



Original / *Pediatría*

Prevalence and factors associated with overweight and obesity in children under five in Alagoas, Northeast of Brazil; a population-based study

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Abstract

Objective: To investigate the prevalence and associated factors with overweight and obesity among children under five in the Alagoas state, Northeast of Brazil.

Design: Cross-sectional population-based study. The study was based on 1115 children with an average age of 24.7 months (SD \pm 16.8), and 51.7% were female. Nutritional status was classified according to BMI / age. The z score $> +1$ and $\leq +2$ z identified children with overweight and $> +2$ z score identified those with obesity, according to the standard reference of World Health Organization. To identify the variables associated with overweight and obesity was performed Poisson regression analysis.

Results: The prevalence of overweight and obesity was 23.9% and 7.8%, respectively, 33.8% for girls and 29.4% in boys. After adjustment, the per capita income equal to or greater than 2.5 times the minimum wage, age 6 to 23 months and mother overweight and obesity remained positively associated with overweight/obesity. On the other hand, it was observed negative association between low and insufficient birth weight with child overweight/obesity.

Conclusions: The results show a similar prevalence of overweight and obesity to other studies in the country for children under five years, warning for possible impairment of adequate child growth and development.

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Key words: *Overweight. Obesity. Anthropometry. Risk factors. Childhood.*

PREVALENCIA Y FACTORES ASOCIADOS CON SOBREPESO Y OBESIDAD EN LOS NIÑOS MENORES DE CINCO AÑOS EN ALAGOAS, NOROESTE DE BRASIL; UN ESTUDIO BASADO EN LA POBLACIÓN

Resumen

Objetivo: Investigar la prevalencia y los factores asociados con el sobrepeso y la obesidad en niños menores de 5 años en el estado de Alagoas, al noreste de Brasil.

Diseño: Estudio poblacional transversal. El estudio se basó en 1.115 niños con una edad promedio de 24,7 meses (DE \pm 16,8), de los que el 51,7% eran niñas. El estado nutricional se clasificó según el IMC / edad. El score $> +1$ and $\leq +2$ z identificaba a los niños con sobrepeso y aquellos con un score $> +2$ z a aquellos con obesidad, en función de la referencia estándar de la Organización Mundial de la Salud. Para identificar las variables asociadas con el sobrepeso y la obesidad se realizó un análisis de regresión de Poisson.

Resultados: La prevalencia de sobrepeso y obesidad fue del 23,9% y del 7,8%, respectivamente, del 33,8% en las niñas y del 29,4% en los niños. Tras el ajuste, la renta per cápita igual o superior a 2,5 veces el salario mínimo, la edad de 6 a 23 meses y el sobrepeso y la obesidad maternos seguían asociándose positivamente con el sobrepeso/obesidad. Por otro lado, se observó una asociación negativa entre el peso al nacimiento bajo o insuficiente con el sobrepeso/obesidad infantil.

Conclusiones: Los resultados muestran una prevalencia similar de sobrepeso y obesidad a la de otros estudios en este país para los niños menores de 5 años, alertando de una posible alteración del crecimiento y desarrollo del niño.

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Palabras clave: *Sobrepeso. Obesidad. Antropometría. Factores de riesgo. Infancia.*

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Abbreviations

BMI: Body mass index.
WHO: World Health Organization.
PR: Prevalence ratio.
CI: Confidence interval.
WC: Waist circumference.
WHtR: Waist to height ratio.
NCHS: National Center for Health Statistics.
CDC: Centers for Disease Control and Prevention.
MW: Minimum wage.

Introduction

The global prevalence of overweight and obesity in children, in 2010, was estimated at 43 million (35 million in developing countries and was observed an increase of 4.2% in 1990 to 6.7% in 2010 and this trend is expected to reach 60 million or 9.1% in 2020¹.

In Brazil, the prevalence of overweight in children has increased more than three times from 1989 to 2008-2009². This increase is worrying because its consequences are disastrous in terms of health and quality of life, both in short and long term. Thus, it is estimated that obesity epidemic will generate enormous costs to society, both through loss of productivity and increased spending by Healthcare³.

Studies in different Brazilian regions that compare the nutritional status of children, between different family income groups and parents' education, indicate that children from families with low socioeconomic status have significantly higher risk of underweight and stunting^{4,5} while risk of overweight also tends to be higher in families with high socioeconomic conditions^{5,6}.

Obese children have a high risk of becoming obese adults, and are more susceptible to several morbid conditions, including thelarche and early menarche in girls, advance pubertal in boys and adverse effects on bone maturation and development in boys/girls. Childhood obesity can also affect most organs and often cause serious consequences, including hypertension, dyslipidemia, insulin resistance/diabetes, hepatic steatosis and psychosocial complications⁷.

Research has sought to identify factors associated with the occurrence of overweight and obesity in childhood such as parents' level of education, family income, birth weight, maternal health care and child care, inadequate food intake, lifestyle, sanitation and housing conditions, among others^{5,6,8}. Considering the severity of overweight/obesity, early diagnosis and identification of determinants and / or causes, is still the best and less expensive strategy to prevent this problem⁹. Therefore, the present study has the main objective to investigate the prevalence and associated factors with overweight and obesity in children under five in the Alagoas state.

Methods and procedures

This is an analytical cross-sectional population-based study, representative of children under five years, conducted in the Alagoas state, from september 2005 to february 2006.

For the calculation of sample size, it was taken into account an estimated prevalence of overweight of 20% (Body mass index – BMI/age ≥ 1 z score), an error of ± 3.0 , a trust level of 95% and a design effect of 1.5 for a population of 308,000 children. Therefore, the minimum sample size calculated in the Epi-info 6.04 version was 1,023 children.

With the aim of obtaining a representative sample, a multistage sampling process with three stages was adopted. In the first stage, 20 municipalities were randomly selected by systematic sampling with probability proportional to size (number of inhabitants). Maceió, capital of the state, by having $\frac{1}{3}$ of the state population, was selected six times. In the second stage eight census tracts were drawn within each municipality, respecting the proportion between urban and rural sectors. In the third step, a starting point was drawn up within each sector from which nine consecutive homes were visited, considering all children under five living in these households who were eligible for the study. Excluded from the study were those children with anatomic or pathologic changes that compromise anthropometric assessment. To reduce sample loss, there was a second home visit when child was not present at the time of data collection. When there was refusal of the mother or legal guardian to participate in the study, a second contact was made by field supervisor, accompanied by a health professional. From a total of 1.162 children selected, occurred a loss of 57 (5.1%) by refusals or absence of children in the household, thus the final sample consisted of 1.115 children, and 775 (70.5%) living in urban and 324 (29.5%) in rural areas.

The fieldwork was conducted by a team of nutrition students and supervisors. Students, appropriately trained, interviewed the biological mothers or legal guardian and collected data on the family, mother, and her child.

We collected data on demographic and socioeconomic conditions: geographic location, per capita family income, consumer goods (color TV, refrigerator, washing machine and/or vehicle), family composition and number of compartments; living conditions (type of house, water supply and sanitation); child variables (gender, age, birth weight and current weight and length/height); maternal variables (age, education, menarche, prenatal care, parity, type of parturition, birth weight, height and waist circumference).

Anthropometric measurements of weight and height were performed according to recommendations of the Ministry of Health¹⁰. We used portable electronic scale with a capacity of 180 kg and 100 g precision (PP180 balance Mars®, São Paulo, Brazil). Children and their mothers were measured with minimal clothing for obtaining weight. For children under 24 months, initially,

the mother was weighed, and then holding the child in her arms, the weight of the mother/child was obtained, and difference between these two measurements was recorded. The weight of children aged equal or greater than 24 months was merged with the child in the standing position on the center of the scale base.

The length of children aged less than 24 months was measured in supine position in pediatric stadiometer, equipped with a measuring tape of 100 cm and subdivisions in mm, while the height of children equal or greater than 24 months and their mothers was obtained using a portable stadiometer build of anodized aluminum, having a platform, 216 cm in height and sensitivity to 1 mm (WCS stadiometer®).

The readings of weight and height were said aloud by anthropometrist and registered in specific questionnaire by his assistant, who repeated values, also aloud before registering them, with the purpose of avoiding errors.

The standards used for comparison of anthropometric measurements of weight and height were the new curves of World Health Organization (WHO)¹¹ for assessing the growth of children from birth to five years. Nutritional status was classified according to BMI / age. The z score $> +1$ and $\leq +2$ z identified children with overweight and $> +2$ z score identified those with obesity¹¹. Overweight and obese children were also combined into one group in the analysis.

The nutritional status of the mothers was defined according to body mass index (BMI). The classification for mothers overweight and obese was based on BMI of 25-29.9 kg/m² and equal or more than 30 kg/m², respectively¹². The distribution pattern of the mother body fat was determined by measurement of waist circumference (WC), obtained at the midpoint between the last rib and the iliac crest, as well as the waist to height ratio (WHtR), whereas above the normal range WC value equal to or greater than 80 cm¹³ and WHtR above 0.5¹⁴.

Statistical analysis was performed using the Epi-Info, version 6.04, SPSS (Statistical Package for Social Sciences), version 13.0 and Stata, version 7.0. To evaluate the associated factors with overweight and obesity was used the Poisson regression model. It was calculated the prevalence ratios by robust method and its confidence interval of 95%. The level of significance was set at 5%. All variables with $p < 0.20$ in the not adjusted bivariate analysis were selected for multivariate analysis, using stepwise method. In the final model only those variables with $p < 0.05$ remained.

This study was approved by the ethics committee of the Health Sciences Center of Alagoas Federal University (Process n° 010102/03 - 55), being the procedures employed in the study in accordance with the ethical standards for human studies. All subjects signed a written informed consent.

Results

The final sample consisted of 1115 children with an average age of 24.7 months (SD \pm 16.8), and 51.7%

were female, where 55.9% lived with per capita income lower than 0.25 minimum wage. The prevalence of overweight and obesity was 23.9% and 7.8%, respectively, totaling in 31.7% of overweight/obesity, with 33.8% in girls and 29.4% in boys (table I).

In the bivariate analysis, it was observed that children from families with per capita income greater than or equal to 0.25 times the minimum wage, those who had three or more consumer goods and who had access to the sewer network or closed sink had a higher prevalence of overweight/obesity (table II).

With regard to the child variables, aged 6 to 23 months and those born with high birth weight ($\geq 4,000$ g) had higher prevalence of overweight/obesity. Moreover, children with low birth weight had lower prevalence of overweight/obesity (table II).

Maternal variables as less than eight years of education, parity equal to or greater than three children, normal birth, height less than 1.55m, overweight, obesity, WC equal to or greater than 80 cm and greater than 0.5 WHtR were positively associated with the outcome (table II).

Table III shows the variables that remained independently associated with children overweight/obesity, after adjustment for other associated factors. The more favorable socioeconomic conditions, maternal overweight/obesity and children aged 6-23 months were positively associated with overweight and obesity. In contrast, low and insufficient birth weight were inversely associated with children overweight/obesity.

Discussion

The results of this study show some specificity because they have been obtained from a homogeneous sample of individuals of Alagoas, this being one of the states with the poorest socioeconomic conditions in Northeastern Brazil¹⁵. Despite their precarious living conditions, the prevalence of overweight/obesity in the study population (31.7%), was 10 and 3 times than low weight (2.9%) and short stature (10.4%), respectively, and these preliminary data was published by Ferreira et al.¹⁵ That is, overweight and obesity today constitute, in terms of magnitude, more important nutritional disorders than weight and height deficit.

Simon et al.¹⁶, in São Paulo, in Southeastern Brazil, found that prevalence of overweight/obesity was 35.4% in 806 preschoolers, similar to the findings of the present study. It is important that the sample is homogeneous because it consists of children enrolled in private schools from families of higher socioeconomic status. In Canada, in 2011, a survey was conducted to compare the prevalence of overweight/obesity according to different patterns of references. Among 1,026 children evaluated, the prevalence was 37.9%, according to WHO criteria, thus revealing a similar result to that obtained in the present study¹⁷.

Until 2006, most of the publications addressing the issue of nutritional status and/or infant growth was per-

Table I
Prevalence ratio (PR) and confidence interval (CI) 95% of overweight and obesity among children under five according to demographic and socioeconomic conditions and housing. Alagoas, Brazil, 2005-2006

Variables	Total		Overweight/Obesity		PR ^a (CI _{95%}) ^b	p ^c	
	n	%	Yes	No			
Geographic location							
Urban	775	70.5	249	32.1	526	67.9 1.03 (0.85-1.25)	0.81
Rural	324	29.5	101	31.2	223	68.8	1
Per capita family income							
≥ 0,25 MW	461	44.1	166	36.0	295	64.0 1.25 (1.01-1.55)	0.01
< 0,25 MW	584	55.9	168	28.8	416	71.2	1
Consumer goods							
≥ 3 items	702	63.0	245	34.9	457	65.1 1.33 (1.06-1.66)	0.01
0-2 items	411	36.9	108	26.3	303	73.7	1
Family composition							
1-5 persons	712	64.0	230	32.3	482	67.7 1.05 (0.87-1.26)	0.66
≥ 6 persons	399	36.0	123	30.8	276	69.2	1
Number of compartments							
≥ 4	206	18.5	59	28.6	147	71.4 0.88 (0.70-1.12)	0.33
< 4	907	81.5	294	32.4	613	67.6	1
Type of house							
Masonry	113	10.2	33	29.2	80	70.8 0.92 (0.68-1.24)	0.63
Others	997	89.8	318	31.9	679	68.1	1
Water supply							
Public network/fountain/mineral water	356	32.0	114	32.0	242	68.0 1.02 (0.85-1.22)	0.91
Well/river/lagoon/others	756	68.0	238	31.5	518	68.5	1
Sanitary drainage							
Sewer network/closed sink	827	74.4	280	33.9	547	66.1 1.32 (1.06-1.64)	0.01
Other places/ no specific place	284	25.6	73	25.7	211	74.3	1

Note: Total number of participants in each variable is different because of the number of respondents; ^aPR= Prevalence ratio; ^bCI = Confidence interval; ^cp (error probability); ^aMW = Minimum wage was US\$ 146.81 at the time of the study (2005-2006); ^eitems (color TV, refrigerator, washing machine and/or vehicle).

formed according to the growth curves of the National Center for Health Statistics (NCHS), 1977 or Centers for Disease Control and Prevention (CDC), 2000. In this study, however, was used the growth curves recommended by WHO¹¹ and recently adopted by Ministry of Health of Brazil. The new growth pattern of breastfed infants, compared to previous references will result in increased rates of overweight/obesity assessed by BMI/age¹⁸. Therefore, similar prevalence of overweight/obesity among children of low socioeconomic status in the Alagoas state, compared to several studies in the country, may also be due to this effect, besides the absence of a consensus between the methodologies established between them.

In the present study, was observed a higher prevalence of overweight/obesity among children from families with more favorable living conditions (higher per capita income, better sanitation and access to consumer goods), results similar to other epidemiological studies^{5,6,8}. Among the demographic, socioeconomic and housing studied, only the per capita income remained positively associated in multivariate analysis, confirming the data from the Child and Woman National Demographic and Health Survive.¹⁹ Moreover,

households with higher purchasing power may have greater chance to obtain foods and more calories, among other conditions^{5,8}.

In this survey, the prevalence of overweight/obesity among children 6 to 23 months was similar to observed by Corso et al.²⁰ and probably associated to early weaning and introducing inappropriate feeding during the first years of life, that, according to Taddei et al.²¹ occurs more frequently in subpopulations of urban areas.

According to Dias et al.²², the nutritional adequacy of complementary foods is essential to prevent morbidity and mortality in childhood, including malnutrition and overweight/obesity. Health professionals should be encouraged breastfeeding and appropriate complementary feeding practices, which include the introduction, timely, of appropriate food to complement breastfeeding.

Moreover, high birth weight was associated with children overweight/obesity, and the effect of those lost explanatory variables after adjusting for potential confounders. On the other hand, low birth weight and insufficient birth weight proved protective against overweight/obesity. These results could broaden the base of support of the hypothesis of a positive associa-

Table II
Prevalence ratio (PR) and confidence interval (CI) 95% of overweight and obesity in children under five according to maternal and child variables. Alagoas, Brazil, 2005-2006

Variables	Total		Overweight/Obesity		PR ^a (CI _{95%}) ^b	p ^c		
	n	%	Yes	No				
Child's features								
Gender								
Female	577	51.7	195	33.8	382	66.2	1.15 (0.97-1.37)	0.13
Male	538	48.3	158	29.4	380	70.6	1	
Age (months)								
0-6	164	14.7	42	25.6	122	74.4	1	
6-23	413	37.0	154	37.3	259	62.7	1.46 (1.03-2.05)	0.002
≥ 24	538	48.3	157	29.2	381	70.8	1.14 (1.08-1.60)	0.09
Birth weight (g)								
≥ 4,000	96	9.0	45	46.9	51	53.1	1.37 (1.00-1.89)	0.005
≥ 3,000 < 4,000	666	63.1	227	34.1	439	65.9	1	
≥ 2,500 < 3,000	223	21.1	50	22.4	173	77.6	0.66 (0.48-0.89)	0.001
< 2,500	70	6.8	11	15.7	59	84.3	0.46 (0.25-0.84)	0.005
Mother's features								
Schooling (full years)								
≥ 8	250	23.1	93	37.2	157	62.8	1.22 (1.01-1.47)	0.06
< 8	832	76.9	254	30.5	578	69.5	1	
Age (years)								
< 25	504	46.0	165	32.7	339	67.3	1.06 (0.89-1.26)	0.55
≥ 25	593	54.0	183	30.9	410	69.1	1	
Menarche (years)								
< 13	718	69.8	238	33.1	480	66.9	1.09 (0.89-1.32)	0.45
≥ 13	311	30.2	95	30.5	216	69.5	1	
Prenatal care^d								
Adequate	232	30.4	72	31.0	160	69.0	0.91 (0.73-1.14)	0.47
Inadequate	532	69.6	181	34.0	351	66.0	1	
Parity (sons)								
≥ 3	736	83.3	239	32.5	497	67.5	1.26 (0.94-1.70)	0.13
< 3	148	16.7	38	25.7	110	74.3		
Type of parturition								
Normal	385	34.6	136	35.3	249	64.7	1.19 (1.00-1.41)	0.07
Cesarean	729	65.4	217	29.8	512	70.2	1	
Maternal height (m)								
< 1.55	608	54.6	206	33.9	402	66.1	1.17 (0.98-1.39)	0.09
≥ 1.55	506	45.4	147	29.1	359	70.9	1	
Maternal BMI (kg/m²)								
≥ 30	148	13.3	60	40.5	88	59.5	1.52 (1.13-2.04)	0.02
25-29.9	332	29.8	124	37.3	208	62.7	1.40 (1.11-1.77)	0.009
≤ 24.9	635	56.9	169	26.6	466	73.4	1	
Maternal WC (cm)^e								
≥ 80	394	35.5	146	37.1	248	62.9	1.29 (1.09-1.53)	0.005
< 80	717	64.5	206	28.7	511	71.3	1	
Maternal WHtR^f								
> 0.5	423	38.0	157	37.1	266	62.9	1.31 (1.10-1.55)	0.003
≤ 0.5	691	62.0	196	28.4	495	71.6	1	

Note: Total number of participants in each variable is different because of the number of respondents; ^aPrevalence ratio; ^bCI - Confidence interval; ^cp (error probability); ^dAdequate (six or more prenatal visits); ^eWC (Waist circumference); ^fWHtR (Waist to height ratio).

Table III
Crude and adjusted prevalence ratio (PR) of overweight and obesity for associated factors in children under five. Alagoas, Brazil, 2005-2006

Variables	Overweight/Obesity					
	PR ^a _{crude}	CI _{95%} ^b	p	PR ^a _{adjusted}	CI _{95%} ^b	p
Per capita family income ^c	1.25	1.01-1.55	0.01	1.25	1.01-1.55	0.04
Consumer goods ^d	1.33	1.06-1.66	0.01	1.24	0.96-1.59	0.09
Overweight (mother) ^e	1.40	1.11-1.77	0.009	1.37	1.07-1.74	0.01
Obesity (mother) ^f	1.52	1.13-2.04	0.02	1.52	1.12-2.04	0.006
Children age (6-23 meses)	1.46	1.03-2.05	0.02	1.45	1.00-2.10	0.045
Children age (≥ 24 meses)	1.14	1.08-1.60	0.09	1.06	0.73-1.54	0.75
Low birth weight ^g	0.46	0.25-0.84	0.005	0.48	0.25-0.91	0.02
Insufficient birth weight ^h	0.66	0.48-0.89	0.001	0.67	0.49-0.91	0.01
High birth weight ⁱ	1.37	1.00-1.89	0.005	1.19	0.84-1.67	0.32

Poisson regression – adjusted model for overweight and obesity.

^aPR - Prevalence Ratio; ^bCI - Confidence Interval; ^cPer capita family income (2005-2006) = minimum wage was US\$ 146.81 at the time of the study; ^dConsumer goods = Items (color TV, refrigerator, washing machine and auto); ^eOverweight (BMI 25-29.9 kg/m²); ^fObesity (BMI ≥ 30kg/m²); ^gLow birth weight (< 2,500 g); ^hInsufficient birth weight (≥ 2,500 g < 3,000 g); ⁱHigh birth weight (≥ 4,000 g).

tion, in which children who are born with greater weight have an increased likelihood of childhood obesity, and thus, low and insufficient birth weight would act as protective factors.²³ It is possible that among children in this study there is a positive association between low and insufficient birth weight with poor nutritional conditions, which the studied population may be exposed to and which is continued throughout childhood.

Martins & Carvalho²⁴ in a systematic review, conducted in 2006, identified positive association between high birth weight and childhood obesity. Likewise, according to a recent systematic review published in 2010 on association between birth weight and overweight/obesity in childhood, the authors conclude that there was a predominance of high birth weight associated with overweight/obesity in studies conducted in different countries, including Brazil²⁵.

According to review of epidemiological studies, the association between birth weight and overweight/obesity during childhood is not linear^{24,25}. Thus, both children born with low²⁵ and high birth weight are likely to have childhood obesity, but this probability is higher for those born at higher weight²⁶. Therefore, it can be stated that the effect of birth weight on overweight and obesity is controversial in the literature. The inconsistency of some aspects related to this association suggests an approach that incorporates the effect of different contexts within the framework of components associated with childhood obesity.

In relation to the association of maternal education with overweight/obesity in children in this study, we have observed a higher prevalence among children of mothers with higher education levels, but this variable did not remain associated with the outcome after statistical adjustment. This aspect has been considered in the

literature in different ways, associated in some studies^{5,8,27} and no association in others^{28,29}.

Studies show a relationship between the mother's BMI and obesity in children, ie, with higher maternal BMI greater chance of a child being overweight. This association may be due to genetic and/or factors related to living conditions, which act independently or facilitating gene expression^{30,31}. The adiposity assessed on the mother's BMI remained positively associated with overweight/obesity in children after adjustment.

Relating to the limitations of this study, it was not possible to analyze the prevalence of overweight/obesity in relation to exclusive breastfeeding, because the difficulty of mothers to report the exact age of introduction of other foods, including water and teas. Another limitation was not including in the analysis variables on food and physical activity patterns of children. However, the authors believe that these variables have not interfered on the results obtained considering the homogeneity of the sample with regard to socioeconomic and cultural level and, consequently, to feeding.

Final considerations

The findings of this study show a similar prevalence of overweight and obesity compared to other researches in the country, encouraging for the possible issue to which children of Alagoas state and other similar regions may be submitted. Moreover, regardless of gender, there was a higher association of overweight and obese among children in families with greater income per capita, and those with low and insufficient birth weight, aged 6 to 23 months and mothers with overweight/obesity. Nutritional assessment and nutritional education programs should be strong allies against

obesity in schools, clinics and pediatric nutrition, and public health services, in order to control problems associated with overweight and obesity, especially at younger ages, as of preschoolers. We believe that preventing overweight/obesity will mean decreasing rationally the costly incidence of chronic diseases in adulthood.

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