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The Association between Socioeconomic Status and Obesity in Peruvian Women

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Abstract

Historically in developing countries, the prevalence of obesity has been greater in more advantaged socioeconomic groups. However, in recent years the association between socioeconomic status (SES) and obesity has changed and varies depending on the country's development stage. This study examines the relationship between SES and obesity using two indicators of SES: education or possession assets. Using the cross-sectional 2008 National Demographic and Family Health Survey of Peru (ENDES 2008) we investigated this relationship in women aged 15 to 49 years living in rural and urban settings. Descriptive, linear and logistic regressions analyses were conducted accounting for the multi-staged nature of the sampling design. The overall prevalence of obesity in this study was 14.1% (95%CI: 13.3–14.8); 8.4% (95%CI: 7.5–9.3) in rural areas and 16.2% (95%CI: 15.2–17.2) in urban areas. Wealthier women were more likely to be obese, and this association was stronger in rural areas. Conversely, more educated women were less likely to be obese, especially in urban areas. The distribution of obesity in Peruvian women is strongly related to socioeconomic position, and differs whether measured as possession assets or by level of education. These findings could have important implications for policy development in Peru.

INTRODUCTION

Low- and middle-income countries, such as those in Latin America, are undergoing a rapid epidemiological and nutritional transition. Typically, the factors responsible for this shift are urbanization, changes in dietary patterns and reduction of physical activity, resulting in increased rates of obesity (1–5).

In a 1989 review comparing the association between socioeconomic status (SES) and obesity, Sobal et al. found that women with higher SES were less likely to be obese in developed societies; whereas the opposite relationship was observed in developing countries (6). In a recent update of this review (7), the association between indicators of SES (education and material possessions) and Body Mass Index (BMI) varied depending on the socioeconomic development of the country. Comparing low-, middle- and high-income countries, defined using the human development index, McLaren found the association with

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DISCLOSURE

The authors declared no conflict of interest.

socioeconomic indicators and obesity was mostly positive in low- and middle-income countries, and largely negative in high-income countries (7).

The relationship between obesity and SES in developing countries has been extensively investigated. For example, in urban China, higher household income was associated with higher obesity risk, whereas women with higher education had a reduced risk of obesity (8). On the other hand, both higher education and income have been described to be associated with increased obesity rates in Bangladesh and India (9, 10). In a nationally representative sample of Indian subjects, which included both rural and urban groups, obesity rates were higher in women who were wealthier, and greater as the level of urbanization increased (10). In some Latin American countries, higher education levels have been found to be associated with decreased odds of obesity (11, 12).

The results from a Brazilian study suggest that there may be within country variation in the association between SES and obesity (12). Monteiro et al, found the odds ratios for obesity were greater in individuals with higher incomes in disadvantaged region (12). Furthermore, women with greater education levels were less likely to be obese, and this effect was stronger in more developed region. In addition, a study in Mexico examined the relationship in poor rural regions, and found that higher socioeconomic status was associated with higher odds of obesity (13). However, in another analysis of the entire Mexican population (14), Barquera et al. reported less obesity in higher socioeconomic groups. These results suggest the relationship between SES and obesity may not be uniform between Latin American countries and even within each country.

Peru is at a relatively early stage of the nutrition transition, with obesity rates for Peruvian woman showing an increase from 9% in 1991 to 11% in 2005 (15). The prevalence of chronic non-communicable diseases, based on self-report surveys considering hypertension, diabetes, asthma and other conditions together, has increased from 20.5% in 2005 to 25.4% in 2009 (16). In one Peruvian study, conducted in six cities, higher SES was associated with greater obesity in women (17). In the same population, higher education was associated with a lower likelihood of obesity, although this relationship was attenuated in the adjusted models. The current study expands and further explores the relationship between SES and obesity in Peru using a nationally representative household survey of women aged 15 and 49 years.

METHODS AND PROCEDURES

Study design and population

Cross-sectional data were analyzed from the Peruvian National Demographic and Family Health Survey (ENDES Linea de Base 2008) (18), conducted by the National Institute of Statistics and Informatics (INEI). This survey is a national multi-staged random sample of women aged 15 to 49 years and children aged 0–5 years. In the rural areas, primary sampling units were villages of 500–2,000 people and secondary sampling units were households within each of these villages. In the urban areas sampling units consisted of blocks or groups of blocks with more than 2,000 people, and an average of 100 houses and secondary sampling units were the same as in rural settings. The sample provides information on various demographic and health characteristics and includes objective anthropometric measures. Originally, the sample consisted of 31,911 women. Height and weight measurements were not available for 8,645 women, and therefore excluded from this analysis. In addition pregnant women (n=1,102), and foreigners (n=13) were excluded, thus leaving 22,151 subjects available for analyses.

BMI, defined as weight in kilograms divided by height in meters squared (Kg/m^2), was used to create the main outcome variable. Weight was measured to the nearest 0.1Kg with participants wearing light clothing and without shoes. Height was measured to the nearest 0.1cm. According to international standards (19, 20) overweight and obesity were defined as BMI ≥ 25 and $<30 \text{ Kg/m}^2$; and $\geq 30 \text{ Kg/m}^2$, respectively. Normal weight was defined as BMI between 18.5 to 24.9 Kg/m^2 , and underweight as BMI below 18.5 Kg/m^2 .

Independent variables

The main exposure variable, SES, was defined as two indicators, expressed as quartiles: possession assets index and educational level. The possession assets index variable was constructed by the INEI using factor analysis (21). We subsequently categorized this variable into quartiles separately for rural and urban areas, and then combined into a single variable. Similarly, education level, based on the number of years of education attained, was also categorized separately into quartiles for rural and urban areas, and merged into a single variable. Covariates for multi-variable analyses included: age groups (15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49 years), place of residence (rural or urban), and language spoken most frequently at home (Spanish or non-Spanish) as a proxy for ethnicity.

Statistical Analysis

Descriptive, univariable and multivariable analyses were conducted using survey weights (svy command) to account for the multi-staged nature of the sampling design with the statistical program STATA version 10 (STATA Corp, College Station, TX, US). Independent effects of possession assets and education on the association with BMI, overweight and obesity were evaluated using linear and logistic regressions, respectively. β coefficients and odds ratios, with 95% confidence intervals (95%CI), are presented. Interactions between the main exposures and residence were tested because of a priori evidence of within country differences; stratified results are presented where appropriate.

RESULTS

The average age of women in the ENDES survey was 30.6 years ($\text{SD} \pm 10.1$). Mean BMI was 25.5 Kg/m^2 (95%CI 25.4–25.6); 24.7 (95%CI 24.6–24.9) in rural areas and 25.8 (95%CI 25.6–25.9) in urban areas. The overall prevalence of obesity in this study was 14.1% (95%CI 13.3–14.8); 8.4% (95%CI 7.5–9.3) in rural areas and 16.2% (95%CI 15.2–17.2) in urban areas.

Study population characteristics

The sample of the population missing anthropometric data was not different from the sample used in this analysis (Table 1). Table 2 displays the prevalence of underweight, normal weight, overweight and obese women by key demographic and socioeconomic characteristics. The most advantaged women, defined as those in the highest quartile of possession assets index, had the highest prevalence of obesity. In terms of educational attainment, however, there was a tendency towards a pattern in the opposite direction. The prevalence of obesity also increased with increasing age, and was greater in urban populations.

Association between SES and obesity

Table 3 presents the relationship between SES and BMI, as a continuous outcome. Compared to the lowest possession assets quartile BMI was 0.6 to 0.7 units greater in the higher quartiles. The opposite pattern was observed for education quartiles, that is, those with higher educational attainment had a BMI 0.4 to 1 Kg/m^2 units lower than the lowest

education quartile. Rural residents and non-Spanish native speakers also had lower BMI than their respective counterparts.

Logistic regression analyses are presented in Table 4. There was evidence of a strong association between household possession assets index and overweight and obesity, and this association was stronger in adjusted models. In the adjusted models and compared to the bottom possession assets quartile, wealthier women were 30–40% more likely to be overweight and 80–100% more likely to be obese.

On the other hand, there was also strong evidence of a negative association between educational attainment and overweight or obese status, the higher the educational attainment the less likely to be overweight or obese. These associations were somewhat attenuated in the adjusted models but remained significant (Table 4). We did not observe an interaction between possession assets and education.

Rural vs. Urban settings

Further analysis identified a significant interaction between residence (rural or urban) and both household possession assets index and level of education ($p < 0.0001$). These stratified results are presented in Tables 5a and 5b.

The positive association between possession assets index and anthropometric indicators was greatest in rural residents, with twice the odds for being overweight and up to 5 times the odds of being obese in the highest possession assets quartile. In the urban setting, following adjustment for potential confounders, the association between possession assets index and overweight did not change. This association, however, was strengthened and became significant in obese women in the third and top quartiles of possession assets index.

In the case of education, the analysis by place of residence showed a different pattern. In rural settings, there was no evidence of an association between education and overweight or obesity. However, in urban areas women with higher levels of education were less likely to be overweight and also less likely to be obese. In urban models, the relationship between education and obesity was somewhat strengthened after adjusting for confounders; and women with higher education were 70% less likely to be obese compared to urban women with lower educational attainment.

DISCUSSION

Obesity poses a considerable health burden in Peru, and the prevalence has grown from 9.4% in 1996 (22), to 14.1 % in 2008. This study demonstrates that SES, measured as education and possession assets index, is an important predictor of obesity in Peru and the directionality of the association differs depending on the SES indicator used. Furthermore, this association varies depending on the level of urbanization within the country. Overall, higher possession assets and lower education levels were associated with greater odds of obesity. These associations with obesity were strongest for possession asset index in rural areas, and for both, possession assets and education, in urban settings.

Our findings for possession assets association with obesity based on ENDES 2008 survey are similar to results from India, China, Cameroon and Brazil (8, 10, 12, 23). Furthermore, our results are consistent with Jacoby et al. (17), who also evaluated SES and obesity in a smaller Peruvian population and observed that higher possession assets were associated with greater obesity. Monteiro et al., suggested that in countries with a gross national per capita income (GNI) greater than \$2,500 the odds of obesity is greatest in the poorest populations. During the period of the survey Peru was considered as an upper middle-income country by

the World Bank, thus, we expected greater obesity in poorer populations. Our results are contrary to a study conducted in Argentina, which found the opposite associations where both income and education were inversely associated with obesity in women (24), demonstrating different directions of the association between SES indicators and obesity among South American countries. These differences could be due to different socioeconomic development in different regions or to methodological differences.

Education was an important factor for obesity in our study population; specifically, higher education was associated with a lower likelihood of obesity. These findings are similar to other studies conducted in developing countries (8, 12, 25, 26), but not all (10, 23, 24). In particular, the results from the ENDES 2008 analysis are consistent with the study by Jacoby et al (17), which also found a negative association between education and obesity in Peruvian women, but not in men. The discordant results with other studies may reflect the fact that different countries are at different stages of the nutritional transition. This assumption is consistent with a multi-national study of women from 37 developing societies, which found SES, measured by education, showed a positive association with obesity in low-income countries, but a negative association in upper- to middle-income economies (27). Furthermore the discordant results could reflect different standards of education, or definitions of educational attainment used in each study. A recent study pooling 54 demographic and health survey datasets, similar to the ENDES, from low- and middle-income countries, demonstrated a positive association between socioeconomic status and BMI or overweight (28). In this global analysis, the authors found a positive association for both, household wealth –similar to our possession assets index approach- and educational level with the likelihood of being overweight (defined as $BMI > 25 \text{ Kg/m}^2$) (28). While in global pooled analyses that may be case, our results at the national level and separately for overweight and obesity showed that the direction of such association is not necessarily the same. As such, our work further disentangles the complexities of relying on a single indicator as a proxy for SES in countries low- and middle-income countries currently undergoing through different socioeconomic transitions.

Within-country analysis, comparing rural and urban settings, revealed that the association between possession assets index and level of education differed in rural and urban areas. Specifically, women living in rural areas, which are typically more disadvantaged, were more likely to be obese if their possession assets were greater. Our results are similar to studies conducted in poor and rural areas of Mexico and disadvantaged populations in Brazil (12, 13). In the current study, there was an inverse association between education and obesity in women who live in urban areas (an economically advantaged group compared to rural settings). These results are consistent with findings from a Brazilian study which found women from more developed regions had lower odds ratio of obesity (12). In contrast, results from rural Mexico demonstrated a positive association between education and obesity (13). These contradictory results may reflect the diverse effect of education in different societies. Given Peru's higher obesity rates compared to other Latin American countries (11), improving education levels may be an important strategy and target for interventions, which in turn could improve nutrition in rural Peru.

The ENDES survey is a large and representative national survey of Peruvian women, and therefore our results are generalizable across the country. However, the sample is limited to women, and given the sex differences observed in other studies (8, 12, 24, 29), further studies in males are needed. Additionally, the sample is cross-sectional and consequently it is not possible to infer causal relationships. The survey is also limited because it does not measure other important factors which are known to contribute to obesity such as, physical activity (30, 31), television viewing habits (32, 33), dietary patterns (13, 34), health knowledge (1, 17), and acculturation (35), among others.

While this study contributes important information regarding nutrition and obesity in Peru, further studies are required to investigate the effects of migration on the development of obesity, particularly because Peru has undergone unique migration patterns over the past 30 years. A comparison of the relationship between SES indicators and obesity across different survey years of the ENDES may provide more evidence and understanding of how this relationship has evolved over time.

This secondary analysis of the ENDES survey, suggests intervention strategies need to consider that different risk factors may be important in different regions of the country. Improving education levels, particularly in wealthier women living in rural areas, may be an important strategy and target for interventions and could make better use of the scarce resources available for the prevention and treatment of obesity and other non-communicable diseases.

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Table 1

Characteristics of participants by body mass index (BMI, Kg/m²) data availability, ENDES Peru 2008.

	With BMI data (%)	Missing BMI (%)	p-value ^a
Possession assets	N=23,252	N=8,199	
1 st bottom	19.3	21.0	0.66
2 nd	23.0	22.0	
3 rd	26.2	26.2	
4 th top	31.5	30.9	
Education	N=23,252	N=7,930	
1 st bottom	28.6	27.9	0.91
2 nd	35.1	34.8	
3 rd	19.6	20.1	
4 th top	16.7	17.2	
Age	N=23,252	N=7,930	
15–19	19.0	18.3	0.14
20–24	15.2	15.2	
25–29	15.2	13.7	
30–34	14.4	14.9	
35–39	13.4	13.2	
40–44	12.1	13.5	
45–49	10.8	11.1	
Residence	N=23,252	N=8,635	
Urban	72.3	74.8	0.34
Rural	27.7	25.2	
Language spoken at home	N=23,249	N=7,928	
Spanish	91.2	90.6	0.92
Quechua	7.4	8.2	
Aymara	1.0	1.0	
Other	0.3	0.2	

^aDifferences were determined using Chi-square test.

Table 2

Characteristics of the study population by nutritional status, ENDES Peru 2008.

	N (%)	Underweight (%)	Normal Weight (%)	Overweight (%)	Obese (%)	p-value ^d
	22,151	N=439	N=11,113	N=7,503	N=3,096	
Possession assets						
1 st bottom	5,540	1.5	55.1	32.6	10.8	
2 nd	5,540	1.8	48.1	35.3	14.8	
3 rd	5,540	1.7	49.6	33.8	14.9	<0.005
4 th top	5,531	2.2	48.4	34.4	15.0	
Missing	0					
Education						
1 st bottom	6,736	1.4	42.2	36.6	19.8	
2 nd	7,440	2.2	51.7	33.8	12.3	
3 rd	2,513	3.2	59.1	29.4	8.3	<0.0001
4 th top	5,462	1.3	52.6	33.6	12.5	
Missing	0					
Age						
15–19	4,278	5.1	74.5	17.8	2.4	
20–24	3,334	2.6	63.9	28.3	5.2	
25–29	3,241	1.3	53.2	34.8	10.7	
30–34	3,136	0.6	44.2	40.4	14.8	
35–39	3,031	0.5	36.4	42.1	21.0	<0.0001
40–44	2,747	0.6	30.6	42.6	26.2	
45–49	2,384	0.4	30.8	41.3	27.5	
Missing	0					
Residence						
Urban	14,436	2.0	46.8	35.0	16.2	
Rural	7,715	1.6	58.3	31.7	8.4	<0.0001
Missing	0					
Language spoken at home						

	N (%) 22,151	Underweight (%) N=439	Normal Weight (%) N=11,113	Overweight (%) N=7,503	Obese (%) N=3,096	p-value ^a
Spanish	19,802	1.9	49.1	34.3	14.7	
Non-Spanish	2,346	0.8	60.1	31.7	7.4	<0.0001
Missing	3					

^aCalculated using Chi-square test.

Table 3

The relationship between socioeconomic status indicators and BMI (Kg/m²), ENDES Peru 2008.

	Univariable N=22,151		Multivariable ^a N=22,148	
	β	95%CI	β	95%CI
Possession assets				
1 st bottom	--		--	
2 nd	0.5	(0.2; 0.8)	0.6	(0.3; 0.8)
3 rd	0.5	(0.2; 0.7)	0.6	(0.3; 0.8)
4 th top	0.6	(0.3; 0.9)	0.7	(0.3; 1.0)
Education				
1 st bottom	--		--	
2 nd	-1.1	(-1.3; -0.9)	-0.4	(-0.7; -0.2)
3 rd	-1.9	(-2.2; -1.6)	-0.7	(-1.0; -0.4)
4 th top	-1.0	(-1.2; -0.7)	-1.0	(-1.3; -0.7)
Age				
15-19	--		--	
20-24	1.3	(1.1; 1.5)	1.4	(1.1; 1.6)
25-29	2.4	(2.1; 2.6)	2.5	(2.3; 2.8)
30-34	3.3	(3.0; 3.5)	3.4	(3.1; 3.6)
35-39	4.1	(3.8; 4.5)	4.2	(3.9; 4.6)
40-44	4.8	(4.5; 5.1)	4.8	(4.5; 5.1)
45-49	5.0	(4.7; 5.4)	5.0	(4.6; 5.3)
Residence				
Urban	--		--	
Rural	-1.0	(-1.2; -0.8)	-0.9	(-1.1; -0.6)
Language spoken at home^b				
Spanish	--		--	
Non-Spanish	-0.9	(-1.2; -0.6)	-0.7	(-0.9; -0.4)

^a Adjusting for age, place of residence (rural/urban), language spoken at home (Spanish/Non-Spanish), and possession assets or education where appropriate.

^b Sample for analyses was N=22,148 in the crude model.

Association between socioeconomic status indicators and overweight and obesity, ENDES Peru 2008.

Table 4

	Overweight* 25 Kg/m ² BMI <30 Kg/m ²				Obese* BMI 30 Kg/m ²			
	N=18,616 Univariable		N=18,613 Multivariable ^a		N=14,209 Univariable		N=14,207 Multivariable ^a	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Possession assets								
1 st bottom	1		1		1		1	
2 nd	1.2	(1.1; 1.4)	1.4	(1.2; 1.6)	1.6	(1.3; 1.9)	1.8	(1.4; 2.2)
3 rd	1.1	(1.0; 1.3)	1.3	(1.1; 1.4)	1.5	(1.2; 1.9)	1.9	(1.5; 2.4)
4 th top	1.2	(1.0; 1.4)	1.3	(1.1; 1.5)	1.6	(1.3; 1.9)	2.0	(1.5; 2.6)
Education								
1 st bottom	1		1		1		1	
2 nd	0.8	(0.7; 0.9)	0.9	(0.8; 1.0)	0.5	(0.4; 0.6)	0.7	(0.6; 0.8)
3 rd	0.6	(0.5; 0.8)	0.8	(0.6; 1.0)	0.3	(0.2; 0.4)	0.5	(0.4; 0.6)
4 th top	0.7	(0.6; 0.8)	0.6	(0.5; 0.7)	0.5	(0.4; 0.6)	0.4	(0.3; 0.5)

^aAdjusted for age, place of residence (rural/urban), language spoken at home (Spanish/Non-Spanish), and education or possession assets where appropriate.

^bPopulation in obese analyses was N=14,207 in the crude model.

^cPopulation in overweight analyses was N=18,613 in crude model.

* Baseline group defined as BMI between 18.5 to 24.9 Kg/m².

Association between socioeconomic status indicators and overweight and obesity in rural settings, ENDES Peru 2008.

Table 5a

	Overweight				Obese			
	N=6,886		N=6,885		N=5,127		N=5,126	
	Crude ^a	Adjusted ^b	Crude ^a	Adjusted ^b	Crude ^a	Adjusted ^b	Crude ^a	Adjusted ^b
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Possession assets								
1 st bottom	1		1		1		1	
2 nd	1.3	(1.0; 1.5)	1.3	(1.0; 1.6)	2.6	(1.8; 3.6)	2.6	(1.8; 3.6)
3 rd	1.4	(1.1; 1.7)	1.4	(1.1; 1.7)	3.4	(2.4; 4.9)	3.5	(2.5; 5.0)
4 th top	2.1	(1.6; 2.6)	2.0	(1.5; 2.5)	6.0	(4.2; 8.6)	5.8	(3.9; 8.7)
Education								
1 st bottom	1		1		1		1	
2 nd	1.0	(0.8; 1.2)	1.0	(0.8; 1.1)	1.1	(0.8; 1.5)	0.8	(0.6; 1.0)
3 rd	1.1	(0.8; 1.4)	1.1	(0.8; 1.4)	2.2	(1.5; 3.3)	1.3	(0.9; 2.0)
4 th top	0.8	(0.6; 1.1)	0.8	(0.6; 1.0)	1.7	(1.1; 2.6)	0.8	(0.5; 1.2)

^a Adjusted for age.

^b Adjusted for age, language spoken at home (Spanish/Non-Spanish), and education or possession assets, where appropriate.

Association between socioeconomic status indicators and overweight and obesity in urban settings, ENDES Peru 2008.

Table 5b

	Overweight				Obese			
	N=11,730	N=11,728	N=9,082		N=9,081	N=9,081		
	Crude ^a	Adjusted ^b	Crude ^a		Adjusted ^b	Adjusted ^b		
	OR	95%CI	OR	95%CI	OR	95%CI	OR	
Possession assets								
1 st bottom	1	1	1	1	1	1	1	
2 nd	1.5	(1.2; 1.7)	1.5	(1.2; 1.8)	1.5	(1.2; 1.9)	1.8	
3 rd	1.2	(1.1; 1.4)	1.3	(1.1; 1.5)	1.2	(0.9; 1.6)	1.7	
4 th top	1.2	(1.0; 1.5)	1.2	(1.0; 1.5)	0.9	(0.7; 1.2)	1.7	
Education								
1 st bottom	1	1	1	1	1	1	1	
2 nd	0.9	(0.7; 1.0)	0.9	(0.7; 1.0)	0.7	(0.6; 0.9)	0.6	
3 rd	0.7	(0.5; 0.9)	0.7	(0.5; 0.9)	0.4	(0.3; 0.5)	0.3	
4 th top	0.5	(0.4; 0.6)	0.5	(0.4; 0.6)	0.4	(0.3; 0.5)	0.3	

^a Adjusted for age.
^b Adjusted for age, language spoken at home (Spanish/Non-Spanish), and education or possession assets, where appropriate.