Dinsa, Goryakin, Fumagalli, & Suhrcke, 2012). One of the most comprehensive studies of a middle-income country to date showed reversals of the gradient for mortality, obesity, metabolic syndrome, and other diet-related health conditions in older adults; in contrast, other aspects of health followed an expected positive pattern (Rosero-Bixby & Dow, 2009). In other studies of older adults in middle-income countries, education, body mass index, and waist circumference were either not related (Goldman et al., 2011) or contrasting patterns appeared depending on rural/urban residence (Smith & Goldman, 2007).

Demographic Regimes of the 20th Century and Nutritional Transitions in Middle-income Countries

There are several reasons for cross-national differences observed in the SES gradient for health. Unequal societies tend to have a more negative impact on health (Wilkinson, 1996) and high levels of inequality mean that certain subgroups within a population remain at lower levels of development even though the country as a whole may prosper (López-Alonso, 2007). Limited social mobility and limited access to quality health care affect the magnitude of differences between SES groups (CHDS, 2008). Levels of country development may also affect health. Reversals in the gradient appear for obesity according to levels of development; at higher levels of development, there is a shift toward an expected positive gradient of low SES and obesity (Dinsa et al., 2012; Monteiro, Conde, Lu, & Popkin, 2004; Pampel, Denney, & Krueger, 2012). However, level of development alone does not completely explain the SES gradient given that, among middle-income countries, positive, negative and no associations appear between SES and health (Dinsa et al., 2012).

The rapid demographic, epidemiological, and nutritional transitions from the 20th century to the present are relevant explanations for the mixed patterns found in the SES gradient in middle-income countries. Three aspects of these rapid transitions are notable. First, the demographic transitions of the 20th century characterized by mortality decline did not affect all countries equally in terms of the timing, pace, and reasons for the transitions. Even within countries, transitions have been uneven, particularly in rural areas where existing disparities between rural and urban are large and transitions have lagged behind urban areas. Rapid urbanization produced even greater differences between rural and urban areas (Flórez, Guataquí, Mendez, & Cote, 2016). The increase in obesity and chronic conditions among older adults is predominantly concentrated in urban areas (Carrillo et al., 2016; Ford, Patel, & Narayan, 2017; Unwin & Alberti, 2006) and suggests that the impact of rapid demographic and nutritional transitions in terms of health is most evident in urban areas.

Weak associations between SES and health could thus reflect the stark contrast between rural and urban areas in their demographic and nutritional transitions. Urban areas (particularly large metropolitan areas) may be more similar to developed economies in SES health patterns whereas rural areas may produce a reversal of the gradient for obesity because lower SES groups still maintain a more traditional diet while higher SES do not (Smith & Goldman, 2007). On the other hand, higher inequality in urban areas in some developing economies (World Bank Group, 2017c) could produce ***sharp SES gradients*** when examining urban areas only.

Second, older adults born in the mid-20th century in middle-income countries experienced rapid changes in nutrition later in life (FAO, 1946, 2010) with increased exposure to foods high in saturated fats amidst increased urbanization (Lloyd-Sherlock, Beard, Minicuci, Ebrahim, & Chatterji, 2014; Popkin, 2006; Schmidhuber & Shetty, 2005). The transition away from more traditional food to a diet with higher saturated fat content in developing economies increases the risk of poor health (Popkin, 2006; Popkin, Horton, & Kim, 2001) and could account for differences in the SES health gradient. ***Reversals of the gradient*** in middle-income countries could be a result of worse health behavior among higher SES groups. In more developed economies, higher SES groups tend to have access to healthier foods and obesity is more prevalent in lower SES groups (Dinsa et al., 2012). However, higher SES groups in some middle-income countries may be engaging in risky behavior by consuming foods higher in saturated fat content, suggesting a deteriorating health profile for those with higher SES who engage in risky health behaviors (Rosero-Bixby & Dow, 2009), even in settings with good health care coverage and quality health care.

A third aspect of the transitions has yet to be thoroughly examined. That is, we know very little regarding the long-term consequences of the demographic regimes of the 20th century on adult health in developing economies. Mortality declined in the 20th century in many countries but the type of demographic regime most of interest is that characterized by rapid mortality decline without parallel improvement in standard of living. The dramatic decrease in mortality in the mid to late 20th century in developing economies, in particular among infants and children, produced cohorts characterized by increasing survivorship of poor early life conditions (nutrition and infectious diseases in particular). Improvements in early life health occurred largely in the context of stagnant improvements in standard of living resulting in continued exposure to poor environmental conditions during childhood. Poor early life conditions not only affected childhood health but also may affect the health of these unique cohorts at older ages (Palloni & Souza, 2013). There is now ample

evidence of the long-term consequences of poor childhood conditions for older adult health (Barker, 1998; Bateson & Gluckman, 2011; Crimmins & Finch, 2006; Elo & Preston, 1992; Gluckman & Hanson, 2005).

The historical circumstances of the 20th century provide a pertinent explanation for the SES health gradient among older adults in developing economies (McEniry, 2014; Palloni & Souza, 2013). Poor early life nutrition can affect cognitive and non-cognitive skills that lead to poor educational attainment (Martorell, Stein, & Schroeder, 2001). Cohorts increasingly characterized by survivorship of poor early life conditions could result in a larger group of individuals in low SES groups with lower educational attainment and less opportunity for social mobility producing ***sharper SES health disparities*** (Palloni & Souza, 2013).

Alternatively, for these unique cohorts, mismatches between early life and later nutritional environments, in combination with increased social mobility among lower SES groups and negative health behavior among higher SES groups, could explain ***weak SES gradients***. Predictive physiological and metabolic adaptations to an undernourished environment in early life lead to mismatches later in life if there is more favorable nutrition-enriched environments at older ages, resulting in disease (Bateson & Gluckman, 2011; Gluckman & Hanson, 2005). Improved economic status and social mobility for lower SES groups born into poor nutritional environments could lead to changes in food consumption resulting in a more enriched diet higher in saturated fat content. These circumstances could produce mismatches, increasing the risk of obesity, diabetes, and heart disease. Weak gradients appear because there are fewer differences between middle and higher SES groups in terms of diet, especially if higher SES groups also engage in negative health behavior and consume a diet rich in saturated fat.

Taken as a whole, the complexity of historical circumstances in developing economies in transition and the importance of early life conditions may produce conflicting patterns of the SES gradient for health—reversals, sharp or weak gradients—in contrast to what occurred in developed economies with different historical circumstances. The demographic regimes of high-income countries in the 20th century are characterized by earlier and more gradual mortality decline (early 1900s or before) attributed to both improvements in standard of living and public health (McEniry, 2014). These regimes produced the pervasive increase in the older adult population and in chronic conditions and the established pattern of low SES being associated with poor health. In contrast, these increases are a more recent phenomenon in middle-income countries, more evident in urban areas, and more characterized by survivorship of poor early life conditions.

Our Study

Our study expands upon other studies of the SES health gradient in middle-income countries in two important ways. First, we compare the SES gradient and health across developed and developing world settings in the context of the demographic regimes of the 20th century. One type of regime (urban settings in upper-middle income countries) is characterized by rapid mortality decline without parallel improvement in standard of living and which has resulted in relatively recent increases in the aging population and chronic conditions. The other type of regime (high-income countries) experienced an earlier, more gradual mortality decline, where increases in the older population and chronic conditions have been pervasive for quite some time. Although other authors have made cross-national comparisons of older adult health in middle and high-income countries (Goldman et al., 2011; Payne et al., 2017), there have been few studies that use the framework of the demographic regimes of the 20th century to examine the health of older adults born during those regimes. Second, we compare gradients for obesity, diabetes, and hypertension relative to several other health outcomes along with adult lifestyle and early life nutritional status. With a notable exception (Rosero-Bixby & Dow, 2009), there have been few studies which have examined the SES gradient with such a diversity of outcomes in middle-income countries.

We select three upper middle-income countries (Colombia, Mexico, and South Africa) and two high-income countries (United States and England) with the purpose of comparing, where possible, SES gradients from the study of the upper middle-income country of Costa Rica (Rosero-Bixby & Dow, 2009). The selected middle-income countries experienced similar rapid demographic transitions in the mid-20th century, but are also similar in terms of present-day country-level national income. The United States and England are settings with similar demographic transitions and levels of income but where health results and health systems are quite different.

Rapid mortality decline occurred in Colombia beginning in the mid-1930s (Flórez et al., 2016) and in Mexico and South Africa in the 1940s, although, in the case of South Africa, political and economic events may have had slowed improvements for segments of the population until much later (Beinart & Dubow, 1995; Riley, 2005; de Romo & de Pérez, 1998). Poor nutritional environments were pervasive for older adults born in these settings during the 1930s–1940s although there was rapid improvement in nutrition in the decades after, in particular for Colombia and Mexico (FAO, 1946, 2010). Both Colombia and Mexico experienced some degree of increased social mobility toward the end of the 20th and beginning of the 21st centuries (directly benefiting either older adults or their children), increasing purchasing power for families, particularly in urban areas (Franco, Leon, & Atria, 2007).

The selected middle-income settings show similarities in per capita gross national income (World Bank Group, 2017b) and human development (United Nations Development Program, 2016). Nevertheless, there are country differences in life expectancy, health systems,

inequality, and history in the selected settings. Life expectancy at age 60 is lowest in South Africa (World Health Organization, 2015) and the quality of its health system is rated much lower than either Colombia or Mexico (World Health Organization, 2000). Apartheid dominated the political and economic system in South Africa for much of the mid to late 20th century; the HIV epidemic greatly impacted population health (Hosegood & Timaeus, 2006). Inequality is much higher in South Africa than in Colombia and Mexico; South Africa is one of the most unequal countries in the world; inequality in the United States and England is much lower than all three middle-income countries (World Bank Group, 2017a). Large discrepancies exist between rural and urban areas in the middle-income countries. However, although there is greater concentration of wealth and resources in urban settings, better economic opportunities, and better access to health care than rural areas, inequality is higher in urban areas than in rural areas in Colombia, Mexico, and South Africa (Bhorat, van der Westhuizen, & Jacobs, 2009; World Bank Group, 2017c).

Our focus is on the direction and magnitude of the SES gradient for obesity, diabetes, and hypertension relative to other health outcomes and lifestyle. We examine reversals in the gradient and the degree to which the gradient is sharper or weaker than expected especially for obesity, diabetes, and hypertension. We also examine the degree to which there are similar patterns across countries with other health outcomes and behaviors. We expect that the gradient will be consistently strong and positive in high-income countries and mixed in middle-income settings. We expect to observe sharper inequalities in the middle-income countries, in particular in South Africa. Using the framework of rapid demographic, epidemiological, and nutritional transitions, we identify the most plausible explanations for cross-national differences and similarities in the SES health gradient for the middle-income settings.

Methods

Data

Data on older Colombian adults come from **SABE-Bogotá.** SABE Bogotá is a representative cross-sectional sample of 2,000 older adults, 60 years and older within the metropolitan area of Bogotá from 2012 and is based on the original SABE study carried out in seven major cities of Latin America and the Caribbean. We select respondents 60 years and older living in urban areas in Mexico and South Africa using the WHO Study on Global Ageing and Adult Health Study (**SAGE**, 2007–2008) and in the United States and England using the Health and Retirement Study (**HRS**, 2000, 2006–2008) and the English Longitudinal Study on Ageing (**ELSA**, 2007–2008). For the United States, we obtained measured hypertension, diabetes, and performance measures first collected in 2006–2008. Race is an important distinguishing factor in South Africa; we focus on the two majority racial groups in the SAGE survey using their racial categories of South African blacks and colored. The final sample sizes were Bogotá (2,000), Mexico (1,286), South Africa (911), the United States (12,527), and England (6,183). The data form part of a NIA-funded project to harmonize data from major surveys of older adults or households (McEniry, 2015). The studies are representative of the older adult population either nationally or in major country provinces. All studies had good interviewer training, good questionnaire design, concern for data quality, and high response rates. All selected surveys collected measured blood pressure in addition to other dimensions of physical and mental health.

Measures

We use *education* for **SES** because education is a comparable measure of SES in older adults in cross-national studies (Goldman et al., 2011). However, the definition of educational categories can influence study results (Montez, Hummer, & Hayward, 2012). Because educational attainment differs between middle-income and high-income countries, we use a slightly different coding of education to reflect low, middle, and high educational groups. For the middle-income countries, we use three categories similar to educational categories used in other cross-national studies of middle-income countries (Goldman et al., 2011; Rosero-Bixby & Dow, 2009): incomplete primary, incomplete secondary, and complete secondary plus. For the United States and England, we use three categories defined by cross-national studies (Banks, Marmot, Oldfield, & Smith, 2006): low (0–11 years England, 0–12 years United States), middle (12–13 years England, 13–15 years United States), and high (more than 13 years England, more than 15 years United States).

For **health outcomes**, we define *obesity* as a body mass index (BMI) of greater than or equal to 30. We define *hypertension* as systolic blood pressure rates greater than or equal to 140 mmHg, diastolic blood pressure rates greater than or equal to 90 mmHG, or taking medication to control hypertension. *Diabetes* is self-reported except for in the United States and England where we also include diabetes based on the biomarker HbA1c using a cutoff point of 6.5% or greater (of total hemoglobin), or taking diabetes medication (Yan et al., 2012). Although important in some settings, underestimation of diabetes may not be so problematic in some middle-income countries such as Colombia (Vargas-Uricoechea & Casas-Figueroa, 2015). Other chronic conditions are self-reported (*heart disease*, *arthritis*, *respiratory disease*, *cancer*, and *stroke*). We define *poor self-reported health* (SRH) based on a question asking respondents about their overall health.

We use comparable and well-validated measures across countries for other **dimensions of health**, using established cutoff points where possible. *Cognitive impairment* is based on learning and immediate recall of words. For SABE-Bogotá, we defined impaired cognition as a short-term

memory of 0–1 out of 3 words from a modified version of the Minimental State Exam. HRS, ELSA, and SAGE all had immediate recall of 10 words, with a cutoff point of less than 4 to define impaired cognition. *Depression* is defined in terms of major depressive symptoms. SABE-Bogotá uses the Geriatric Depression Scale (Yesavage et al., 1982–1983), which includes 15 items, and major depression is identified by scoring 10 points or higher on this scale. Depression in the SAGE surveys is based on the DSM IV criteria reviewed by psychiatrists. We define major depression as reporting at least one of two major symptom categories (mood and loss of interest), daily symptoms lasting at least 2 weeks, plus having at least four additional symptoms (insomnia, weight loss, psychomotor agitation, feelings of worthlessness, diminished ability to think, recurrent thoughts about death, or low energy). HRS and ELSA use the CES-D (Radloff, 1977) scale based on eight items. We define a score of 4 or greater as depressed. *Difficulty with functionality* is harmonized across countries and based on difficulty with at least one ADL (bathing, dressing, transferring, or toilet use). We define *trouble walking* (an indicator of frailty) in terms of the highest quintile of time to perform a normal walking test and *weak grip strength* in terms of a dynamometer reading of less than or equal to 20 kg.

For adult lifestyle or **risky health behavior** (smoking, exercise, and diet), we define *smoking* as those who currently smoke, *no rigorous exercise* as those who do not perform consistent and weekly rigorous exercise, and *poor diet* as those who consume less than two servings of fruits and vegetables daily. We use the first quartile of height as a marker of *poor early life nutritional status*.

Analyses

For each country and health outcome and behavior, we estimate logistic regression models using age, gender, and educational groups with the reference group as the middle educational group. We control for race in South African models. To put our analyses of South African blacks and colored into better perspective, we estimate models for the entire population of South African older adults living in urban areas including the white and Asian populations and we estimate models for U.S. blacks. Comparing similar racial/ethnic groups may help better understand health disparities; national context is important and environmental factors differ across countries (Agyemang et al., 2010). Because there may be differences in cohorts in terms of diet, we estimate models with interactions between age and education for obesity, hypertension, and diabetes as a very broad dietary evaluation of cohorts. We summarize results with graphs showing patterns of the gradient across all countries along with joint SES significance levels. We estimate predicted probabilities and calculate the ratio of the predicted probabilities between low and high education groups as a measure of the magnitude of the gradient (Beltrán-Sánchez et al., 2016). To reduce the amount of cluttering in tables we show only the odds ratio with its significance level. The 95% confidence intervals for models are available upon request. Missing values were more notable in the middle-income countries (see Supplementary Notes for an explanation regarding missing values).

Results

Sample Characteristics and Health Profiles

The selected samples are all similar in terms of a majority female composition (56%–61%) with the exception of Mexico where only 51% are female (Table 1). Age patterns are similar across all countries but there are noted differences in education. The large metropolitan area of Bogotá has a higher percent (26%) of respondents with at least a secondary educational level as compared with urban Mexican and South African respondents (10% and 11%). The United States and England have similar percent in the lowest educational group (63% and 60%).

Large differences exist in health outcomes and risk factors across countries (Table 2). We observe particularly higher percentages with obesity, hypertension, and trouble walking in South Africa (48%, 86%, and 29%), heart disease in the United States and England (25% and 29%), and arthritis in the United States (61%). For overall health, we find high percentages in poor SRH in Bogotá (48%), cognitive impairment in Mexico (40%), and weak grip strength in Bogotá and urban Mexico (48% and 46%). For risky behavior, we find a high percent of older adults do no regular strenuous exercise in the middle-income countries (88%–90%) or in England (86%), and eat less than two servings of fruit or vegetables in Bogotá and urban Mexico (33% and 35%). On average, female respondents in middle-income country settings are between 3–9 (7–13) cm shorter than their English (United States) counterparts. Likewise, male respondents are 9 (14) cm shorter than their English (United States) counterparts.

Table 1. Basic Sample Characteristics

	Colombia Bogotá	Mexico Urban	S Africa Urban	England	United States
Female (%)	57	51	61	56	59
Age group (%)					
60–64	35	24	34	23	24
65–69	25	22	31	22	22
70–74	17	17	14	18	20
75–79	12	19	9	16	17
80+	12	18	12	20	17
Education (%)					
Low	39	57	56	60	63
Middle	35	34	34	15	18
High	26	10	11	26	18

Source. SABE Bogotá; SAGE-Mexico, urban dwellers; SAGE-South Africa, urban dwellers, African blacks and colored; ELSA-England; HRS-US.
Note: Weighted; numbers do not always sum to 100 due to rounding.

Table 2. Overall Prevalence of Health/Risk Factors

	Colombia Bogotá	Mexico Urban	S Africa Urban	England	United States
Overall health (%)					
Poor self-reported health	48	14	17	32	26
Difficulty with functionality	6	25	25	25	16
Trouble walking	21	19	29	21	19
Weak grip strength	48	46	27	29	28
Cognitive impairment	10	40	18	15	16
Depression	7	8	1	16	15
Chronic conditions (%)					
Hypertension (measured)	76	73	86	54	73
Diabetes	18	21	12	9	22
Heart disease	5	10	10	29	25
Stroke	4	6	5	7	7
Respiratory disease	15	7	4	8	10
Arthritis	28	13	30	42	61
Cancer	6			9	14
Adult risk factors (%)					
Obesity	26	30	48	28	21
Current smoker	8	21	23	13	12
No vigorous exercise	90	89	88	86	57
Less than 2 fr/veg daily	33	35	21		
Early life nutritional status					
Height (cm)					
Female	150 (6)	149 (7)	155 (11)	158 (7)	162 (7)
Male	163 (7)	163 (7)	163 (10)	172 (7)	177 (7)

Source. SABE Bogotá; SAGE-Mexico, urban dwellers; SAGE-South Africa, urban dwellers, African blacks and colored; ELSA-England; HRS-US.
Note: Early life nutritional status shows averages with standard deviations. Weighted. Prevalence for diabetes in England and United States based on biomarkers.

Health Outcomes

The effects of education on several health outcomes show expected consistent and significant patterns of lowest educational group being most at risk of being in poor health in the United States and England (Table 3). In Colombia, strong gradients appear in all variables except trouble walking and grip strength, and in Mexico, strong gradients appear with the exception of grip strength. The gradients in South Africa are significant for poor SRH, functionality, and trouble walking which shows a reversal in the gradient. The total urban South African population of older adults shows similar patterns with the blacks and colored; U.S. blacks tend to display sharper disparities than South African blacks/colored (Supplementary Table S1).

Graphical depictions of the gradients by ordering the regression odds ratios summarize these initial general impressions for Colombia, Mexico, South Africa, United States (Figure 1), and England, which is similar to the United States (Supplementary Figure 1). Although the order of the odds ratios differs across countries, the general patterns for these aspects of health are similar in Colombia, Mexico, the United States, and England especially for cognitive impairment, depression, functionality, and poor SRH. South Africa shows fewer significant associations between education and health/adult lifestyle and more variation in the SES patterns.

Predicted probabilities show the sharpest gradients in the middle-income countries in functionality, cognitive impairment, and depression (Colombia), and SRH, trouble walking (Mexico) and weak grip strength (South Africa) (Figure 2, Supplementary Table S3). The probability of poor health for the lowest SES group is between two to nearly four times that of the probability of poor health for those in the highest SES group for these aspects of health in the middle-income countries.

Chronic Conditions and Obesity

The middle-income settings show a weaker pattern for the effects of obesity, diabetes, and hypertension with the exception of obesity and diabetes in South Africa where a reversal of the gradient appears showing a strong likelihood of being obese among high SES and protective effects of being obese and diabetic for low SES (Table 4). Models for obesity with all urban South African older adults show similar results for low SES but the significant effect in high SES disappears; U.S. blacks tend to display sharper disparities than South African blacks, although the gradients for obesity and diabetes are flat for U.S. blacks (Supplementary Table S1). High SES shows protective effects on diabetes (Colombia) and hypertension and obesity (Mexico). In contrast, strong gradients in England and the United States

Table 3. Effects of Education on Selected Health Outcomes

		Colombia Bogotá	Mexico Urban	S Africa Urban	England	United States
Poor SRH	L	1.46***	1.87**	1.55*	1.96***	2.14***
	H	0.41***	0.59	0.58	0.74**	0.68***
Difficulty with Functionality	L	1.68**	1.88***	0.71	1.47***	1.50***
	H	0.77	1.08	0.23***	0.91	0.99
Trouble Walking	L	1.22	1.85**	0.36***	2.05***	2.06***
	H	0.79	0.62	1.43	0.83	1.03
Weak Grip Strength	L	1.29	0.94	1.01	1.53***	1.31**
	H	1.06	1.52	0.46	0.85	1.03
Cognitive Impairment	L	1.86*	1.87***	1.33	2.48***	2.17***
	H	0.77	0.78	0.46	0.90	0.67**
Depression	L	1.51*	2.04**	1.10	1.79***	1.91***
	H	0.38**	0.79	1.13	0.98	0.76**

Source. SABE Bogotá; SAGE-Mexico, urban dwellers; SAGE-South Africa, urban dwellers, African blacks and colored; ELSA-England; HRS-US.
Note: Shown are odds ratios by education group (low/high). Reference group is middle educational group. Models significantly differently from null model at $p <$ .001 for England and the United States; models also significant in other countries with some exceptions (see note in Supplementary Material). SRH = Self-reported health.
*$p < .05$; **$p < .01$; ***$p < .001$.

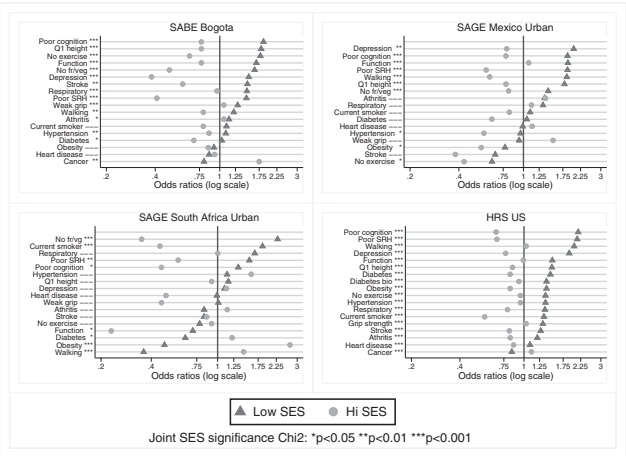

Figure 1. Cross national patterns of SES health disparities. SES = Socioeconomic status; see Supplementary Figure 2.

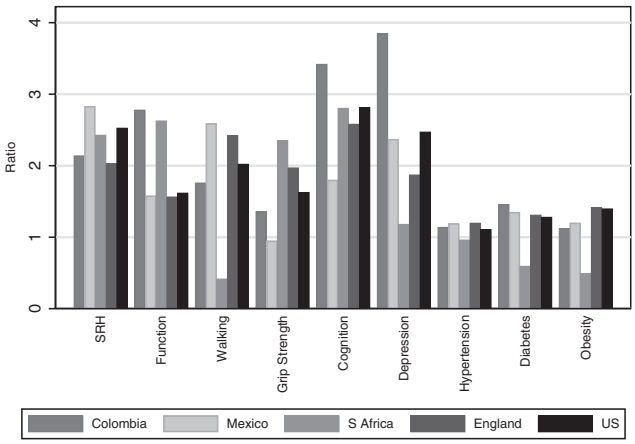

Figure 2. Ratio of predicted probabilities for low/high SES. SES = Socioeconomic status; see Supplementary Figure 3.

appear in the expected direction. Predicted probabilities (Figure 2, Supplementary Table S3) show weaker gradients for hypertension, diabetes, and obesity across all countries, although the gradient is sharpest for diabetes in Colombia and Mexico and sharpest for obesity in the United States and England. The predicted probability of diabetes for the lowest SES group is almost 1.5 times the predicted probability of diabetes for the highest SES group in Colombia and Mexico; similarly for obesity in the United States and England (Figure 2, Supplementary Table S3). Models with interactions for age and education produced no consistent significant interactions across countries and are not shown.

No significant gradients appear in other chronic conditions (heart disease, stroke, arthritis, or respiratory disease) in Colombia, Mexico, or South Africa with the exception of respiratory disease in Colombia. There are strong gradients for these chronic conditions in the United States and England and a reversal of the gradient appears for cancer in Colombia, England, and the United States (Supplementary Table S2). South African urban residents and blacks/colored show similar patterns; the gradient for U.S. blacks is mostly flat with the exception of arthritis (Supplementary Table S2). Predicted probabilities (Supplementary Table S3) show the sharpest gradients appear mostly in the middle-income countries with the exception of arthritis and respiratory disease. Colombia shows the sharpest gradient for stroke and cancer and South Africa the sharpest gradient for heart disease. The predicted probability of stroke for the lowest SES group is nearly three times that of the highest SES group in Colombia. The predicted probability of heart disease for the lowest SES group in South Africa is nearly two times that of the highest SES group. Being in the lowest SES group

Table 4. Effects of Education on Hypertension, Diabetes, Obesity, Adult Risk Factors, Childhood Conditions

		Colombia Bogotá	Mexico Urban	S Africa Urban	England	United States
Hypertension	L	1.09	0.96	1.14	1.15	1.36***
	H	0.86	0.57*	1.59	0.82*	0.94
Diabetes	L	1.03	1.05	0.64*	1.40*	1.38***
	H	0.69*	0.64	1.21	0.96	0.93
Obesity	L	0.92	0.77	0.48***	1.54***	1.38***
	H	0.85	0.55*	2.72***	0.93	0.82*
Smoker	L	1.10	1.10	1.86***	1.89***	1.33***
	H	0.79	0.82	0.45	0.73*	0.57***
No Vigorous Exercise	L	1.78*	0.64*	0.78	1.61***	1.36***
	H	0.65*	0.43**	0.92	0.77*	0.95
LT 2 Fr/Veg Daily	L	1.64***	1.42**	2.29***		
	H	0.49***	0.81	0.35*		
Low Height	L	1.80***	1.79***	1.16	1.70***	1.49***
	H	0.77	0.78	0.92	0.83	0.85

Source. SABE Bogotá; SAGE-Mexico, urban dwellers; SAGE-South Africa, urban dwellers, African blacks and colored; ELSA-England; HRS-US.
Note: Shown are odds ratios by education group (low/high). Reference group is middle educational group. Models significantly differently from null model at $p <$ .001 for England and the United States; models also significant in other countries with some exceptions (see note in Supplementary Material). Models for diabetes for England and the United States use diabetes based on biomarkers; models using self-reported diabetes produced similar patterns and are not shown in table.
*$p < .05$; **$p < .01$; ***$p < .001$.

reduces the probability of reporting cancer by about 50% as compared to being in the highest SES group in Colombia. The predicted probability of respiratory disease (arthritis) for the lowest SES group in England is about two (1.3) times more than that of the highest SES group.

Risky Adult Behavior and Early Life Nutritional Status

We find strong gradients for smoking in South Africa, England, and the United States (Table 4). Strong gradients also appear for exercise in Colombia, England, and the United States but a reversal in low SES in Mexico and no significant gradient in South Africa. Strong gradients appear for consumption of fruits and vegetables across all middle-income settings. With the exception of South Africa, strong gradients appear for low height across all countries. South African urban residents follow similar patterns as South African urban blacks and colored; U.S. blacks show a sharp gradient for exercise but flatter gradients for smoking and height (Supplementary Table S1). Predicted probabilities show a weak gradient for exercise across all countries with the exception of the United States. The sharpest gradients for smoking and consumption of fruits and vegetables appear in South Africa and for low height in Colombia (Supplementary Table S3). The predicted probability of being a current smoker (poor diet) for the lowest SES group is more than three (almost 5) times that of the highest SES group in South Africa. The predicted probability of short height for the lowest SES group is over two times that of the highest SES group in Colombia.

Discussion

We examined the SES health gradient using education for an extensive group of health outcomes and risky adult behavior in three middle-income urban settings, benchmarking with England and the United States within the framework of the demographic and nutritional transitions of the 20th century. High-income countries consistently showed strong gradients for health in the expected direction (low SES predicts poor health) whereas mixed patterns appeared in middle-income countries. The sharpest gradients appeared mostly in middle-income countries but followed expected patterns found in the United States and England especially in health outcomes such as poor SRH, functionality, trouble walking, cognitive impairment, and depression; however, weaker gradients appeared for obesity, hypertension, diabetes, and other chronic conditions in Colombia and Mexico with reversals observed in South Africa. Reversal of the gradient appeared for cancer in Bogotá, England, and the United States. Strong disparities existed in risky health behavior related to diet and early life nutritional status in the middle-income settings.

The results contribute to expanding knowledge regarding cross-national comparisons of the SES health gradient in middle- and high-income settings. There have been few cross-national studies that examine the SES gradient across such a diverse group of health outcomes and risky health behaviors. The selection of urban populations in Colombia, Mexico, and South Africa is relevant given the increased prevalence of obesity and chronic conditions among older adults in the context of rapid demographic and nutritional transitions, increased urbanization, and high inequality. We

do not claim that our selection of middle-income countries is representative of other upper middle-income countries. However, the selected countries are comparable in terms their demographic, epidemiological, and nutritional transitions and level of national income. The comparison with United States and England provides the perspective of well-established patterns from developed countries, which experienced much earlier growth of the older adult population and associated chronic conditions.

We highlight four main points in regards to the SES gradient and health in middle-income countries. First, high level of inequality due to rapid urbanization is a relevant explanation for the sharpness of the gradient found in some health outcomes. Consistent with other studies in middle-income countries (Rosero-Bixby & Dow, 2009) and high-income countries (Banks et al., 2006), our study showed similar patterns in the expected direction for health such as poor SRH, cognition, depression, functionality, and trouble walking. However, the sharpest gradients appear in urban settings in middle-income countries. Sharper gradients are not surprising given that there are high levels of inequality found in urban settings in middle-income countries (World Bank Group, 2017a). Rapid urbanization accompanied the rapid demographic and nutritional transitions affecting middle-income countries (Flórez et al., 2016).

Second, the combination of rapid transitions, poor early life nutritional environment, social mobility, and an enriched nutritional environment later in life provides a pertinent explanation for the weaker gradients for obesity, diabetes, and hypertension in Colombia and Mexico. The sharp disparities in poor early life nutritional status and current diet suggest a history of poor nutrition among low SES groups. The argument for the switch in the gradient in health conditions such as obesity according to country-level gross national income (Monteiro et al., 2004) does not adequately explain the patterns encountered in obesity in the middle-income countries in our study.

The weaker gradient for obesity (particularly in Colombia and Mexico) and the differences noted in the gradient (particularly in South Africa) suggest multiple and opposing factors. The historical circumstances of cohorts born in the 20th century and characterized by increasing survivorship of poor early life conditions (Palloni & Souza, 2013) combined with uneven development affecting different SES groups and changes in food consumption is a plausible explanation for the weaker gradients. Both Colombia and Mexico experienced increased social mobility in the late 20th and early 21st century (Franco et al., 2007), potentially resulting in changes in food consumption characterized by higher consumption of saturated fats and processed foods and producing higher risk of obesity, diabetes, and hypertension. Older adults from cohorts of the 20th century with increased social mobility may be experiencing a mismatch in nutritional environment later in life (Bateson & Gluckman, 2011; Gluckman & Hanson, 2005) leading to higher risk of disease. In contrast, those in the lowest SES may not yet be experiencing large nutritional changes and not everyone in the highest SES may be better consumers of healthy food and value healthy behavior. Thus, even though the determinants of obesity, diabetes, and hypertension are different between groups (higher SES due to adult lifestyle and middle SES due to early life plus adult lifestyle), weaker gradients appear between middle and high SES groups.

The weaker gradients could partially reflect a weaker association among educational attainment in the selected middle-income settings. However, improved access to education among lower SES groups due to public policy is probably not a major confounding factor in explaining the gradient in settings such as Colombia and Mexico because strong gradients appear with other health outcomes such as cognitive impairment, depression, functionality, and poor SRH. On the other hand, weaker gradients could reflect the long-term negative consequences of economic inequality unique to segments of the South African population. Educational attainment for some segments of the South African population may not have resulted in increased wealth.

The coverage and quality of the health care system in countries such as Colombia, noted to have a good health system (World Health Organization, 2000), could provide an explanation for the weaker gradients. Better health observed in several health outcomes among Colombians due to a good health care system and better health across all SES groups would be an expected product of more equalized access to quality health care. However, similar results in the gradients appear for Mexico with a much lower rated health system. Additionally, studies from Costa Rica, which has a quality health system, showed reversals in the gradient for obesity and diet-related health conditions (Rosero-Bixby & Dow, 2009). Thus, better health care may not be the prime explanation for the observed weaker gradients.

Underestimation of health conditions due to self-reported health could partially explain the reasons for weaker gradients in chronic conditions in the middle-income countries (Vellakkal et al., 2015). However, in some settings, underestimation of chronic conditions, such as diabetes, produces reliable estimates of disease (Banks et al., 2006; Goldman, Lin, Weinstein, & Lin, 2003) and estimates of prevalence based on self-reported diabetes and diabetes based on biomarkers are very similar in Colombia (Vargas-Uricoechea & Casas-Figueroa, 2015). Access to quality health care can explain underestimation of chronic conditions. However, urban areas, which are more prone to better resources and health care, make it more likely that individuals are aware of their health, which suggests that underreporting may be less problematic in our study.

The reversal of the gradient for cancer in Colombia, England, and the United States points to the role of health education creating awareness of cancer risks in terms of early detection and diagnosis. Educational awareness provides a likely explanation for the reversal in developed world economies (Kinsey, Jemal, Liff, Ward, & Thun, 2008). In that

sense, the large metropolitan city of Bogotá exhibits a pattern similar to high-income countries although the sharper gradient indicates higher inequality in health education.

A third main point resolves around unique country histories. National context and differences in environmental factors matter in terms of interpreting cross national health patterns (Agyemang et al., 2010; Hebert et al., 1998). Explanations for the SES gradient are particularly complex in South Africa given its political and economic history (see Supplementary Material). South Africa is one of the most unequal societies in the world and income inequality is highest among South African blacks and colored (Bhorat et al., 2009; World Bank Group, 2017a). Our study showed a very high prevalence of obesity and reversals of the gradient for obesity, diabetes and trouble walking in South Africa similar to other studies (Alaba & Chola, 2014); obesity is a risk factor for diabetes and difficulty with functionality (Kuh & Ben-Shlomo, 2004). Costa Rica also showed a reversal in the SES gradient for obesity (Rosero-Bixby & Dow, 2009), but the likelihood of being obese among high SES groups is much greater among South African blacks/colored. The sharp SES disparity in obesity and higher prevalence of obesity in South Africa could thus indicate the added impact of difficult economic conditions experienced by the cohort of African black and colored populations born before the 1950s. As a result, even in a middle-income country, circumstances for a subgroup of the population may be similar to that of low-income countries, where the poorest experience food shortages and the richest have access to excess food and live a more sedentary lifestyle leading to the reversal of the gradient (Dinsa et al., 2012). The sharp gradient for consumption of fruits and vegetables in South Africa—double that of Colombia and Mexico—suggests the merit of this argument.

The legacy of South Africa's unique historical circumstances also provides explanations for the nonsignificance of the gradient in some aspects of health. Education may not be the best indicator of SES for older adult African blacks and colored born in the 20th century (Beinart & Dubow, 1995). Even though some cross-national studies suggest that education alone is a good indicator of SES for older adults (Goldman et al., 2011), multiple measures of SES may be more appropriate (Banks et al., 2006; Rosero-Bixby & Dow, 2009). Although our classification of education is very similar to that used by SAGE researchers (Vellakkal et al., 2015), and we follow other studies in classifying education into three categories (Banks et al., 2006; Rosero-Bixby & Dow, 2009), it may be that this grouping does not sufficiently distinguish inequality in South Africa.

Admittedly, the sample size is smaller for urban South African blacks and colored but we observe similar patterns when we examine both urban and rural residents (results available upon request). Thus, sample size alone cannot explain the patterns observed. Explanations for the gradient in some aspects of health may not be unique to South Africa as other SAGE middle-income countries, for example, also show no education effects for depression (Anand & Phil, 2014). Although higher educational levels tend to engage in moderate or rigorous exercise (Malambo, Kengne, Lambert, De Villiers, & Puoane, 2016), it may that our measure of exercise (rigorous exercise) does not adequately distinguish between SES groups for older adults.

A final main point is in regard to obesity. While sharp disparities in risk factors, such as smoking in South Africa, carry risks for health, it is not yet clear the degree to which the increasing prevalence of obesity will affect the SES gradient in middle-income countries. Obesity is an important risk factor for chronic conditions (Kuh & Ben-Shlomo, 2004) and other aspects of health such as cognition, depression, functionality. The large increase in obesity is a relatively recent phenomenon among older adults in middle-income countries. It may be too early to determine the impact of increasing obesity on the SES gradient for other aspects of health. The increasing prevalence of obesity in these populations ultimately may produce mixed patterns in the SES gradient in these other aspects of health.

There are limitations to our study. First, cross-national comparisons require comparable measures of health and SES, which is not always possible in surveys of older adults. Having comparable measures for household wealth and health prevention, while enriching our study, was not possible given differences among surveys. There were no biomarkers for consumption of foods high in saturated fat in the middle-income settings. Second, cross-national comparisons are not precise due to country differences, which are often not measurable in surveys of older adults. Third, the meaning of educational attainment differs across countries signaling caution when making comparisons. Fourth, we used the legal definition of urban dwellers in the SAGE survey for Mexico and South Africa, making a direct comparison with older adults living in the capital city of Bogotá, Colombia not feasible.

In spite of these limitations, rapid demographic and nutritional transitions, poor early life conditions, social mobility, an enriched nutritional environment later in life, negative health behavior, urbanization, and unique country circumstances provide a useful framework for understanding the SES gradient for health in middle-income countries. Given the importance of obesity as a risk factor, monitoring changes in the SES health gradient in related aspects of health in middle-income countries continues to be relevant.

Supplementary Material

Supplementary data is available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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Conflict of Interest

None reported.

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