

## Obesity and undernutrition in a very-low-income population in the city of Maceió, northeastern Brazil

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Obesity is the nutritional disorder which has shown the greatest increase in prevalence, even in those countries in which deficiency diseases represent a severe public health problem. The goal of the present study was to analyse the anthropometric profile of a community living in the outskirts of Maceió, capital of Alagoas (northeastern Brazil), and to investigate the hypothesis of a coexistence of undernutrition and obesity in a very low-income population. The survey was conducted on 315 families (1247 individuals). Among the children (aged  $\leq 10$  years), the prevalence of wasting, stunting and wasting plus stunting was 3.8, 8.3 and 8.7 % respectively. Wasting (10.2 %) was the most prevalent form of undernutrition among adolescents; nonetheless, a higher frequency of stunting (11 %) and overweight–obesity (5.5 %) was seen specifically in girls, in agreement with trends found in other studies. Adults exhibited a high prevalence of overweight–obesity (25 %), but stunting was also present (22 %). Of the stunted individuals, 30 % were overweight–obese and 16.3 % were underweight. There were eighty-six families with at least one parent who was underweight (27 %) and 104 families with at least one parent who was overweight (33 %). Underweight and overweight–obesity were both present in ninety-six households (30 %). These results may indicate that better living conditions in urban areas in a population ‘adapted’ to chronic famine might increase the susceptibility to obesity. Considering the harm caused by the cumulative effect of these two conditions (undernutrition in childhood and obesity in adult life) there is a clear need for new studies to uncover the determinant factors so that preventive measures can be implemented.

### Nutritional transition: Obesity: Undernutrition: Brazil

Obesity is the nutritional disorder which has shown the greatest increase, not only in rich countries, but also in developing countries (Monteiro *et al.* 1992, 1995; Flegal *et al.* 1998; Popkin & Doak, 1998).

Obesity is usually associated with excessive food intake, study of this disease has not been a priority in Third World countries, where protein–energy malnutrition is a grave public health problem. However, the last decade has been marked by changes in individual feeding patterns due to modifications in economic, social, demographic

and health structures; this phenomenon is defined by some authors as ‘nutritional transition’ (Popkin, 1994; Monteiro, 1995; Popkin *et al.* 1996a,b; Mondini & Monteiro, 1997; Sawaya, 1997; Sichieri *et al.* 1994).

Studies of the prevalence of obesity in Brazilian adults have shown an epidemic increase, mostly among women from lower social strata (Instituto Nacional de Alimentação e Nutrição, 1991; Coitinho, 1998; Florêncio, 1998; Monteiro & Mondini, 1998).

Although the improvement in economic conditions can

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partly explain such trends, there is a possibility that other factors are also important (Popkin & Bisgrove, 1988). Some surveys have supported the theory that undernutrition in early life might promote obesity in adulthood, as reflected by the higher incidence of obesity among men whose mothers experienced food deprivation in pregnancy during the Dutch famine in the Second World War (Ravelli *et al.* 1976) and in the studies by Barker (1992, 1994) that show that adults born underweight developed abdominal obesity and other features strongly related to a metabolic syndrome.

This hypothesis is of particular concern with regard to those populations in underdeveloped countries where, according to some reports, 43% of school-age children show some stunting, as impairment in physical growth is the major metabolic adaptation to undernourishment (De Onis *et al.* 1993). Thus, these individuals would be subject to all the problems resulting from undernutrition and, as adults, would be more susceptible to obesity and all its consequences.

In Brazil, a study carried out in the poorest areas of the city of São Paulo (Sawaya *et al.* 1995) revealed a 14.6% occurrence of obesity and 8.5% undernutrition; however, the prevalence of overweight and obesity was higher (35%) in stunted adolescent girls.

In a longitudinal study by Sawaya *et al.* (1998), a greater susceptibility to gains in weight-for-height was found in girls with a previous history of undernutrition when compared with the control group, again supporting the hypothesis that undernutrition in early life may lead to obesity in later life. Another relevant report is that of Joseph & Kramer (1996).

Although further studies are needed to explain better the plausibility of this hypothesis, evidence from animal studies and preliminary evidence from human studies suggests that adverse events in early life may influence early neuroendocrine development. The result is long-term alterations in the levels of several major hormonal axes, including an increase in adrenal glucocorticoid secretion. These hormonal alterations may contribute to the predisposition to diabetes and metabolic syndrome in individuals who were small at birth (Phillips, 1998). Phillips *et al.* (1994a) observed that men and women who were thin at birth, as measured by a low ponderal index (weight index), were more insulin resistant. However, there was no relationship between insulin secretion and measurements of prenatal growth in either normoglycaemic or glucose-intolerant subjects (Phillips *et al.* 1994b).

There are 44.9 million inhabitants in the northeast of Brazil, the least developed region in the country, where morbidity–mortality indices have gradually drifted from infectious and parasitic diseases towards chronic-degenerative disorders, i.e., from ‘backwardness’ to ‘modernity’. This so-called ‘epidemiological mosaic’ is found in a region where the same population is exposed to distinct morbidity–mortality risks (Superintendência de Desenvolvimento do Nordeste do Brasil, 1997). Alagoas is one of the northeastern states with the worst social conditions, aggravated by a marked rural exodus that has happened during the last few years as a consequence of successive setbacks in the sugarcane industry, the state’s main economic activity. As a result, there is now a destitute

population living in the outskirts of the capital (Maceió). In 1996, several families, victims of this exodus and of the high cost of urban dwellings, settled in an area next to the Federal University of Alagoas, originating the so-called encampment of ‘the homeless peasants’.

The ‘Homeless’ Workers Movement is characterized mainly by the struggle for home ownership. Its main tactic is the occupation of urban areas, where a temporary encampment is set up with plastic-covered tents. In most cases, families manage to survive in extremely precarious conditions and in areas totally devoid of any public infrastructure.

The objective of the present study was to investigate the nutritional status of this ‘Homeless’ community by performing anthropometric measurements in adults and children. We intended to test the hypothesis of a coexistence of undernutrition and obesity in very-low-income populations facing nutritional transition.

## Materials and methods

### Population

A total of 315 families (1247 individuals) were surveyed, matching the number of inhabited dwellings at the ‘Homeless people’s’ encampment, which was located in the city of Maceió, Alagoas. The state of Alagoas has a total area of 27 976 km<sup>2</sup>, its demographic density is 94.3 persons/km<sup>2</sup>, the population is 2 633 390 inhabitants (urban 63% and rural 37%), the urbanization rate is 63.11%, life expectancy at birth is 56.6 years, infant mortality rate is 68.8/1000 live births, and the illiteracy rate is 45.6% (urban 33.4% and rural 64.6%).

### Protocol

From May to September 1999, two nutritionists and two properly-trained nutrition students went from home to home collecting identification data and information on the socio-economic conditions of each of the families, making use of previously tested and used questionnaires (Sawaya *et al.* 1995). Questions were answered by an adult member of each household (generally the mother) who was responsible for managing the family’s income and who was familiar with all the family members. A protocol of gathering all individuals to assess body weight and height was devised in the community. Weight was measured in kg using electronic scales (Filizola; Indústrias Filizola S.A., São Paulo, Brazil) for children (20 kg capacity; recording body weight to the nearest 10 g) and for adults (150 kg capacity; recording weight to the nearest 100 g).

Anthropometric measurements were carried out according to Frisancho’s (1990) recommendations.

### Anthropometric measurements

The nutritional status of children aged ≤10 years was evaluated using the weight-for-age and height-for-age indices, identifying wasting, stunting and wasting plus stunting, which were all compared with the distributions provided by the National Center for Health Statistics (1977).

As recommended by the World Health Organization (1995), the cut-off point  $Z \leq -2$  SD was used to define a deficit.

The nutritional status of adolescents aged between 10 and 18 years was evaluated by combining two classifications: height-for-age (cut-off point  $Z$ -score  $\leq -2$  SD) and BMI-for-age, (cut-off point percentile  $\leq 5$  undernutrition; percentile  $\geq 5$ –percentile  $< 85$  normal; percentile  $> 85$  overweight–obesity (World Health Organization, 1995).

The nutritional status of adults (aged  $> 18$  years) was determined using the World Health Organization (1998) BMI classification: underweight  $< 20 \text{ kg/m}^2$ ; normal  $20$ – $< 25 \text{ kg/m}^2$ ; overweight  $25$ – $< 30 \text{ kg/m}^2$ , and obesity  $> 30 \text{ kg/m}^2$ .

For the definition of height deficit, the chosen cut-off point was  $Z \leq -2$  SD of the National Center for Health Statistics distribution (Instituto Nacional de Alimentação e Nutrição, 1989).

### Statistical analysis

Nutritional data (for subjects aged 0–18 years) were analysed using Epi-Info (Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA which is based on age, gender, height and weight and provides the height-for-age and weight-for-height indices, both in percentiles and  $Z$ -score.

The socio-economic conditions of the families were analysed using the SPSS 6.0 software (SPSS Inc., Chicago, IL, USA).

Paired  $t$  tests, multiple regression and variance analyses were used to compare nutritional status and socio-economic indices. Differences were regarded as significant when  $P < 0.05$ .

## Results

Table 1 shows the socio-economic status of the population

**Table 1.** Socio-economic conditions in a 'Homeless' population in Maceió, Alagoas, Brazil, 1999

Population	
No. of families	315
No. of individuals	1247
Average no. of individuals per dwelling	4
Income	
Monthly family income	US\$ 40.32*
Per capita income	US\$ 9.62*
Schooling ( $\geq 7$ years; % total)	
Able to read	37.3
Able to write	36.7
Illiterate	63.3
Employment (% total)	
Unemployed	81.6
Legally hired employees	3.6
Housing (% total)	
Plastic-built houses	81.0
No flooring	91.0
No refrigerator	80.6
One-room houses	89.0
Sanitary conditions (% total)	
Houses with no water supply	97.0
Houses with no bathroom	95.0
Houses without treated water (drinking water)	78.0

\* Exchange rate on 30 October 1999: US\$ 1=R\$ 1.87.

studied. Family income was  $< \text{US\$}2/\text{d}$ . Housing conditions were of an extremely poor standard: the majority of the families lived in plastic shacks with only one room and one household appliance; almost all the dwellings lacked floor covering; most dwellings had no water supply and the families used untreated water; almost all dwellings were without a bathroom and excrement was disposed of in the area surrounding the dwelling. The employment rate in the area was very low, with only a few members of the population having a registered job. The majority of the population aged  $\geq 7$  years was illiterate.

Children aged  $< 10$  years showed a high prevalence of wasting plus stunting, and most were badly affected. Overweight was only seen in  $< 2\%$  of the children, and in those children who were not stunted (Table 2).

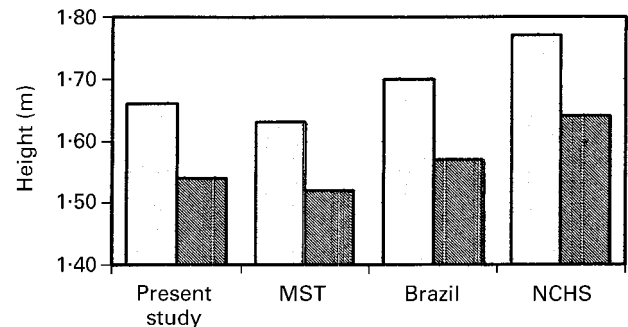
Adolescents also showed a high prevalence of undernutrition, with wasting being predominant, followed by stunting and then wasting plus stunting (Tables 3 and 4).

Among adults, there was a higher prevalence of overweight–obesity than of underweight (Table 5). According to the classification used (BMI), both underweight and overweight–obesity were more common in women than in men; in women the prevalence of overweight–obesity was approximately twice that of men.

Statistical evaluation using ANOVA and multiple regression showed that there is no association between nutritional status of the whole population and socio-economic variables. However, a positive association between BMI and *per capita* family income was found in adult males ( $P < 0.001$ ).

The prevalence of stunting in the adult population was very high (Table 6). Fig. 1 shows the average height of the population studied compared with that seen in a 'landless workers' encampment in the rural area in the state of Alagoas (Ferreira *et al.* 1996); also shown are the average height of the Brazilian population (Instituto Nacional de Alimentação e Nutrição, 1990) and that published for 18 year olds by the National Center for Health Statistics (1977).

Among stunted adults, 30% were overweight–obese and 16% were underweight. At least one of the parents was underweight in eighty-six families (27%), and there were



**Fig. 1.** Mean height for the adult population ( $> 18$  years) living in a 'homeless people's' encampment, (Maceió, Alagoas, Brazil; present study) for a rural population in a 'landless workers' encampment (Porto Calvo Alagoas, Brazil; Ferreira *et al.* 1996; MST), for the Brazilian population (Instituto Nacional de Alimentação e Nutrição, 1990; INAN) and for the US population (National Center for Health Statistics, 1900; NCHS) (□), men; (■), women.

**Table 2.** Nutritional status classification of children (aged <10 years) living in a 'homeless' encampment in Maceió (Alagoas, Brazil), according to weight-for-age and height-for-age indices as compared with the National Center for Health Statistics (1977) distribution\*

Height-for-age	Weight-for-age									Total	
	<-2 SD			≥-2 SD-≤+2 SD			>+2 SD			n	%
	Classification	n	% total	Classification	n	% total	Classification	n	% total		
<-2 SD	W+S	39	51.3	S	37	48.7	OWS	0	0.0	76	100
% total		8.7			8.3			0.0		17	
≥-2 SD	W	17	4.6	N	348	93.5	OW	7	1.9	372	100
% total		3.8			77.7			1.5		83.0	
Total		56	12.5		385	85.9		7	1.6	448	100

W+S, wasting+stunting; W, wasting; S, stunting; N, normal; OW, overweight; OWS, overweight and stunting.

\* For details of subjects and procedures, see p. 278.

**Table 3.** Nutritional status classification of adolescents (aged >10 and ≤18 years) living in a 'homeless' encampment in Maceió (Alagoas, Brazil) according to height-for-age (Z score), BMI-for-age (percentiles), as compared with the National Center for Health Statistics (1977) standard\*

Height-for-age	BMI-for-age									Total	
	<Percentile 5			≥Percentile 5-<Percentile 85			≥Percentile 85			n	%
	Classification	n	% total	Classification	n	% total	Classification	n	% total		
<-2 SD	W+S	4	23.5	S	13	76.5	OWS	0	0.0	17	100
% total		2.7			8.8			0.0		11.6	
≥-2 SD	W	15	11.5	N	111	85.4	OW	4	3.1	130	100
% total		10.2			75.5			2.7		88.4	
Total		19	12.9		124	84.4		4	2.7	147	100

W+S, wasting+stunting; W, wasting; S, stunting; N, normal; OW, overweight; OWS, overweight and stunting.

\* For details of subjects and procedures, see p. 278.

**Table 4.** Nutritional status classification of adolescents (aged >10 and ≤18 years) living in a 'homeless' encampment in Maceió (Alagoas, Brazil) according to gender, BMI-for-age (percentiles) and height-for-age (Z-score), as compared with the National Center for Health Statistics (1977) reference standard\*

Gender	Height-for-age	BMI-for-age									Total	
		<Percentile 5			≥Percentile 5-<Percentile 85			≥Percentile 85			n	%
		Classification	n	% total	Classification	n	% total	Classification	n	% total		
Male	<-2 SD	W+S	4	44.4	S	5	55.6	OWS	0	0.0	9	100
	% total		5.4			6.8			0.0		12.2	
	≥-2 SD	W	12	18.5	N	53	81.5	OW	0	0.0	65	100
	% total		16.2			71.6			0.0		87.8	
	Total		16	21.6		58	78.4		0	0.0	74	
Female	<-2 SD	W+S	0	0.0	S	8	100	OWS	0	0.0	8	100
	% total		0.0			11.0			0.0		11	
	≥-2 SD	W	3	4.6	N	58	89.2	OW	4	6.2	65	100
	% total		5.3			79.5			5.5		89.0	
	Total		3	4.1		66	90.4		4	5.5	73	

W+S, wasting+stunting; W, wasting; S, stunting; N, normal; OW, overweight; OWS, overweight and stunting.

\* For details of subjects and procedures, see p. 278.

104 families with at least one obese parent (33%). It was also observed that low body weight and being overweight-obese coexisted in ninety-six families (30% of the population).

Table 7 shows some characteristics of the parents of the children in the study. The parents' mean age, height, weight and BMI were similar, regardless of the nutritional condition of the children. However, body weight and height in the mothers of undernourished children were lower than

those for mothers of normal weight or overweight-obese children ( $P<0.05$ ).

## Discussion

In developing countries, the rapid increase in urbanization has made it extremely difficult to provide the basic infrastructure of services, especially to the poorest regions. The families considered in the present study lived in

**Table 5.** Nutritional classification, based on BMI, of adults living in a 'homeless' encampment in Maceió, (Alagoas, Brazil) 1999\*

BMI	Gender					
	Male		Female		Total	
	<i>n</i>	% total	<i>n</i>	% total	<i>n</i>	%
Underweight (<20 kg/m <sup>2</sup> )	42	16.9	62	22.1	104	19.5
Normal (≥20–<25 kg/m <sup>2</sup> )	166	66.1	229	45.9	295	55.5
Overweight (≥25–<30 kg/m <sup>2</sup> )	40	15.9	65	23.1	105	19.7
Obese (>30 kg/m <sup>2</sup> )	3	1.2	25	8.9	28	5.3
Total	251	47.2	281	52.8	532	100

\* For details of subjects and procedures, see p. 278.

inhumane conditions: most houses had just one room; they were made of plastic, which allowed indoor temperatures to reach highly uncomfortable levels during the summer (40°C); the absence of flooring resulted in everyone having to walk in water during the rainy season.

Almost all dwellings were without a bathroom and excrement was thrown into the nearby environment, worsening the proliferation of flies and mosquitoes. Furthermore, there was no system to supply running water and all the water used by the community was fetched from a fountain located in the vicinity. The average income was extremely low, less than one-third the amount necessary to prevent food shortage (Sawaya *et al.* 1995).

Such unfavourable environmental and socio-economic conditions were a determining factor in the prevalence of undernutrition among children (21%), with wasting plus stunting showing the highest prevalence among those who were undernourished. This condition is known to be linked to long-term food scarcity (and probably to other aggravating factors, such as infections). This hypothesis is supported by the fact that the mothers of undernourished children were lighter and shorter than the mothers of non-undernourished children, highlighting the historical aspects of the process and the greater nutritional risk faced by children born into families that experience starvation for several generations.

An earlier study carried out in the same community (Xavier, 1997) found 22.4% of the children aged <5 years to be stunted and 3.1% to be acutely undernourished. In the present study, the corresponding values were 17 and 3.8%, leading us to believe that very little, or virtually nothing, has changed with regard to quality of life during the last 2 years.

A study carried out at a 'Landless Workers Movement' encampment in a rural area in the state of Alagoas (Ferreira *et al.* 1997) found the prevalence of stunting to be twice as high (39.8%) as that reported here. Considering that the socio-economic characteristics in the two communities were quite similar (Ferreira & Siqueira, 1998), it appears that the rural v. urban differential may be the factor determining such disparities. In a previous study covering the whole state of Alagoas (UNICEF, 1993), the prevalence of height-for-age deficit ( $Z \leq -2$  SD) in children aged <5 years was 5.4% in urban areas and 22.7% in rural areas.

Based on these studies, the magnitude of the effect of undernutrition on the 'Homeless' children is evident; the prevalence of undernutrition being higher than that for Latin American countries and close to that found in Asian nations (de Onis *et al.* 1993), where undernutrition is highly prevalent (20–29%).

Wasting was the most predominant category of nutritional status found in adolescents (10.2%), demonstrating that socio-economic conditions had a marked effect on

**Table 6.** Nutritional classification, based on (BMI) and height, of adults (aged >18 years) living in a 'homeless' encampment in Maceió (Alagoas, Brazil), 1999\*

Gender	Height	BMI							
		Underweight (<20 kg/m <sup>2</sup> )		Normal (≥20 kg/m <sup>2</sup> –<25 kg/m <sup>2</sup> )		Overweight–Obese (≥25 kg/m <sup>2</sup> )		Total	
		<i>n</i>	% total	<i>n</i>	% total	<i>n</i>	% total	<i>n</i>	%
Male	<–2 SD	6	10.5	37	65	14	24.5	57	100
	% total		2.4		14.7		5.8		22.9
	≥–2 SD	36	18.4	129	65.8	29	14.8	196	100
Female	% total		14.3		51.4		11.5		77.1
	Total	42	16.6	166	65.6	43	17.8	251	100
	<–2 SD	14	22.2	27	42.9	22	34.9	63	100
Female	% total		4.9		9.6		7.9		22.4
	≥–2 SD	48	22.0	102	46.7	68	31.3	218	100
	% total		17.1		36.3		24.2		77.6
	Total	62	22.0	129	46.0	90	32	281	

\* For details of subjects and procedures, see p. 278.



**Table 7.** Age, body weight, height and BMI for fathers and mothers of children aged 0–18 years living in a 'homeless' encampment in Maceió (Alagoas, Brazil) under different nutritional conditions†

Nutritional condition of children	Mothers						Fathers									
	Age (years)		Weight (kg)		Height (m)		BMI (kg/m <sup>2</sup> )		Age (years)		Weight (kg)		Height (m)		BMI (kg/m <sup>2</sup> )	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Undernutrition	28.7	11.0	52.5	13.3	1.51	0.14	22.6	4.4	32.2	9.2	61.7	7.2	1.66	0.07	22.5	3.0
Normal	32.5	11.4	56.4	12.7	1.55	0.08	23.3	4.7	34.7	11.6	62.3	9.9	1.65	0.09	22.7	3.0
Overweight–obese	27.5	11.7	56.0	12.6	1.56	0.06	22.8	5.1	33.2	6.4	65.8	8.8	1.67	0.06	23.6	2.6

Undernutrition, wasting, stunting and wasting+stunting ( $Z \leq -2$  SD of the respective index, i.e., weight-for-age, height-for-age, or both) Normal,  $Z \geq -2$  SD of the respective index; overweight–obese,  $Z > 2$  SD (weight-for-age).

Mean values were significantly different from those for the other groups: \*  $P < 0.05$ .

† For details of subjects and procedures, see p. 278.

this age-group, probably due to the high physiological demands and the resulting increase in nutritional requirements. It is worth stressing that, when examined separately, girls suffered more from stunting (11 %) and overweight–obesity (5.5 %) than boys, consistent with the trends in other studies (Sawaya *et al.* 1995; Sichieri *et al.* 1995).

While studying the nutritional status of Chinese adolescents, Wang *et al.* (1998) found a higher prevalence of undernutrition in boys and a greater tendency towards being overweight in girls. In a report on obesity and undernutrition in a shanty town population in the city of São Paulo, Brazil, Sawaya *et al.* (1995) showed that among adolescents, the prevalence of being overweight was different for girls and boys, reaching 21 and 8.8 % respectively. The findings of these studies suggest that in those populations the higher frequency of obesity in women begins to be defined in adolescence.

In the present study overweight–obesity emerges as the most prevalent nutritional problem in adults, affecting 32 % of the women and 16.6 % of the men. Stunting was also an important problem in this group, affecting 22.6 % of the individuals. The mean height was only slightly higher than that found in a study involving a rural population of another social movement (Landless Workers Movement) in the state of Alagoas (Ferreira *et al.* 1996) and about 0.07 m below the average height of the Brazilian population (Instituto Nacional de Alimentação e Nutrição, 1990) and 0.14 m below the average height of 18 year olds according to the National Center for Health Statistics (1977). Among the short adults, 30 % were overweight or obese and 16.3 % were underweight. Considering the harm caused by the cumulative effect of these two conditions (undernutrition in childhood and obesity in adulthood) it is clear that there is a need for new studies that seek to uncover determining factors within the community itself, so that preventive measures can be implemented.

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