Contribuição Internacional

Socioeconomic factors and adult body composition in a developing society

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Abstract

Objective: To examine socioeconomic variables in relation to three indices of adult body composition: the body mass index; and, percent body fat and lean-to-fat body mass ratio, both derived from bioelectric impedance analysis.

Purpose: To investigate the relationship between obesity and socioeconomic variables in a developing country.

Research methods and procedures: A cross-sectional survey of four neighborhoods differing in socioeconomic status. A random sample of 304 healthy adults, 181 females and 123 males, age range 18-78. Body composition was measured with the body mass index derived from height and weight, and the assessments of percent body fat and the ratio of lean-to-fat body mass derived from bioelectric impedance analysis.

Results: Using a linear model with age as a covariate and sex as an additional factor, there were significant interaction effects between sex and socioeconomic group for all three of the body composition variables ($p < 0{,}005$). Analysis of trends within sex revealed primarily a linear association between socioeconomic group and body composition for males ($p < 0, 001$), and a curvilinear association between socioeconomic group and body composition for females ($p < 0{,}03$).

Discussion: The association of socioeconomic status and body composition is significant for males and females, but the pattern of the association varies by gender. It is argued that these results can be explained by three processes: socioeconomic differences in caloric demands of labor; socioeconomic differences in the social value attached to food; and, gender differences in standards of physical attractiveness.

Keywords: Prevalence of obesity; Socioeconomic status; Developing country; Body composition; Body fat.

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Introduction

A variety of studies have demonstrated an association between socioeconomic variables and adult body composition. The best known of these studies are between socioeconomic status and rates of obesity (usually defined as 120% of ideal body weight), as summarized in the review article by Sobal and Stunkard[1] and in the recent collection by de Garine and Pollock[2]. In industrialized or developed societies, there is an inverse association between socioeconomic status and obesity. In developing societies, there appears to be a direct association between socioeconomic status and obesity[1]. This is consistent with the large body of literature showing a direct association between exposure to modernizing influences within developing societies and increases in body mass[3]. Understanding the transition from a direct association between socioeconomic status and body mass in developing societies to the inverse association in developed societies may be helpful in ultimately explaining the etiology of obesity.

When patterns are examined more closely within developing societies, more complicated patterns can emerge. For example, a study from Brazil showed that the prevalence of adult obesity (as measured by a high body mass index) had increased significantly over time (the years between 1974 and 1989), and that the distribution depended on a variety of other factors, including region of the country (higher in the more developed south of the country), community of residence (higher in urban areas), and income (increased with increasing income)[4]. Also, the prevalence of obesity had increased more among males than among females. An earlier study of schoolchildren in Brazil showed that the distribution of obesity (defined as high weight for height) and the distribution of malnutrition (defined as low weight for height) were associated with socioeconomic status in opposite directions: obesity increased with increasing socioeconomic status and malnutrition decreased with increasing socioeconomic status[5]. What is noteworthy about this latter study is that these associations were demonstrated within a single community, the city of Ribeirão Preto in the state of São Paulo.

In a developing society like Brazil, in which the extremes of industrial affluence and impoverished underdevelopment exist side-by-side, a focused study of adult body composition may provide some clues to a better understanding of the social patterns of obesity. In the remainder of this paper a study will be described that examined socioeconomic variables in relation to three indices of adult body composition: the body mass index; and, percent body fat and lean-to-fat body mass ratio, both derived from bioelectric impedance analysis.

The research was conducted in Ribeirão Preto is a city of approximately 500,000 people in the interior of the state of São Paulo in the industrial south of Brazil. The city has served as a center for commerce and finance for the area, and more recently as a center for light manufacturing.

In order to sample the full range of economic contrasts in the city, careful attention was paid to the selection of four neighborhoods for intensive study. The first neighborhood, or *favela*, is a squatter settlement made up both of migrants from other areas and of local persons at the lowest socioeconomic level. Persons in the *favela* are employed as agricultural laborers and in other forms of unskilled labor such as construction of domestic employment. The second neighborhood is a type of planned community known as a *conjunto habitacional*. This is an area of low-cost housing for stably employed, working-class families. In this neighborhood, persons are employed in skilled trades or in occupations such as a bus driver.

The third neighborhood is a traditional middle-class neighborhood in the city. Residents have varied occupations, including school-teachers, owners of small businesses, and mid-level supervisors. The fourth neighborhood is an upper-middle class development that caters to professionals (physicians and attorneys) and to the owners and managers of large factories and businesses. By paying careful attention to the cultural and socioeconomic characteristics of these neighborhoods, it was possible to sample a large range of variation in lifestyles in the city. A more complete description can be found in Dressler, Santos and Balieiro[6] and Dressler, Balieiro and Santos[7].

Methods

A variant of cluster sampling was used here. The four neighborhoods (referred to henceforth as sites 1 through 4, corresponding to the order above) each served as a sampling cluster. In sites 2, 3 and 4, maps of occupied house lots were obtained from the municipality. Each house lot was assigned a number, and a simple random sample of 40 households from each site was obtained with a table of random numbers. In site 1 no maps were available; however, there was a community organization that maintained a listing of all households in the site, and a simple random sample of forty households was chosen from this list. Households as a unit were approached for participation in the study. Both head of household and spouse (if present), and one resident child over the age of 18, were invited to participate in the study. It was rare that individuals (as opposed to households) refused to participate in the study. When a household refused, a new one was substituted at random. The final participation rate was 68,5%. The final sample size consisted of 304 individuals; however, because of the number of interviews required from each respondent (see below), there were inevitable dropouts before the final, clinical data collection. Missing data reduce the final sample size to 256.

Four interviews were conducted with each individual. The first interview consisted of the collection of social and psychological data. The second and third interviews consisted of 24-hour dietary recalls. One recall was always carried out on a Monday, and the other was carried out on a day convenient for the respondent. The fourth interview consisted of the collection of a fasting blood sample, body composition data, and blood pressures.

Site of residence is used here as the socioeconomic variable. Because of the possibility raised in other studies that the relationships between body composition and socioeconomic status might differ for males and females, sex is included as a factor in analyses. Age in years is used a covariate throughout.

Height and weight were obtained at the final interview using clinically-sensitive equipment. Body mass index was calculated as weight (in kilograms) divided by height (in meters) squared. In the fasting state bioelectric impedance analysis was used to obtain estimates of percent body fat and ratio of lean-to-fat body mass for each individual[8].

Results

Table 1 shows descriptive statistics for the entire sample and for each site. As a demonstration of the validity of residence site as an indicator of socio-economic status, differences between sites in occupational status of the household head (assessed using a ranking of occupations developed in Brazil), educational attainment (assessed as grade level achieved), and monthly family income (converted to U.S. dollars) are shown. These differences are all highly statistically significant ($p < 0,001$).

Table 2 shows age-adjusted means for the body mass index, percent body fat, and lean-to-fat body mass ratio by site for males and females. These age-adjusted effects were tested using a general linear model, which showed significant main effects for age, sex and site for all three body composition variables ($p < 0,01$), with the exception of no significant main effect for sex on the body mass index. Additionally, the interaction effects between sex and site were significant for all three variables (for body mass index $F = 4,38$, $df = 3,251$, $p = 0,005$; for percent body fat $F = 4,39$, $df = 3, 247$, $p = 0,005$; and, for lean-to-fat body mass ratio $F = 9,67$, $df = 3,247$, $p = 0,0001$).

The relationships between site and body composition variables are shown separately for sex in figures 1-3. Visually there appears to be a curvilinear association between site and body composition for females, and a linear association between site and body composition for males. Linear and nonlinear trends were tested between site and body composition for males and females. These results are shown in table 3. For females, the association between site and all of the body composition variables is nonlinear (although the association does not quite

Table 1 – Descriptive statistics for sample [Mean (s.d.)]

Variable	Total sample (n = 304)	Site 1 (n = 83)	Site 2 (n = 75)	Site 3 (n = 73)	Site 4 (n = 73)
Sex (% male)	40	41	40	37	44
Age*	38,5 (12,5)	34,3 (12,0)	36,2 (10,3)	44,1 (13,5)	39,8 (11,9)
Occupation*	3,1 (1,5)	1,7 (0,9)	2,7 (0,9)	3,4 (1,2)	4,7 (0,9)
Education*	7,4 (5,6)	3,4 (1,7)	5,4 (3,5)	5,5 (4,1)	15,8 (2,8)
Income*	512,54 (180,9)	356,62 (160,1)	449,33 (134,9)	581,94 (142,7)	686,30 (180,9)

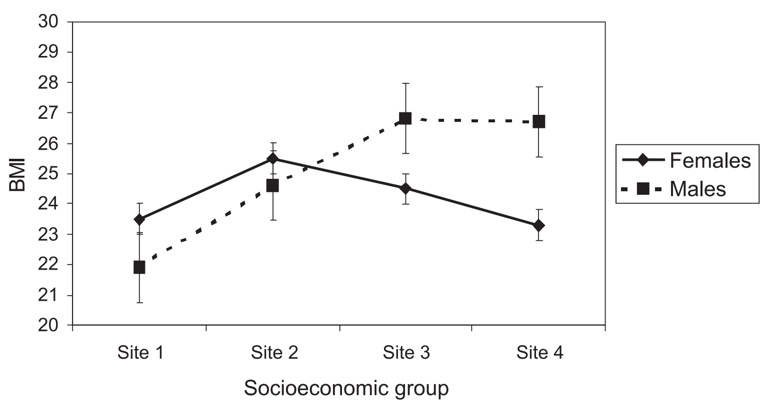
*Differences between sites statistically significant from oneway analysis of variance ($p < 0,001$).

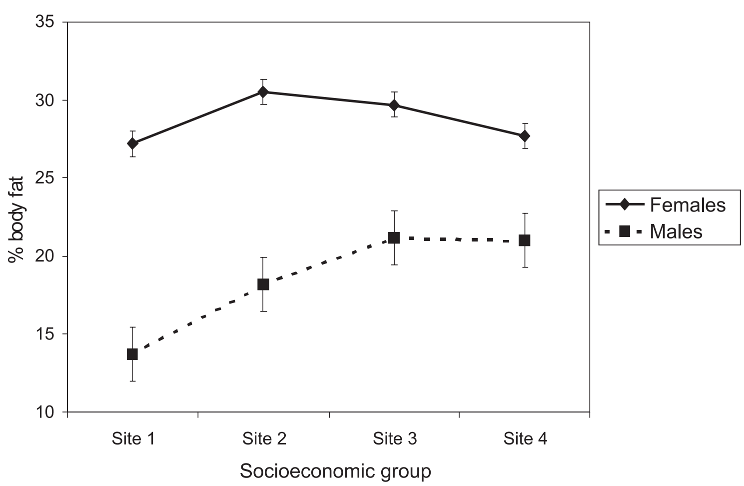
Table 2 – Body mass index (BMI), percent body fat (%fat), and lean-to-fat body mass ratio (L/F) by sex and site (age adjusted)

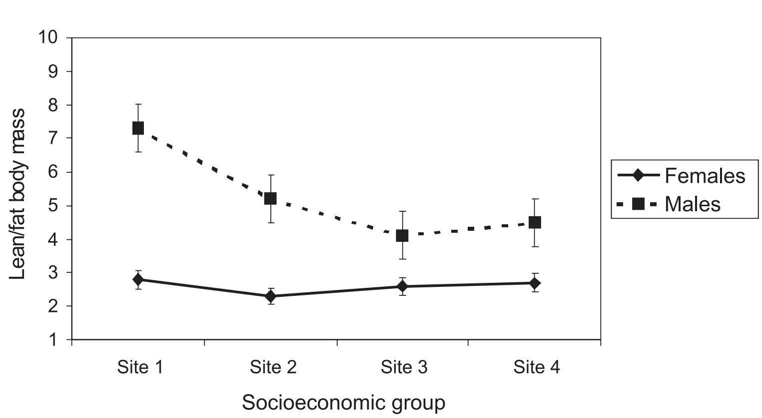
		Site 1	Site 2	Site 3	Site 4
	BMI	21,9 (±3,5)	24,6 (±4,5)	26,8 (±4,1)	26,7 (±5,2)
Males	%fat	13,7 (±5,6)	18,2 (±6,5)	21,2 (±5,7)	21,0 (±7,4)
	L/F	7,3 (±2,9)	5,2 (±2,2)	4,1 (±1,9)	4,5 (±2,3)
	BMI	23,5 (±4,0)	25,5 (±4,7)	24,5 (±5,8)	23,3 (±3,4)
Females	%fat	27,2 (±6,0)	30,5 (±5,2)	29,7 (±6,0)	27,7 (±5,1)
	L/F	2,8 (±1,3)	2,3 (±0,7)	2,6 (±0,7)	2,7 (±0,7)

Table 3 – Tests for linear and nonlinear trends by site within sex

Variable	Females	Males
Body mass index	Linear trend: F = 0,19, df = 1,152, n.s.	Linear trend: F = 17,9, df = 1,100, p = 0,001
	Nonlinear trend: F = 2,76, df = 2,152, p = 0,06	Nonlinear trend: F = 1,38, df = 2,100, n.s.
Percent body fat	Linear trend: F = 0,01, df = 1,149, n.s.	Linear trend: F = 18,3, df = 1,99, p = 0,001
	Nonlinear trend: F = 4,01, df = 2,149, p = 0,02	Nonlinear trend: F = 1,56, df = 2,99, n.s.
Lean-to-fat body mass	Linear trend: F = 0,87, df = 1,149. n.s.	Linear trend: F = 19,0, df = 1,99, p = 0,001
	Nonlinear trend: F = 3,68, df = 2,149, p = 0,02	Nonlinear trend: F = 3,23, df = 2,99, p = 0,04







achieve the conventional level of statistical significance for the body mass index). For males, there is a significant linear association between site and all of the body composition variables, although there is also a significant deviation from linearity for lean-to-fat body mass ratio.

Discussion

The aim of this paper has been to examine measures of adult body composition in a focused study in an urban community in Brazil. In prior research it has been shown that obesity is associated inversely with socioeconomic status in developed societies, and it is associated directly with socioeconomic status in developing societies. In many respects, however, the distinction of "developed" *versus* "developing" societies is too gross a characterization to be truly accurate in describing a society. Many societies, with Brazil prominent among them, have characteristics of the developed and the developing world. Consequently, the association of socioeconomic status and body composition may be more complex.

In the study reported here, neighborhood of residence was used as an indicator of socioeconomic status. This was justified by the extreme differences in occupational attainment, educational attainment, and income between the four sites. At the same time, residence can be regarded as a heuristic device in this regard, since the same results reported in this paper can be obtained by using any of the conventional measures of socioeconomic status to analyze the data.

Interaction effects were obtained between site and sex for each of the body composition variables. For females, there is an increase in the body mass index and percent body fat, and a decrease in the lean-to-fat body mass ratio, from the poorest to the intermediate socioeconomic groups; then, there is a decrease in the body mass index and percent body fat, and an increase in the lean-to-fat body mass ratio, from the intermediate to the wealthiest socioeconomic group. For males there is an increase in the body mass index and percent body fat, and a decrease in the lean-to-fat body mass ratio, from the poorest to the wealthiest socioeconomic groups. This increase tends to level off in the higher intermediate and wealthiest group.

Three factors may be responsible for this pattern: systematic differences in typical physical activity between the sites; differences in the social value associated with food between the sites; and, social values regarding physical attractiveness that differ for males and females. As noted above, the residents of the poorest socioeconomic group tend to be employed as unskilled laborers in agriculture and construction. In agriculture this consists of work on the local sugar plantations in the harvesting of cane. The caloric demands in this form of labor, as well as the caloric demands of construction work, are large[9]. In the intermediate and wealthy socioeconomic groups, the typical caloric demands of work are much lower. At the same time, the calories available to the workers differ significantly across the four sites. A thorough discussion of the dietary differences between sites would be beyond the scope of this paper; however, from the 24-hour recall results it was found that total caloric intake increased significantly for both males and females across the four sites after controlling for between-site differences in alcohol consumption. Adjusting for ethanol intake, the average daily caloric intake for males in the poorest group was 2,239 kilocalories, *versus* 2,419, 2,514, and 2,888 for the other three sites, respectively (corresponding averages for females were 1,432, 1,688, 1,936, and 1,872 kilocalories). The between-site difference is highly statistically significant ($F = 7{,}72$, $df = 3{,}264$, $p = 0{,}0001$). In short, the caloric demands are greatest on those males who have the least caloric intake to meet those demands.

At the same time, the social value of food differs between the four groups. In a companion study, women (n = 18) from each of the socioeconomic groups were interviewed regarding the social status of different foods[10]. This was a focused, ethnographic study in which women were interviewed in considerable detail about the status of foods, as well as the status associated with food use in different contexts (i.e. home preparation versus eating in restaurants), as well as the status associated with shopping in different kinds of establishments. In addition to open-ended interviewing, systematic ethnographic techniques were employed that can be used to test for overall consensus among the respondents, as well as for potential subgroup differences (see Romney, Weller and Batchelder[11] for a discussion of this technique). A pattern emerged in which women from the intermediate socioeconomic groups rated foods as higher in social status that are both high in fat and traditionally associated with affluence in Brazilian society, especially the consumption of beef in its traditional form known as *churrasco*. Other foods considered to be high status in these groups included heavily advertised fast foods such as pizza and soft drinks, all of which require a modicum affluence to consume. It was striking, however, that the highest socioeconomic level women tended to rate a different set of foods as having higher status, including such things as fresh fruits and vegetables and seafood.

The results of the focused study of the social value of food may help to explain the curvilinear pattern in socioeconomic status and body composition for females. As socioeconomic level increases beyond the poorest level, women are able to participate more in the traditional value system regarding foods, which means an increased intake of high fat foods such as beef and various forms of fast food. At the higher socioeconomic levels, however, there appears to be an adoption of a different model of food status, one that corresponds to that current in European and North American middle and upper classes for some time. In this model of food use, the healthfulness of foods with respect to the avoidance of chronic disease morbidity and the maintenance of ideal body weight have supplanted more traditional food values.

The only way this can truly explain the differences observed between males and females across socioeconomic levels, however, is to include one more factor: the different norms of physical attractiveness for males and females in Brazil. Sobal and Stunkard[1] discussed this factor at some length as a possible explanation for socioeconomic differences in obesity, and their arguments apply quite well to Brazil. The images that surround Brazilians of all socioeconomic strata regarding standards of physical attractiveness are rooted in the internationally-recognized images of the beaches of Rio de Janeiro. Women especially are expected to conform to the standard of the Brazilian girl on the beach. This emphasis increases for women in higher socioeconomic groups, because these women are the ones most likely to have the leisure time and the financial resources to actually partake of that lifestyle. The North American and European middle-class values associated with foods that can help one to maintain an ideal weight and physical fitness would thus appeal to Brazilian women in this group. There are certain kinds of pressures on men in upper socioeconomic groups to maintain an ideal weight and to remain fit, but these are not nearly as great as they are for women.

In conclusion, it was found in this study conducted in Brazil that adult body mass increased in association with socioeconomic status for men. For women, body mass increased with the change from poor to intermediate socioeconomic group, and then decreased with the increase from intermediate to wealthy socioeconomic group. For men, it was argued that this pattern could be explained by decreasing levels of occupationally-related physical activity along with increases in caloric intake. For women, it was argued that this pattern could be explained by increasing access to economic resources in combination with changing values attached to food and cultural values associated with physical attractiveness. This combination of biological and cultural factors may prove to be useful in accounting for the socioeconomic variation in adult body composition in other societies as well.

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