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Prevalence and determinants of overweight in preschool children

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Abstract

Objective: To examine the prevalence of overweight and its association with socioeconomic and environmental factors, ownership of household goods, maternal nutritional status, and healthcare in preschoolers.

Methods: Cross-sectional study with 954 preschoolers from the state of Pernambuco, Brazil, 2006. Multiple logistic regression with hierarchical modeling was conducted. Odds ratios for overweight (crude and adjusted for confounders) were calculated for each independent variable.

Results: The prevalence of overweight was 8.1% for the state as a whole and 9% for the Recife Metropolitan Region. In urban and rural areas, the prevalence was 9.7 and 6.8%, respectively. A high prevalence of overweight was found among children whose families lived in better socioeconomic conditions (*per capita* family income, high educational achievement and access to household goods, better housing and sanitation, and healthcare). The logistic regression final model indicated that maternal educational achievement, ownership of household goods, and maternal body mass index were the determinants that best explained child overweight.

Conclusion: Overweight was more prevalent than malnutrition among preschoolers. The prevalence was highest among children living in more privileged socioeconomic conditions.

J Pediatr (Rio J). 2011;87(3):231-237: Overweight, preschool children, associated factors.

Introduction

The World Health Organization (WHO) defines overweight as an multifactorial accumulation of excess body fat due to positive energy balance.[1] Overweight and obesity are considered non-communicable diseases, and are clearly associated with risk of adverse health outcomes in adulthood.[2]

Childhood obesity is an emerging public health issue worldwide.[3] It warrants particular attention in many developing countries, where low birth weight and acute and chronic malnutrition are still highly prevalent.[4] Childhood obesity is known to be comorbid with psychosocial disturbances (as overweight children are usually less sociable

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and experience low self-esteem), as well as mood- and sleep-related disorders.[5]

Overweight in childhood and adolescence is a major risk factor for development of obesity in adulthood, that is, obese children and adolescents are at increased risk of remaining so into adulthood when compared to children with normal weight.[6] Evidence also suggests that length of exposure to obesity is directly associated with cardiovascular morbidity and mortality.[7]

A recent population-wide study conducted in Brazil found a 7.3% prevalence rate of excess weight-for-height in children under the age of 5 years – roughly three times over the 2.3% upper bound of the reference range, and, perhaps most notably, exceeding the prevalence of height-for-age deficit, or stunting, found in the same study (7%).[8]

The increasing prevalence of childhood obesity has been associated with several factors, including parental income and educational achievement, birth weight, sedentary lifestyle, and inadequate dietary habits.[9] Taking into account that the factors associated with nutritional changes can depend on regional differences, this study sought to assess the prevalence of overweight among preschoolers and its association with socioeconomic and environmental conditions, ownership of household goods, maternal body mass index (BMI) and access to healthcare in the state of Pernambuco, Brazil, during the year 2006.

Methods

This was a cross-sectional study based on data from the 3rd Statewide Survey on Health and Nutrition (III Pesquisa Estadual de Saúde e Nutrição, III PESN/2006[10]). Families with children under the age of 5 were defined as the sampling unit. A probability (stratified random) sample was designed so as to ensure representativeness for the state of Pernambuco and its urban and rural geo-economic strata. For a maximum error of 1.2% and a 95% confidence level, the minimum overall sample size was calculated as 1,489 children, 760 and 729 in each of the aforementioned strata respectively. The Statcalc module of the Epi-Info 6.04 software package was used for sample size calculation.

The sampling procedure involved three stages of random selection: municipalities in the state of Pernambuco; census-designated sectors in each municipality; and a random starting point within each sector, from which visitation of the sampled households began.

Assessment of nutritional status as expressed by BMI-for-age was based on the data for 954 children between the ages of 2 and 5. Factors possibly associated with overweight were analyzed in 940 children, 77 of whom were overweight (BMI ≥ 2 z scores), with 863 normal-weight children (BMI ≥ -2 to < 2 z scores) as a comparison group. Fourteen underweight children (< -2 z scores) were excluded from the sample.

Fieldwork was carried out by a team of trained interviewers and anthropometrists. Weight and height measurements were performed according to WHO and Brazilian Ministry of Health recommendations.[11]

Data were collected by means of questionnaires containing items on anthropometric, socioeconomic, demographic, biological, and healthcare-related information regarding children and their mothers.

The Anthro-2007 software package[12] was used for assessment of nutritional status. Children were classified by BMI-for-age, expressed as z scores. Height and weight measurements were classified according to WHO reference curves,[13] with the following cutoffs adopted for categorization of results: BMI < -2 z scores, underweight; BMI -2 to < 2 z scores, adequate weight; BMI ≥ 2 z scores, overweight. All mothers with BMI values ≥ 25 kg/m^2 were considered overweight.

Analysis of factors associated with overweight included the following variables: geographic location of the subject's household, *per capita* family income (as a function of minimum wage), number of persons in the household, access to household goods, sanitation [a) Mains water and sewage and waste collection; b) Two of the above; c) One or none of the above], living conditions, maternal educational achievement (in years of formal schooling) and nutritional status (expressed as BMI), gender and birth weight of the child, and access to healthcare (adequate: access to six or more prenatal visits and in-hospital birth; inadequate: access to one or neither of these services).

Processing and analysis of data were performed in the Epi-Info 6.04 (CDC, Atlanta, GA) and SPSS 12.0.1 (SPSS Inc., Chicago, IL) software environments. Double data entry was used for validation purposes.

The prevalence of overweight was determined by comparison of simple frequencies and their respective confidence intervals. The chi-square test and chi-square test with Yates' correction for continuity were used for between-group comparison of categorical and dichotomous variables respectively. The significance level was set at $p \leq 0.05$.

Hierarchical multiple regression was used for analysis of factors associated with overweight in the sample. Odds ratios for overweight (crude and adjusted for confounders) were calculated for each exposure variable. Variables with $p < 0.20$ on bivariate analysis were carried forward to logistic regression analysis.

Variables were entered into the regression model in blocks. In Block 1, overweight was adjusted by maternal educational achievement and ownership of household goods. The maternal BMI variable was added to the model in Block 2, and access to healthcare, in Block 3. For adjustment of odds ratios, Block 1 variables were entered

into a regression model. First-level variables found to be significantly associated with overweight ($p < 0.05$) were carried forward to the lower hierarchical level models; the same procedure was adopted for the remaining levels.

The present study was approved by the Instituto de Medicina Integral Prof. Fernando Figueira Human Research Ethics Committee (09/11/2005), in accordance with Brazilian National Health Council Resolution 196/96 (federal standards for human subject research). The legal guardians of all participating children provided written informed consent.

Results

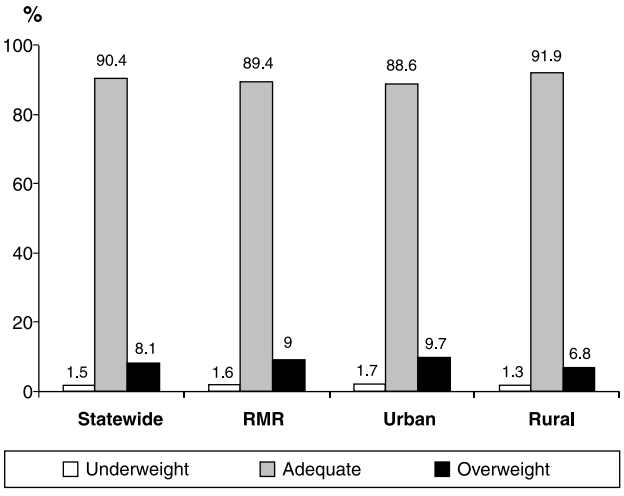
The overall prevalence of overweight (BMI-for-age) among children between the ages of 2 and 5 was 8.1% for the state of Pernambuco as a whole and 9% for the Recife Metropolitan Region (RMR). Prevalence rates in urban areas other than the RMR and in rural areas were 9.7 and 6.8% respectively – at least three times as high as the rate of weight deficit, which had a statewide prevalence of 1.5% (Figure 1).

For children aged < 24 and ≥ 24 months, prevalence rates of overweight ranged from 7 to 10% in all areas of the state, with no statistically significant differences (unpublished data).

The prevalence of overweight was significantly higher among preschoolers whose mothers had 4 or more years of formal education (13.5%), access to six or more prenatal visits and in-hospital birth (10.1%), and BMI ≥ 25 kg/m^2 (10.4%). Overweight was also more prevalent in preschoolers with a birth weight of 2,500 g or more (8.6%) than among children with low birth weight (3.6%), although this finding did not reach statistical significance. Regarding gender, the prevalence of overweight was 9.4% in males and 6.9% in females (Table 1).

Regarding socioeconomic variables (Table 2), the highest prevalence rates of overweight were found in children whose families had a *per capita* income of ≥ 0.5 minimum wages per month (11.9%), owned all household goods of interest (11%), and had access to mains water, sewage treatment, and waste collection (11.4%). Overweight was also more prevalent in children whose households comprised five or fewer inhabitants (9.5%) and among those living in homes with tile flooring (13.6%) and concrete slab roofs (16.5%).

The results of crude and adjusted logistic regression analysis of explanatory variables for overweight are shown in Table 3. Maternal educational achievement, ownership of household goods, and maternal BMI remained in the model as being independently associated with overweight in preschoolers.



BMI = body mass index; Rural = rural areas of Pernambuco; Urban = urban areas of Pernambuco outside the Recife Metropolitan Region; RMR = Recife Metropolitan Region.

Figure 1 - Nutritional status (BMI/age) of preschoolers according to geographic location, Pernambuco, 2006

Discussion

The positive aspects of the so-called nutrition transition – such as the marked decline of child malnutrition – notwithstanding, certain factors may arise and offset the benefits of this process, particularly socioeconomic changes,[14] which have led to prevalence rates of overweight (exceeding those of malnutrition[15]) indicative of a health issue of epidemic proportions among children.

The findings of the present study, particularly in light of their magnitude, show that overweight among preschool children is a nutritional disorder that warrants particular attention, consolidating the antagonism of malnutrition and overweight trends[14,15] that characterizes the third stage of the nutrition transition, represented here by population-wide occurrence of overweight in the state of Pernambuco, corroborating the findings of Batista Filho & Rissin[16] and those of a nationwide study.[8]

In the present study, overweight rates were distinct in different segments of the population. Prevalence was highest among children of families with higher purchasing power and, consequently, more privileged socioeconomic conditions (higher levels of maternal educational achievement and access to household goods), as well as improved sanitation and living conditions, higher *per capita* family income, and greater access to healthcare. These results corroborate the findings of a nationwide, population-based study conducted in Brazil over the past few years.[8]

As a determinant of increased access to high-calorie foods, among other conditions, socioeconomic level interferes with the prevalence of overweight and obesity.[9]

Table 1 - Prevalence of overweight (BMI/age ≥ 2 z scores) among preschoolers according to maternal educational achievement and BMI and maternal and child access to healthcare, Pernambuco, Brazil, 2006

Variable	Total		Overweight		p
	n	%	n (%)	95%CI	
Maternal educational achievement (years)					
≥ 4	275	29.3	37 (13.5)	9.8-17.9	< 0.001
< 4	665	70.7	40 (6.0)	4.4-8.0	
Maternal BMI					
≥ 25.0	433	47.5	45 (10.4)	7.8-13.5	0.012
< 25.0	478	52.5	27 (5.6)	3.8-8.0	
Healthcare*					
Adequate	546	58.1	55 (10.1)	7.8-12.8	0.018
Inadequate	394	41.9	22 (5.6)	3.6-8.2	
Birth weight (g)					
≥ 2,500	856	91.1	74 (8.6)	6.9-10.7	0.159
< 2,500	84	8.9	3 (3.6)	0.9-9.4	
Gender					
Male	491	52.2	46 (9.4)	7.0-12.2	0.209
Female	449	47.8	31 (6.9)	4.8-9.5	

95%CI = 95% confidence interval; BMI = body mass index.
*Healthcare: Adequate = six or more prenatal visits + in-hospital birth; Inadequate = access to only one or neither of these services.

Table 2 - Prevalence of overweight (BMI/age ≥ 2 z scores) among preschoolers according to socioeconomic variables, ownership of household goods, sanitation, and living conditions, Pernambuco, Brazil, 2006

Variable	Total		Overweight		p
	n	%	n (%)	95%CI	
Per capita family income (minimum wages)					
≥ 0.50	160	17.2	19 (11.9)	7.5-17.6	0.089
0.25-0.49	267	28.8	24 (9.0)	6.0-12.9	
< 0.25	501	54.0	33 (6.6)	4.6-9.0	
Number of persons in household					
1-5	568	60.4	54 (9.5)	7.3-12.1	0.09
≥ 6	372	39.6	23 (6.2)	4.1-9.0	
Household goods (TV, refrigerator, stove, radio)					
All	516	54.9	57 (11.0)	8.6-14.0	< 0.001
3	228	24.3	15 (6.6)	3.9-10.4	
< 3	196	20.9	5 (2.6)	0.9-5.6	
Sanitation					
Access to mains water, sewage treatment and waste collection	272	28.9	31 (11.4)	8.0-15.6	0.038
Access to two of the above	348	37.0	28 (8.0)	5.5-11.3	
Access to one or none of the above	320	34.0	18 (5.6)	3.5-8.6	
Living conditions					
Flooring					
Ceramic tile	176	18.7	24 (13.6)	9.1-19.3	< 0.01
Cement (slab)	764	81.3	53 (6.9)	5.3-8.9	
Roofing					
Concrete (slab)	91	9.7	15 (16.5)	9.9-25.2	< 0.01
Clay tile	849	90.3	62 (7.3)	5.7-9.2	

95%CI = 95% confidence interval; BMI = body mass index.

Table 3 - Multiple logistic regression analysis of overweight (BMI/age ≥ 2 z scores) among preschoolers according to socioeconomic, maternal, and healthcare-associated variables, Pernambuco, Brazil, 2006

	Crude odds ratio			Adjusted odds ratio		
Variable	**OR**	**95%CI**	**p**	**OR**	**95%CI**	**p**
Level 1*						
Maternal educational achievement (years)*						
≥ 4	2.43	1.52-3.89	< 0.001	1.94	1.16-3.24	0.01
< 4	1.0			1.0		
Household goods (TV, refrigerator, stove, radio)						
All	4.74	1.87-12.02	< 0.001	3.48	1.33-9.10	0.03
3	2.69	0.96-7.54	< 0.001	2.34	0.82-6.65	0.01
< 3	1.0		0.06	1.0		0.11
Level 2†						
Maternal BMI						
≥ 25.0	1.93	1.17-3.17	0.009	2.01	1.22-3.34	0.007
< 25.0	1.0			1.0		
Level 3‡						
Healthcare§						
Adequate	1.89	1.14-3.16	0.02	1.54	0.89-2.69	0.12
Inadequate	1.0			1.0		

* Level 1: adjusted for remaining Block 1 variables.
† Level 2: adjusted for Block 1 variables.
‡ Level 3: adjusted for Block 1 and Block 2 variables.
§ Healthcare: adequate, six or more prenatal visits + in-hospital birth; inadequate, access to only one or neither service.

Although bivariate analysis revealed a relationship between income and overweight (that is, higher prevalence of overweight among children in higher income strata), this finding was not confirmed on logistic regression. Self-reporting of family income involves a multitude of aspects that may jeopardize the reliability of data; in the present study, maternal educational achievement and ownership of household goods were the most representative markers of socioeconomic status.

The relationship between maternal educational achievement and child overweight/obesity has been widely observed in recent epidemiological studies.[8,17,18] Access to education has traditionally contributed to improvement of nutritional deficits in the population. However, the progression of overweight and obesity rates detected in the past few decades has been directly associated with educational achievement.[8]

In the present study, the proportion of overweight or obesity among children whose mothers had 4 or more years of formal education was more than double that of children whose mothers had fewer than 4 years of schooling or no formal education whatsoever. This fact was also reported in the 2006 National Survey on Demographics and Health (PNDS/2006), which found that increased prevalence of overweight among under-fives was associated with increasing maternal educational achievement (in years of formal schooling).[8]

Conversely, Monteiro et al.,[18] in an analysis of three major studies conducted in Northeast and Southeast Brazil, found a progressive increase in obesity rates among uneducated individuals, with stable or even decreasing rates among adult females with medium to high educational achievement; according to these data, obesity is increasingly prevalent in certain portions of the most disadvantaged segments of the population. This phenomenon did not occur in our sample of preschoolers from the state of Pernambuco, that is, overweight was most prevalent in preschoolers from more privileged families. Nevertheless, efficient surveillance of nutritional status is warranted, to watch for a potential shift in this panorama.

The familial nature of overweight and obesity, characterized by a concomitance of substantial prevalence rates of these conditions in children and their parents and previously documented in the scientific literature,[9,19] was also evident in the present study. Statistically significant differences were found on comparison between overweight rates in children whose mothers had BMI levels ≥ 25 kg/m^2 and rates in children whose mothers were classified

as having adequate weight. In a study of overweight and obesity among parents of children (aged 6 to 10) enrolled in a program for nutritional studies and surveillance run by a Brazilian university, Giugliano & Carneiro[19] found parental overweight to be one of several factors associated with child overweight and obesity.

Considering the relative influence of socio-environmental variables on the nutritional status of mothers and children,[20] no child can be viewed as an independent unit in this regard – that is, its nutritional status cannot be analyzed independently, without taking into account the place of the child within the context of its family, interacting in a common environment.

Thus, improving the nutritional status of women of childbearing age and ensuring universal prenatal care could reduce the number of adults at risk of obesity. This highlights the need for prioritizing nutritional surveillance efforts, in light of the increased nutritional risk posed to these children,[9,21] although, in the present study, prenatal and labor and delivery care were not statistically associated with later development of overweight or obesity.

Birth weight and demographic density at the household level were not associated with overweight in the study population, after controlling for other variables. However, the increased prevalence of overweight among preschoolers with a birth weight ≥ 2,500 g and among children of smaller households may indicate better socioeconomic status in these families.

We also found that prevalence rates of overweight were lower among children living in households without adequate water supply, sewage treatment, and waste collection than among those living in areas with improved basic sanitation, which has a well-documented impact on community health. This reinforces the study hypothesis that childhood overweight and obesity are associated with living in better socioeconomic conditions.[22,23] Common childhood infections, such as diarrhea, might be associated with the lower prevalence of overweight in these preschoolers. However, the prevalence of these infections has been declining markedly in the study areas (III PESN/2006).

Building conditions are directly tied to health risk, and are also considered good markers for socioeconomic status.[24,25] In the present sample, the prevalence of overweight was higher in children who lived in well-built homes (tile flooring, concrete slab roofs) as compared to those living in less salubrious homes (built with bare cement floors and clay roofing respectively), although this association did not carry forward to the explanatory model.

Another variable used as a marker of socioeconomic status was family access to durable consumer goods. In the present study, ownership of all three selected household goods was associated with threefold odds of overweight, suggesting that nutritional status is a function of the place of one's family in society, which helps explain the complex and multicausal nature of this phenomenon.[25,26]

We conclude that, during the study period, among preschoolers in the state of Pernambuco, overweight and obesity were most prevalent in children living in more privileged socioeconomic conditions, represented by a higher level of maternal educational achievement, wide access to household goods, and maternal nutritional status (overweight).

In light of the characteristics of overweight and obesity and their evident heterogeneity, management of these disorders will require adoption of unique strategies and proposals for intervention, both at the individual and at the collective level.[27] Surveillance of the progression of overweight and obesity, particularly in children and in the most susceptible social strata, must be pursued, in an attempt to mitigate the risk of these children growing into obese adults.

Again, it bears stressing that overweight and obesity should be approached in an interdisciplinary and intersectoral manner, at all levels involved in decision making, and require specific action, considering the demographic and epidemiological changes that are currently taking shape and likely to be more entrenched in the coming decades.

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