Factors associated with nutritional status in infants attending public daycare centers in the municipality of Recife, PE, Brazil

Fatores associados ao estado nutricional em crianças de creches públicas do município de Recife, PE, Brasil

Abstract

Objective: To evaluate the nutritional status of infants attending daycare centers in the Municipality of Recife and to verify its association with potential determinant factors. **Methods:** This is a cross sectional study conducted with 321 infants in the age group of 6 to 30 months from August to October 2004. The nutritional status was assessed through length-for-age, weight-for-age, weight-for--length and body mass index-for-age using as reference pattern that of the World Health Organization. Multivariable linear regression analysis assessed the effect of maternal socioeconomic and demographical indicators, and child related variables on infant length-for-age. **Results:** The percentages of malnutrition (Z score < -2) were found in 13.4%, 2.8%, 0.6% and 0.6% for length--for-age, weight-for-age, weight-for-length and body mass index-for-age, respectively. The final model of the linear multivariable regression analysis showed that the socioeconomic (type of roof and water supply) and child biological conditions (birthweight, age and hemoglobin concentration) were the variables that significantly influenced the variation of length-for-age, explaining 3.8% and 12.8%, respectively. **Conclusion:** Among the studied variables, child biological factors had a higher influence in the variation of length-for-age than the socioeconomic ones.

Keywords: Child, nutritional status. Anthropometry. Length-for-age. Child daycare centers. Cross-sectional studies. Epidemiologic factors.

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Resumo

Objetivo: Avaliar o perfil nutricional de crianças frequentadoras de creches do município de Recife e identificar potenciais fatores determinantes. **Métodos:** Trata-se de um estudo transversal conduzido com 321 crianças de 6 a 30 meses no período de agosto a outubro de 2004. A classificação do estado nutricional foi realizada a partir dos índices comprimento/idade, peso/idade, peso/comprimento e de massa corpórea/idade, utilizando o padrão de referência da Organização Mundial da Saúde. A análise de regressão linear multivariada avaliou o efeito das condições socioeconômicas e demográficas maternas e relacionadas às crianças sobre o índice comprimento/idade. **Resultados:** O percentual de desnutrição (< -2 escores Z) foi de 13,4%, 2,8%, 0,6% e 0,6% para os índices comprimento/idade, peso/idade, peso/comprimento e de massa corpórea/idade, respectivamente. O modelo final da análise de regressão linear multivariada mostrou que as condições socioeconômicas (tipo de teto e abastecimento de água) e biológicas da criança (peso ao nascer, idade e concentração de hemoglobina) foram as variáveis que significantemente influenciaram a variação do índice comprimento/idade, explicando 3,8% e 12,8%, respectivamente. **Conclusão:** Entre as variáveis estudadas, os fatores biológicos da criança tiveram uma influência maior na variação do índice comprimento/idade do que as socioeconômicas.

Palavras-chave: Criança. Estado nutricional. Antropometria. Índice comprimento/idade. Creches. Estudos transversais. Fatores epidemiológicos.

Introduction

The nutritional status of a population, especially children, is an excellent indicator of quality of life, reflecting the pattern of development of a certain society[1]. To follow the nutritional status of infants is a key instrument to assess their health conditions, bringing the unique opportunity to obtain objective measures of evolution of the health conditions of a population[2].

An increasing number of children with a lower socioeconomic level, living in the urban centers of Brazil, have been served by public daycare centers. There is great demand for these services, which tends to increase due to the fact that mothers have been working to contribute to the family income[3,4]. Programs based on full-time quality child care, aimed at infants from the first months of life, can play a preventive role as they protect these infants from nutritional disorders, especially chronic malnutrition[3,5].

Although daycare centers are a possible protective factor of nutritional status, as they provide an adequate diet and are responsible for 2/3 of the total nutritional intake of children, their exposure to precarious housing and basic sanitation conditions predisposes them to recurrent infectious processes with resulting damage to their nutritional status, especially those aged less than 24 months[6-9]. Additionally, as observed by Monteiro[10], the height deficit of children at the age of seven years would have been established at 24 months of life. As height is a body measure that evolves slowly and progressively, its dimension reflects the history of socioeconomic and nutritional status of a population[11]. Thus, the present study aimed to assess the nutritional status of infants aged from six to 30 months, who were enrolled in public daycare centers of the city of Recife, and to verify potential factors associated with the length-for-age index.

Methods

The present study was conducted in 13

public daycare centers situated in five of the six Health Districts of the city of Recife, state of Pernambuco, Northeastern Brazil. The centers were selected by simple random sampling from a total of 20 daycare centers that met the inclusion criteria (age and without oral iron supplementation). Infants enrolled in these centers had similar socioeconomic conditions and received the same support for the educational curriculum, diet and health care from the city's Department of Education[12].

The study had a cross-sectional design and was conducted with infants aged between six and 30 months, enrolled in these daycare centers, including a total of 321 participants. Data collection was performed from August to October 2004.

Socioeconomic and demographic factors were assessed for per capita family income, maternal level of education and age, housing and basic sanitation conditions, and ownership of household goods. The child-related variables were as follows: sex, birth weight, age, profile of maternal breastfeeding, and hemoglobin concentration. This information was collected from the children's mothers or legal guardians at the daycare centers through an interview conducted by two research assistants, using a pre-coded questionnaire.

Venous blood samples were collected for hemoglobin count, electronically determined with the ABX Pentra, ABX 120 VEP 0027 model. Values < 9.5 g/dL were considered as moderate to severe anemia; 9.5 – 10.9 g/dL as mild anemia; and ≥ 11.0 g/dL as normal[13].

The anthropometric assessment was made by measuring weight and length, following the recommendations of the World Health Organization[14]. Weight was obtained with a Marte digital scale with a maximum capacity of 160kg (MS 160 model, Goiânia, Brazil) and accuracy of 50g. Length was measured with an anthropometer (Raven Equipment, England) with a maximum amplitude of 100cm and subdivisions of 0.1cm. Infants were measured two times and the difference between measurements should not exceed 0.5cm to guarantee their accuracy; when this limit was exceeded, another measurement was taken, the two closest values were recorded, and the mean of these values was used.

The nutritional status assessment used the Anthro software – 2007[15] and infants were categorized according to the weight--for-age, length-for-age, weight-for-length and BMI-for-age indices expressed in Z scores. The child growth pattern used as reference to classify weight and length measurements was that of the World Health Organization (WHO)[16]. With regard to the nutritional status assessment, the following cut-off points were used: < -2 Z scores = malnutrition, -2 to < -1 Z score = risk of malnutrition, and ≥ -1 Z score = eutrophy for the length-for-age index; and < -2 Z scores = malnutrition, -2 to < -1 Z score = risk of malnutrition, ≥ -1 to < 2 Z scores = eutrophy, and ≥ 2 Z scores = overweight for the weight-for-age, weight-for-length and BMI-for-age indices. Maternal breastfeeding was defined as infants who had received or were receiving maternal milk directly or collected from breasts, regardless of any foods or liquids being provided, including non-human milk[17].

The Epi Info software, version 6.04 (CDC, Atlanta, USA), was used to perform double data entry, aiming to check for consistency and validity of typing.

The length-for-age index, selected as a dependent variable to investigate associated factors, was analyzed as a continuous variable. The associations were made according to this index as it shows a higher prevalence of nutritional deficit and as it is currently the most frequent and representative type of anthropometric deviation. Student's t test and variance analysis (ANOVA) were used to compare the differences between means in the bivariate analyses, considering a p-value ≤ 0.05 to have statistical significance. The correlation matrix did not identify multicollinearity among variables, as Pearson correlation coefficients were lower than 0.52.

The multivariate linear regression analysis was performed with the Statistical

Package for the Social Sciences (SPSS) software, version 12.0.1, when assessing the impact of independent variables on the length-for-age index. Among the independent variables, birth weight, age and hemoglobin concentration were treated as continuous variables. All variables with a p-value < 0.20 in the bivariate analyses were selected to be included in the regression models, using the stepwise method. The model adopted by Lima et al.[18] was used to analyze the associated factors. Initially, the regression of the 11 socioeconomic and maternal variables was performed (housing type; occupancy status; type of wall, floor and ceiling; water supply; sewage system; ownership of television, fridge and landline telephone in the household; and maternal education). Next, the child-related variables were included in the model (birth weight, age and hemoglobin concentration). This research project was approved by the Human Research Ethics Committee of the Health Sciences Center of the Federal University of Pernambuco, under protocol 299/2003. The mothers of participating infants were informed about the research objectives and procedures and signed an informed consent form to be included in the study.

Results

According to Table 1, the percentage of malnutrition observed (< - 2 Z scores) was 2.8% and 13.4% for the weight-for-age and length-for-age indices, respectively, and 0.6% for the weight-for-length and BMI-for-age indices. Overweight was 7.5% and 10.6% for the weight-for-length and BMI-for-age, respectively.

With regard to socioeconomic variables (Table 2), 53.3% of families received a per capita family income lower than 1/4 of a minimum wage, the majority of them (71.3%) lived in a house or apartment with brick or hollow tile walls (82.9%), piped water supply (81%) and flushing toilet (42.7%). In terms of

Table 1 – Nutritional status of children from 6 to 30 months attending daycare centers in Recife, Pernambuco, 2004.
***Tabela 1** – Estado nutricional de crianças de 6 a 30 meses matriculadas em creches públicas do município de Recife, Pernambuco, 2004.*

Indices (Z scores)*	N = 321	%	95%CI
Weight-for-age			
< -2	9	2.8	1.4 – 5.4
-2 to < -1	35	10.9	7.8 – 15.0
-1 to < 2	270	84.1	79.5 – 87.8
≥ 2	7	2.2	1.0 – 4.6
Length-for-age			
< -2	43	13.4	10.0 – 17.7
-2 to < -1	95	29.6	24.7 – 35.0
≥ -1	183	57.0	51.4 – 62.5
Weight-for-length			
< -2	2	0.6	0.1 – 2.5
-2 to < -1	13	4.0	2.3 – 7.0
-1 to < 2	282	87.9	83.6 – 91.1
≥ 2	24	7.5	4.9 – 11.1
BMI-for-age			
< -2	2	0.6	0.1 – 2.5
-2 to < -1	8	2.5	1.2 – 5.0
-1 to < 2	277	86.3	81.9 – 89.8
≥ 2	34	10.6	7.5 – 14.6

* Reference source / *Padrão de referência*: World Health Organization (2006)

household goods available, 2/3 of families or more had a television and refrigerator.

With regard to maternal variables (Table 3), 9.1% of mothers were adolescents and the majority of them (69.4%) were aged between 20 and 29 years. Concerning the level of education, 44.4% had completed from five to eight years of education. Low birth weight (< 2,500g) had a frequency of 6.8%, while that of insufficient weight

Table 2 – *Mean and standard deviation of length-for-age index (Z score) according to the socioeconomic characteristics of children from 6 to 30 months attending daycare centers in Recife, Pernambuco, 2004.*
Tabela 2 - *Média e desvio padrão do índice comprimento/idade (escore z) segundo as características socioeconômicas de crianças de 6 a 30 meses matriculadas em creches públicas do município de Recife, Pernambuco, 2004.*

Variables	N=321	%	Length-for-age index		
			Mean	SD	P
Per capita income (MW)*					
<0.25	160	53.3	-0.87	1.17	0.27
0.25-0.49	104	34.7	-0.87	1.28	
≥0.50	36	12.0	-0.53	0.96	
Housing type					
House or apartment	229	71.3	-0.69	1.17	0.007
Room or others	92	28.7	-1.08	1.21	
Occupancy status					
Owned	184	57.3	-0.89	1.18	0.05
Rented	75	23.4	-0.51	1.24	
Ceded/invaded/others	62	19.3	-0.90	1.15	
Type of wall					
Hollow tiles/bricks	266	82.9	-0.72	1.19	0.01
Rammed earth/wooden boards/cardboard/brass/others	55	17.1	-1.18	1.14	
Floor					
Ceramic	45	14.0	-0.58	1.28	0.18
Cement/granite	233	72.6	-0.80	1.15	
Earth/wooden boards/others	43	13.4	-1.06	1.29	
Ceiling					
Cinder blocks/clay tiles	172	53.6	-0.60	1.14	0.001
Asbestos tiles/others	149	46.4	-1.03	1.22	
Water supply					
With indoor plumbing	260	81.0	-0.71	1.19	0.003
Without indoor plumbing	61	19.0	-1.21	1.15	
Toilet					
Flushing toilet	137	42.7	-0.72	1.28	0.02
Non-flushing toilet	144	44.9	-0.74	1.12	
Absent	40	12.4	-1.30	1.08	
Household goods					
Color television					
Yes	255	79.4	-0.75	1.20	0.12
No	66	20.6	-1.00	1.16	
Refrigerator					
Yes	213	66.4	-0.70	1.17	0.03
No	108	33.6	-1.00	1.23	
Landline telephone					
Yes	54	16.8	-0.59	1.14	0.15
No	267	83.2	-0.85	1.20	

Cases without information: * 21 (6,5%); MW: Minimum Wages
*Casos sem informação: * 21 (6,5%); SM (Salário Mínimo) = R$ 260,00.*

(2,500 – 2,999g) was 21.5%. A total of 41.4% of infants had moderate to severe anemia and 50.2% had mild anemia. With regard to maternal breastfeeding, 93.8% of infants had been or were still being breast-fed at the moment of the interview, whereas 6.2% had never been breast-fed.

Tables 2 and 3 show the association between the explanatory variables and the length-for-age index. Variables with a p-value < 0.20 were selected for the multivariate linear regression analysis.

This analysis showed that the socioeconomic condition, represented by type

Table 3 - Mean and standard deviation of length-for-age index (Z score) according to the maternal and infant characteristics of children from 6 to 30 months attending daycare centers in Recife, Pernambuco, 2004.
Tabela 3 - *Média e desvio padrão do índice comprimento/idade (escore z) segundo as características maternas e relacionadas às crianças de 6 a 30 meses matriculadas em creches públicas do município de Recife, Pernambuco, 2004.*

Variables	N=321	%	Length-for-age index		
			Mean	SD	P
MATERNAL					
Age (in years)*					
≤ 19	29	9.1	-0.95	1.41	0.79
20 – 24	122	38.1	-0.73	1.19	
25 – 29	100	31.3	-0.82	1.17	
≥ 30	69	21.5	-0.85	1.15	
Maternal level of education (in years)**					
0 – 4	113	36.1	-0.90	1.32	0.15
5 – 8	139	44.4	-0.79	1.14	
≥ 9	61	19.5	-0.54	1.03	
CHILD-RELATED					
Sex					
Male	182	56.7	-0.80	1.19	0.97
Female	139	43.3	-0.80	1.21	
Age (in months)					
6 – 12	58	18.1	-0.53	1.34	0.06
13 – 18	100	31.1	-0.73	1.13	
19 – 24	114	35.5	-0.87	1.07	
≥ 25	49	15.3	-1.13	1.34	
Birth weight (g)***					
< 2500	21	6.8	-1.34	1.21	< 0.001
2500 – 2999	67	21.5	-1.29	1.22	
3000 – 3799	179	57.6	-0.67	1.12	
≥ 3800	44	14.1	-0.27	1.11	
Maternal breastfeeding					
Has been/is being breast-fed	301	93.8	-0.78	1.16	0.24
Has never been breast-fed	20	6.2	-1.10	1.58	
Hemoglobin (g/dL)					
< 9.5	133	41.4	-0.98	1.17	0.003
9.5 – 10.9	161	50.2	-0.76	1.22	
≥ 11.0	27	8.4	-0.14	0.93	

Cases without information: *01 (0,3%); ** 08 (2,5%); *** 10 (3,1%)
*Casos sem informação: *01 (0,3%); ** 08 (2,5%); *** 10 (3,1%).*

of ceiling and water supply, had a significant influence and contributed to 3.8% of the variation in the length-for-age index. Child-related variables, represented by birth weight, age and hemoglobin concentration, were those with a greater impact on the variation in the length-for-age index, jointly contributing 12.8%. When considered together, these variables explained 16.6% of this index (Table 4).

Discussion

The results of the present study corroborate the statement that height deficit is the most frequent and representative form of anthropometric deviation of malnutrition. Consequently, daycare centers can be an important choice of care, as they enable infants to have access to a qualitatively adequate diet, which has the potential of reducing nutritional risks, among which is chronic malnutrition[19,20].

In the present study, the number of infants with a deficit in the length-for--age index (13.4%) was higher than that expected for the reference values of 2.3%[14] and similar to that found in Brazil by the *Pesquisa Nacional de Demografia e Saúde* (PNDS – National Demographic and Health Survey)[21] for children aged between 12 and 23 months (12.3%) and to that found by Oliveira et al.[22] in a study conducted with children in the state of Bahia (12.4%). In daycare centers of the cities of São Paulo and Belo Horizonte, Zöllner and Fisberg[3] and Rocha et al.[23] observed that lower prevalences of height deficit of 5.2% and 4.2%, respectively, indicate better socioeconomic conditions, reflecting regional inequalities and probably better care and infrastructure conditions of daycare centers.

The literature shows that the relationship between height growth and the environmental conditions to which children are exposed has been well documented[22,24]. The same can be observed with regard to socioeconomic conditions, such as family income, where the significant association with nutritional status[2,22,,25] is frequently found. Reporting one's family income involves different aspects that hinder data reliability, so that the "type of ceiling" and "water supply" variables became more representative of family socioeconomic conditions in this study and their significance remained in the multivariate regression analysis.

Additionally, the child-related variables such as birth weight, age and hemoglobin concentration had a significant impact on

Tabela 4 - Regressão linear multivariada dos fatores associados ao índice comprimento/idade (escore Z) de crianças de 6 a 30 meses matriculadas em creches públicas do município de Recife, Pernambuco, 2004.
***Table 4** - Multivariate linear regression analysis of factors associated to length-for-age index (Z score) of children from 6 to 30 months attending daycare centers in Recife, Pernambuco, 2004.*

Variables	Length-for-age index (Z scores)					
	Non-adjusted β[a]	P	Adjusted β[a,b]	95%CI	P	R^{2c}
Asbestos ceiling/others[d]	%	0.001	-0.33	-0.59 a -0.06	0.02	2.5
Water without indoor plumbing[d]	-0.50	0.003	-0.39	-0.73 a -0.05	0.03	1.3
Birth weight (kg)	0.67	< 0.001	0.61	0.39 a 0.84	< 0.001	8.7
Age (in months)	-0.03	0.007	-0.04	-0.06 a -0.02	0.001	1.7
Hemoglobin (g/dL)	0.18	0.002	0.17	0.06 a 0.29	0.002	2.4

[a] Regression coefficient / [a] *Coeficiente de regressão*
[b] Adjusted for: type of housing, occupation regime, type of wall, floor, water closet, maternal education, ownership of TV, refrigerator and telephone / [b] *Ajustado por: tipo de habitação, regime de ocupação, tipo de parede, piso, esgotamento sanitário, escolaridade materna, posse de TV, geladeira e telefone fixo.*
[c] Adjusted determination coefficient / [c] *Coeficiente de determinação ajustado.*
[d] Reference categories for categorical variables: ceiling slab of concrete/clay tiles, water and indoor plumbing. / [d] *Categorias de referência para as variáveis categóricas: teto com lage de concreto/telha de barro; água com canalização interna.*

the variation in the length-for-age index. Birth weight has been frequently assessed for the nutritional status of children[2] and its interference with child growth and development has been continually shown in the literature[22,25-28].

The impact that low weight and insufficient weight have on the height deficit was evident, as they contributed to 8.7% of the variation in the length-for-age index. It should be emphasized that approximately 1/3 of the population experienced this condition, which could reveal precarious prenatal care. As a result, birth weight among live births is directly associated with child quality of life, growth, development and mortality.[29] Thus, the importance of birth weight as a key indicator of interest for nutritional surveillance becomes evident. The importance of this indicator would be even more relevant in statistical terms if studies on the prevalence of malnutrition were not significantly affected by survival bias, resulting from the fact that deaths associated with low birth weight stop being included[30].

Several factors are involved with the occurrence of low birth weight, among which is the manifestation of inadequate health and nutritional conditions of the mother-fetus pair, reflecting the pregnancy conditions and, ultimately, the socioeconomic conditions in which the mother finds herself. Consequently, the birth weight can, on the one hand, reflect what has previously occurred, while, on the other hand, it can act as a predictive factor of possible post-natal complications in the short and long term, especially if the environmental and socioeconomic conditions interfering with birth weight persist[6,,22,26].

With regard to the hemoglobin level or iron deficiency that characterize anemia, when iron deficiency is found in the first two years of life, there is evidence of delayed psychomotor development and behavioral, cognitive and language changes, with important repercussions for the physical and mental development[31].

Iron-deficiency anemia is highly prevalent in Brazilian children aged less than two years and it begins very early during childhood[1,18,32]. In the present study, the prevalence of anemia was 91.6%, of which 41.4% was moderate/severe. This had been recorded in a previously published article[12] and significantly contributed to the variation in the length-for-age index of infants.

While studying the determining factors of hemoglobin level in infants at 12 months of age in the narrow coastal plain of the state of Pernambuco, Northeastern Brazil, Lima et al.[18] observed a significant association with the length-for-age index, where the prevalence of anemia was 73.2%. The same occurred in the studies conducted by Brunken et al.[27] on anemia among children (63.1%) who were enrolled in full-time public daycare centers and by Rocha et al.[23] on the nutritional status and prevalence of anemia in children living in the city of Belo Horizonte (70.4% in those aged less than 24 months). However, these data do not corroborate the findings of Miranda et al.[32], when analyzing the association between iron-deficiency anemia (63.2%) and the nutritional status of children aged from 12 to 60 months in the city of Viçosa, and those of Stefanini et al.[31], when analyzing the association between anemia (51%) and malnutrition among schoolchildren in the city of Osasco.

With regard to the age group, there was a significant inverse association between child age and the length-for-age index. These findings probably result from the dietary pattern of infants younger than 24 months and from the low coverage and quality of public health actions provided to the population. This could justify the adoption of measures in the field of diet and nutrition, aimed at fighting against such health problem affecting infants in this age group. These findings are in agreement with those observed by Oliveira et al.[33], while studying food insecurity and the nutritional status of children in an area of high socioeconomic vulnerability; however, they diverge from the results found by Zöllner and Fisberg[3], when describing the nutritional status of children cared for in daycare centers

managed by the City Hall in São Paulo, and those obtained by Oliveira et al.[22], when analyzing the determinants of weight and linear growth deficits among children in the state of Bahia.

Although this study did not find a statistical association between breastfeeding and the length-for-age index, the importance of maternal breastfeeding is well known, especially in the age group analyzed, as maternal milk contains factors that protect against infections and also represents an important source of nutrients. The literature has shown that quantitatively and qualitatively inadequate post-weaning diets promote the onset of nutritional deficits with repercussions for height growth[1,6]. Although not being the object of the present study, overweight totaled 10.6%, surpassing the 2.3% expected for a reference population. In the age group in question, one should be cautious when analyzing overweight with cross-sectional data, considering the specific dietary pattern and growth process characteristics.

In this context, studies on child eating habits have become more relevant as a strategy to fight malnutrition and it is essential to understand them in the communities studied. It should be emphasized that the height deficit is invariably established during the first 24 months of life. Thus, all efforts must be directed towards providing younger children access to health care and housing infrastructure conditions and, to the extent possible, providing guidance to mothers, aiming to increase the period of maternal breastfeeding, apart from guidance and capacity-building on prenatal and child care[5]. Moreover, it is necessary to establish special care for infants born with low weight, due to its repercussions in the long term, in addition to using risk criteria (birth weight, age group, hemoglobin concentration and housing conditions) as part of the normative principles for nutritional surveillance.

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