Public Health Nutrition: 11(4), 387–394 DOI: 10.1017/S1368980007000390

Determinants of mild-to-moderate malnutrition in preschoolers in an urban area of Northeastern Brazil: a hierarchical approach

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Submitted 24 May 2006: Accepted 13 November 2006: First published online 6 July 2007

Abstract

Objective: To investigate the determinants of mild-to-moderate malnutrition in preschoolers.

Design: Cross-sectional study conducted in October and November 1996, with a representative sample of 1740 children less than 5 years old from the city of Salvador, situated in the Brazilian Northeastern region. Socio-economic and dietary data were collected through a structured questionnaire. Anthropometric measures were performed in duplicate and data analysis was based upon the hierarchical model approach. Logistic regression analysis was used to estimate the prevalence ratio and to identify the determinants of mild-to-moderate deficits in weight-for-age and height-for-age *Z*-scores.

Results: Family monthly income under US$67.00 per capita and family headed by a woman were the main basic determinants of mild-to-moderate weight-for-age and height-for-age deficits in the studied children. Household agglomeration, an underlying determinant, was associated with weight-for-age and height-for-age deficits. Among the immediate determinants, age above 6 months and dietary caloric availability in the lowest tertile ($<930\,\text{kcal}\,\text{day}^{-1}$) were also associated with weight-for-age deficits. In addition to these, hospitalisation in the 12 months preceding the interview was shown to be a predictor of mild-to-moderate weight-for-age and height-for-age deficits.

Conclusion: Adverse social and economic factors interact with family environmental factors to define food consumption and morbidity patterns that culminate in a high prevalence of mild-to-moderate malnutrition. The strengthening and restructuring of nutrition and healthcare actions, the definition of public policies that improve family income, and the adequate insertion of women in the labour market are possible strategies to reduce mild-to-moderate malnutrition and to sustain the decline already observed in severe malnutrition.

Keywords
Mild-to-moderate malnutrition
Determinants
Preschoolers
Brazil
Hierarchical approach

Recent studies have revealed a decline in the prevalence of malnutrition of severe and moderate intensities in several regions of the world[1], including Brazil[2,3]. Although this represents a promising perspective for infant health and nutrition, the fact that high rates of mild malnutrition still persist has epidemiological relevance, because mortality risk may also increase[4,5]. In developing countries, taking into account diarrhoea, pneumonia, measles and all of these together as causes of death, the risk of death for preschoolers with a mild deficit of the weight-for-age indicator (*Z*-score -2.0 to <-1.0) is 1.73–2.32 times higher than for children with adequate weight-for-age. This risk increases from 3.01 to 5.39 times if the child is moderately malnourished (*Z*-score -3.0 to <-2.0), reaching 5.22 to 12.50 times in those severely malnourished (*Z*-score <-3.0)[5]. Similar relative risks have been also estimated by other authors[6]. In analysing data from 28 studies in African and Asian countries, Pelletier[5] estimated that mild-to-moderate malnutrition contributes to 50–75% of deaths in the first years of life.

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He also noted that 83% of deaths in developing countries could be avoided if the mild and moderate forms were included in actions to reduce malnutrition.

Nevertheless, when a greater number of children have mild-to-moderate than have severe malnutrition, the mild-to-moderate forms could overcome the severe form in terms of the contribution to the number of malnutrition-associated deaths[7]. Interventions should be directed to the development of strategies to improve child growth and development and to prevent all forms of malnutrition. The greatest impact of these actions will take place only when all children at risk of malnutrition are considered, and not just those with deficits below −2.0 standard deviations, the cut-off point usually accepted to define specific actions of assistance to the malnourished child[1]. So identification of the determinants of mild-to-moderate malnutrition has clear policy implications.

Northeastern Brazil is the region with the most precarious living conditions in the country, and presents the highest infant mortality rates. Despite the decline of moderate-to-severe malnutrition observed in past decades all over Brazil[1–3], this region still presents the highest prevalence. For instance, considering the indicators of height-for-age and weight-for-age, the rate of moderate-to-severe malnutrition (*Z*-score <-2.0) for the region in 1996 was 17.9% and 8.3%, respectively, much higher than the rates in the richest Southern region (5.1% and 2.0%, respectively)[3]. The Northeastern region continues to exhibit very a high prevalence of mild malnutrition too (*Z*-score −2.0 to <-1.0). Preschoolers from the state of Pernambuco in 1997 presented a prevalence of mild malnutrition of 26.0% and 19.9% according to height-for-age and weight-for-age indicators[8]. The state-wide survey in 1998 in Sergipe revealed a prevalence of 32.5% of weight-for-age mild deficit[9]. In 10 municipalities in the state of Bahia, mild weight-for-age and height-for-age deficits of 27.0% and 26.7%, respectively, were observed in the preschool population in 2000[10].

Our purpose was to study the determinants of mild-to-moderate malnutrition in under-fives living in the city of Salvador, taking into account the living conditions of these children and their families, using a hierarchical approach.

Population and methods

Location

Salvador is the capital of Bahia State, situated in the Northeastern region of Brazil. Its location on the coast and its hilly characteristics have led to the development of many luxurious areas intermixed with slums, configuring a mirror of Brazilian social and economic inequity. In 1996, its population was 2.3 million inhabitants[11].

Sampling

The study sample size was calculated based on an estimated prevalence of moderate-to-severe malnutrition (*Z*-score −3.0 to <-2.0) of 14% (height-for-age) and 8% (weight-for-age) in the population under 5 years old[3]. Hence, a sample size of 1700 children was estimated and 1792 were actually investigated. Forty children presenting with severe nutritional deficits (*Z*-score <-3.0 for weight-for-age, height-for-age or weight-for-age) were excluded from the analysis, as were 12 children due to incomplete data, leaving 1740 in the final analysis. Hence, this sample has a power $(1-\beta)$ greater than 80% for detecting the determinants of mild-to-moderate malnutrition at a confidence level of 95%. A conglomerate technique in three stages was the sampling strategy of choice, in which the census sector was the primary unit of selection, the household was the secondary unit and the child was the tertiary unit. In a first stage, 30 census sectors[11] were selected, randomly distributed among the four zones in which the city was mapped, according to the Living Condition Index proposed by Paim[12]. In each sector, 60 households were visited. Those households in which there was a child under 5 years old were included in the sample. If more than one child was present in the home, a random selection was made and only one index child was included in the study.

Data collection

Data collection was performed during the months of October and November of 1996 by trained interviewers; 10% of the households were revisited for quality control of the collected information. Microelectronic Filizola brand scales with 100 g precision were used. Children were weighed naked or in light clothing (weight under 20 g). Length for children under 2 years, and height for children 2 years or older, was measured using wooden anthropometric instruments with a precision of 0.1 cm. Measurements were taken in duplicate by independent anthropometrists and standardised according to the technical recommendations of the World Health Organization[13]. A variation between the two measurements of 100 g and 0.1 cm was accepted for weight and height/length, respectively. The date of birth was collected from the birth certificate, and the birth weight from the child or maternity card.

Dietary intake was evaluated by the 24-hour recall method on the day preceding the interview[14]. The data were collected from Tuesday through Saturday, avoiding the weekend food intake record, which normally does not represent the usual diet. To aid the interviewee in recalling the serving size of foods, albums with actual-size food pictures were used, in addition to standard measures for liquids[15]. Data on social and economic conditions of the families as well as physical and sanitary conditions of the households were collected using a structured questionnaire. The morbidity history included the occurrence of morbid illness in the preceding 15 days and hospitalisation due to any condition in the preceding 12 months. Information was provided by the mother or child's guardian.

Data analysis

The hierarchical approach was used to investigate the determinants of mild-to-moderate malnutrition, as proposed by the United Nations Children's Fund[16]. The hierarchical model used comprised basic, underlying and immediate determinants of malnutrition. Hence, in the analysis, the basic determinants block served to adjust the parameters of the underlying determinants and these two blocks together were used to adjust the immediate determinants. The basic determinants considered were: educational level of the family head, gender and age of the family head, and monthly family per capita income (in quartiles). Underlying determinants included physical, sanitary and environmental conditions of the households.

For each household an index was calculated[17] taking into account the following characteristics and variables: physical (type of floors, number of rooms and type of walls), sanitary (origin of drinking water, type of garbage disposal, type of sewage and type of toilet) and environmental (number of persons). Based on a scoring system of 0–4 for each variable, the household's conditions were classified into good, regular or precarious. The mean number of inhabitants per bedroom was also integrated into the underlying determinants as a proxy of household agglomeration. The immediate determinants were represented by the following child characteristics: gender, age, morbidity in the past 15 days, hospitalisation in the past 12 months and food intake. Three variables of food intake were analysed: amount of calories, protein and iron density (all in tertiles). When appropriate, a variable was transformed in its respective dummy. The outcome variables were height-for-age and weight-for-age indicators. Anthropometric deficit between -3.0 and <-1.0 *Z*-scores of the National Center for Health Statistics reference standard[18] was employed to define mild-to-moderate malnutrition. Values equal to or greater than -1.0 *Z*-score indicated adequacy.

The study sampling design (multiple stage conglomerates) resulted in different probabilities of the child participating in the sample; thus, weighted models were utilised for statistical analysis. A weight expressing the probability of inclusion of a child into the sample was calculated for each sampling unit, considering the effect of the conglomerate over the standard error and on the estimations of interest[19]. The STATA version 8 software system was used for logistic regression analysis, because it incorporates the expansion factor into complex analysis. The Relrisk command was used for the prevalence ratio (PR) estimation. Two models were built, one for each outcome variable. The Virtual Nutri Program was used to analyse food intake[20]. A significance level of $P < 0.05$ (two-tailed) was adopted to accept a significant association.

Ethical aspects

The child participated in the study after his guardian had signed an informed consent form. The result of the anthropometric evaluation was immediately informed to the guardian, followed by nutritional guidance, as needed. When necessary, the child was referred to the health service and/or to the Nutrition Service of the Health Unit to enrol in the Malnourished Care Program of Bahia's State Health Department.

Results

Table 1 shows that 10.1% of the children included in the study presented low birth weight and 11.3% were preterm. The prevalence of moderate malnutrition (*Z*-score -3.0 to <-2.0) according to the weight-for-age and height-for-age indicator was 3.2% and 3.0%, respectively. The mild form (*Z*-score -2.0 to <-1.0) presented a prevalence of 17.2% for weight-for-age and 15.1% for height-for-age. Hence, the sum of the mild and moderate

Table 1 Biological characteristics of preschool children – Salvador, 1996 ($N = 1740$)

Variable	*n*	%	SE
Age (months)			
0–6	176	10.1	0.8
6–12	243	13.9	0.9
12–24	364	21.2	1.1
24–36	333	19.2	1.0
36–48	338	19.2	0.9
48–60	286	16.3	0.8
Gender			
Male	860	49.7	1.2
Female	880	50.3	1.2
Birth weight*			
<2500 g	155	10.1	0.8
>2500 g	1367	89.9	1.1
Birth conditions†			
Full term	621	81.8	1.4
Preterm	85	11.3	1.2
Post-term	51	6.9	0.8
Weight-for-age (*Z*-score)‡			
Eutrophic (>−1.0)	1387	79.6	1.1
Mildly malnourished (−2.0 to <−1.0)	297	17.2	0.9
Moderately malnourished (−3.0 to <−2.0)	56	3.2	0.5
Height-for-age (*Z*-score)‡			
Eutrophic (>−1.0)	1431	81.9	1.1
Mildly malnourished (−2.0 to <−1.0)	259	15.1	0.9
Moderately malnourished (−3.0 to <−2.0)	50	3.0	0.4

SE – standard error.
* Obtained from the child card.
† Refers to 764 children under 2 years of age.
‡ Severely malnourished (*Z*-score ≤–3.0) according to weight-for-age = 1.2%, according to height-for-age = 1.3% and according to weight-for-height = 0.4%.

Table 2 Crude association between socio-economic, environmental and biological factors and mild-to-moderate deficit of weight and height (*Z*-score –3.0 to <–1.0) – preschool children, Salvador, 1996 (*N* = 1740)

	Weight-for-age				Height-for-age			
Variable	*n*	%	PR	95% CI	*n*	%	PR	95% CI
Basic determinants								
Educational level of family head								
College (complete/incomplete or over)	27	15.6	1.00	–	20	11.2	1.00	–
High school (complete)	52	15.0	0.96	0.65–1.38	53	15.6	1.33	0.84–1.96
High school (incomplete)/elementary school (complete)	53	18.6	1.17	0.78–1.67	52	18.6	1.59	0.98-2.37
Elementary school (incomplete)/illiterate	225	26.2	1.63	1.16–2.22	185	21.8	1.81	1.21–2.56
Gender of family head								
Male	265	19.3	1.00	–	239	17.6	1.00	–
Female	109	29.6	1.57	1.28–1.89	90	24.7	1.56	1.16–2.10
Age of family head (years)								
14–24	22	19.9	1.00	–	19	16.6	1.00	–
25–65	328	21.1	0.90	0.58–1.32	287	19.2	0.83	0.51–1.30
Over 65	20	19.8	0.92	0.56–1.43	19	19.2	1.01	0.62–1.56
Monthly family per capita income*								
>162.05	40	11.8	1.00	–	49	14.6	1.00	–
162.05–66.98	113	32.9	1.42	0.96–1.96	77	22.8	1.29	0.90–1.79
66.97–35.02	78	22.7	1.69	1.16–2.32	95	27.6	1.88	1.34–2.51
≤35.01	63	17.7	2.51	1.82–3.25	36	10.5	2.33	1.67–3.07
Underlying determinants								
Physical, environmental and sanitary conditions of the household, index								
Good	108	18.9	1.00	–	94	16.5	1.00	–
Regular	115	17.8	0.96	0.75–1.19	104	16.6	1.01	0.79–1.28
Precarious	155	28.5	1.48	1.18–1.83	137	25.4	1.49	1.15–1.90
Household agglomeration (people/bedroom)								
Low (1 or 2)	103	15.0	1.00	–	85	12.4	1.00	–
Medium (3 or 4)	179	22.9	1.47	1.21–1.76	152	19.7	1.49	1.19–1.84
High (≥5)	96	32.2	2.00	1.58–2.45	98	33.5	2.46	1.96–3.01
Immediate determinants								
Gender of child								
Male	184	21.0	1.00	–	167	19.5	1.00	–
Female	194	21.9	1.04	0.87–1.24	168	19.0	0.98	0.80–1.18
Age of child (months)								
0.0–6.0	13	7.4	1.00	–	30	17.0	1.00	–
6.1–12.0	52	20.9	2.48	1.66–3.27	53	22.0	1.35	0.88–1.96
12.1–24.0	84	22.6	2.63	1.84–3.37	84	22.7	1.37	0.92–1.94
>24.0	229	23.8	2.88	1.99–3.72	168	17.7	1.09	0.73–1.57
Morbidity†								
No	206	19.4	1.00	–	203	19.6	1.00	–
Yes	170	24.9	1.24	1.06–1.44	130	19.1	0.93	0.75–1.14
Hospitalisation in past 12 months								
No	299	20.2	1.00	–	269	18.4	1.00	–
Yes	71	30.3	1.44	1.13–1.81	57	25.0	1.30	1.02–1.63
Energy content of diet (kcal day^{-1})‡								
>1330.7	111	19.4	1.00	–	91	16.0	1.00	–
1330.7–930.1	122	21.7	1.09	0.86–1.36	105	19.1	1.12	0.86–1.44
<930.1	130	23.2	1.16	0.90–1.46	127	22.9	1.37	1.06–1.74
Protein content of diet (g day^{-1})‡								
>44.6	116	20.2	1.00	–	93	16.4	1.00	–
44.6–28.9	107	19.2	0.95	0.72–1.23	101	18.6	1.13	0.85–1.46
<28.9	140	24.8	1.20	0.94–1.51	129	23.0	1.36	1.06–1.73
Iron density of diet (mg/100 kcal)‡								
>0.6	143	22.9	1.00	–	119	19.4	1.00	–
0.4–0.6	115	20.7	0.87	0.70–1.08	96	17.6	1.06	0.82–1.35
<0.4	120	20.6	0.91	0.73–1.12	120	20.8	0.93	0.72–1.18

PR – crude prevalence ratio; CI – confidence interval.
* Income in US$ expressed in quartiles (minimum wage at the time of study R$112.00 = US$111.78).
† Period of 15 days preceding the interview.
‡ Expressed in tertiles.

malnutrition rates for the weight and height deficits was 20.4% and 18.1%, respectively.

Table 2 presents the crude PR of anthropometric deficits according to the putative basic, underlying and immediate determinants of nutritional status. The majority of the tested variables were significantly associated with weight-for-age or height-for-age mild-to-moderate deficits. Age of family head and iron density of the diet were

Table 3 Hierarchical model for factors associated with mild-to-moderate deficits of weight-for-age and height-for-age in preschool children – Salvador, 1996 ($N = 1306$)

	Mild-to-moderate anthropometric deficit					
	Weight-for-age			Height-for-age		
Variable	Adjusted PR	95% CI	*P*-value	Adjusted PR	95% CI	*P*-value
Basic determinants						
Gender of family head						
Male	1.00	–	–	1.00	–	–
Female	1.43	1.14–1.76	0.003	1.32	1.04–1.65	0.024
Monthly family per capita income*						
>162.05	1.00	–	–	1.00	–	–
162.05–66.98	1.41	0.96–1.96	0.078	1.31	0.92–1.80	0.137
66.97–35.02	1.70	1.16–2.33	0.009	1.94	1.37–2.59	0.001
≤35.01	2.37	1.71–3.08	<0.001	2.28	1.66–2.98	<0.001
Underlying determinants						
Household agglomeration (people/bedroom)						
Low (1 or 2)	1.00	–	–	1.00	–	–
Medium (3 or 4)	1.29	1.02–1.60	0.039	1.16	0.87–1.52	0.312
High (≥5)	1.51	1.15–1.94	0.005	1.70	1.33–2.14	<0.001
Immediate determinants						
Age of child (months)						
0.0–6.0	1.00	–	–	1.00	–	–
6.1–12.0	2.28	1.41–3.17	0.002	1.37	0.80–2.15	0.242
12.1–24.0	2.62	1.76–3.41	<0.001	1.34	0.83–2.02	0.220
>24.0	2.77	1.86–3.67	<0.001	1.09	0.66–1.68	0.720
Calorie content of diet (kcal day^{-1})†						
>1330.7	1.00	–	–	1.00	–	–
1330.7–930.1	1.26	0.95–1.63	0.104	1.12	0.82–1.48	0.473
<930.1	1.45	1.07–1.90	0.020	1.28	0.92–1.72	0.138
Hospitalisation in past 12 months						
No	1.00	–	–	1.00	–	–
Yes	1.59	1.18–2.08	0.004	1.42	1.04–1.90	0.033

PR – prevalence ratio adjusted for the remaining variables of the model; CI – confidence interval.
* Income in US$ expressed in quartiles (minimum wage at the time of study R$112.00 = US$111.78).
† Expressed in tertiles.

the only exceptions. Deficits in weight-for-age were not associated with age of family head, 'regular' physical, environmental and sanitary conditions of the household, child gender, caloric availability, protein and dietary iron density. Concerning height-for-age deficits, lack of association was observed for age of family head, 'regular' physical, environmental and sanitary conditions of the household, child gender, age of the child, morbidity reported in the past 2 weeks and iron density in the diet.

Final models to explain mild-to-moderate deficits in weight-for-age and height-for-age were defined using the variables shown to be significantly associated ($P < 0.05$) in the bivariate analysis. The results of these procedures are presented in Table 3. For the basic determinants, it was observed that children living in households headed by women had a 1.43 (95% confidence interval (CI) 1.14–1.76) greater chance of presenting mild-to-moderate weight-for-age deficit and a 1.32 (95% CI 1.04–1.65) times higher chance for mild-to-moderate deficit in height-for-age, when compared with children in households headed by men. Children coming from families in the second quartile of monthly per capita income (US$35–67) had a 1.70 (95% CI 1.16–2.33) times and 1.94 (95% CI 1.37–2.59) times greater chance of mild-to-moderate weight-for-age and height-for-age deficit, respectively. Furthermore, the chance increased to 2.37 (95% CI 1.71–3.08) and 2.28 (95% CI 1.66–2.98), respectively, when the income was situated in the lowest quartile of the distribution (<US$35). Among the underlying determinants, children living in households with a high degree of agglomeration had 1.51 (95% CI 1.15–1.94) times more chance of presenting mild-to-moderate weight-for-age deficit and 1.70 (95% CI 1.33–2.14) more chance of mild-to-moderate height-for-age deficit. The age of children and calorie content of the diet, at the immediate determinants level, were associated only with weight-for-age deficit. Hence children older than 24 months presented 2.77 times (95% CI 1.86–3.67) more chance for mild-to-moderate weight-for-age deficit. Likewise, the risk decreased when the children were younger. The results showed that children with mean caloric intake located in the lowest tertile (<930.10 kcal day^{-1}) had 1.45 (95% CI 1.07–1.90) times more chance to have a mild-to-moderate weight-for-age deficit compared with those situated in the first tertile (>1330.69 kcal day^{-1}). Those hospitalised during the year prior to the interview presented greater chance of mild-to-moderate weight-for-age deficit (PR = 1.59; 95% CI 1.18–2.08) and height-for-age deficit (PR = 1.42; 95% CI

1.04–1.90) compared with children not hospitalised in this period.

For mild-to-moderate weight-for-age and height-for-age deficit the model included: gender of family head and family per capita income (basic determinants), number of inhabitants per bedroom (underlying determinants) and hospitalisation over the past 12 months (immediate determinants). The remaining variables significantly associated with weight-for-age or height-for-age mild-to-moderate deficits in the bivariate analysis had their statistical importance annulled after adjusting for all the variables representing the basic, underlying or immediate causes.

Discussion

These results indicate that in a developing country urban context, where the prevalence of severe forms of malnutrition is low, a variety of economic and social factors continue to interact with the underlying and immediate determinants of malnutrition, leading to a health and nutrition profile characterised by a high prevalence of malnutrition of mild-to-moderate intensity. From a public health perspective, mild-to-moderate malnutrition is associated with a lower relative risk, but with a higher attributable risk of death than severe malnutrition[5–7]. As a consequence, once nutrition transition is established such as in Salvador, severe malnutrition decreases without a similar drop in the mild-to-moderate form, and the relative importance of the last group is evidenced. Despite the known limitations of cross-sectional studies to control for all confounders in order to explore causal relationships[22], the findings described here are very consistent. In the hierarchical model employed, mild-to-moderate weight-for-age and height-for-age deficits were explained by a large set of basic, underlying and immediate determinants, confirming the fact that its origins emerge from a complex network of determining factors[23].

Structural problems in Brazil – aggravated by huge social, economic and healthcare inequities[24] – form the basis of the remaining levels of malnutrition registered[25]. The hierarchical models fitted in our study indicated the following basic determinants of childhood weight-for-age and height-for-age mild-to-moderate deficits: per capita income and gender of the family head. Families with monthly per capita income smaller than US$67.00 had almost twice the chance of presenting anthropometric deficits. So the income level for the majority of the population in Salvador is well below the sufficient amount to ensure adequate child growth.

Families headed by women were associated with a greater restricting effect on the weight and height adequacy of children compared with families headed by men. This condition could indicate that those mothers solely responsible for generating the household income cannot offer proper care to their children. However, it may also reflect the complexities related to the insertion of women into the productive process as is well known in several societies, including Brazil. Here, women in general are employed in less-specialised activities, but even when in similar jobs, women earn lower incomes than Brazilian men[26]. The rate of families headed by women observed in the households of Salvador (21.4%) was similar to that observed overall in Brazil (20.0%)[3]. Other results of this study, previously published[21], showed that among the families with lower incomes, the number of women in non-specialised activities was greater (44.4%) than that observed for men (21.2%); higher illiteracy levels among female family heads (14.9%) compared with males (3.9%) could possibly explain this scenario[21].

Bedroom agglomeration was another relevant determinant of mild-to-moderate deficits in both weight-for-age and height-for-age, and the only variable defined as an underlying determinant which remained in the final models. It is well known that bedroom agglomeration is a direct expression of inappropriate social and economic family conditions and correlates with the sanitary conditions of the household[27,28]. High degree of agglomeration increases the chance of disease transmission[29].

Of the immediate determinants of mild-to-moderate malnutrition, food intake (inadequate dietary calorie intake) was related only with mild-to-moderate weight-for-age deficits while the occurrence of severe disease episodes (hospitalisation in the preceding 12 months) was associated with both weight-for-age and height-for-age deficits. Despite improvements in children's nutritional situation in Brazil, there are yet groups of children at high risk of malnutrition due to insufficient food intake and its consequent low availability of dietary energy. Severe diseases, mainly diarrhoea and lower respiratory tract infections, which are frequent in similar childhood populations[28], are directly associated with precarious living conditions and healthcare inequity[27]. In Salvador, these two disease groups are responsible for more than 70% of hospitalisation episodes in this age group. At least one hospitalisation in the preceding year was reported by 13.8% of the studied population, reflecting the high burden of disease in this population. This fact may also reflect the effects of malnutrition on the immune response (including its mild-to-moderate forms and specific micronutrient deficiencies, particularly iron, zinc and vitamin A), increasing the risk of infections[30–32]. An anaemia prevalence of 46.3% was registered in the studied sample[33], and another study has shown a 19.7% prevalence of vitamin A deficiency among preschool children of Salvador[34].

In Salvador, the epidemiological transition in the past decade was characterised by a significant decrease in the occurrence of severe malnutrition (Z-score < -3.0) leading to a scenario characterised by a very low prevalence of the severe nutritional deficit, a low occurrence of moderate deficit and high rates of mild malnutrition. This profile is similar to that observed in a study of 10 municipalities of the State of Bahia in 2002. The prevalence of mild underweight was 27.5%, while moderate and severe were 8.4% and 2.5%, respectively, in preschool children[10].

It is therefore valid to enquire about the possible conditions that determine these anthropometric profiles for Brazilian children. It is possible to formulate the following hypothesis that deserves further investigation: (1) the basic child healthcare actions have a more incisive effect on the recovery from severe malnutrition; (2) these actions prevent moderate malnutrition from becoming severe; and (3) mild malnutrition does not respond adequately to the currently implemented interventions.

Research institutions as well as international and national organisations have been focusing almost exclusively on childhood moderate-to-severe malnutrition, to determine its causes, design preventive strategies or propose therapeutic procedures. This happened probably due to its high relative risk for morbidity and mortality. However, from the epidemiological and public health point of view, nutrition interventions and surveillance should be geared also towards the mild forms of malnutrition[35]. This is important not only because the severe degrees of malnutrition derive from it, but also because of the expression of attributable risk that mild malnutrition has on childhood deaths[5–7]. In situations where the prevalence of severe malnutrition has decreased, but high prevalence of mild malnutrition remains – such as Salvador – this becomes relatively more important as a potential cause of morbidity and mortality. Therefore, to sustain the decline in the prevalence of moderate and severe malnutrition observed in Brazil[1], it is necessary to focus interventions also on mild forms. This can be implemented through a reformulation of currently established public health policies for nutritional surveillance and child health care. However, the definition of other policies is also required, such as those aiming to improve the situation of women in the labour market, as well as instruments capable of overcoming the limits of child care. Positive initiatives to increase food-purchasing power were recently taken in Brazil. The federal government decided to eliminate taxes on basic food items and the Conditional Cash Transfer Program (Bolsa Família) expanded its coverage, reaching 11 million families since 2006. Other measures are necessary to improve the precarious household physical and sanitary conditions in which children and families live.

Acknowledgements

Sources of funding: This study was financed by the Ministry of Health, Brazil. A.M.O.A. coordinated the study and the data analysis.

Conflict of interest declaration: None of the authors have financial or personal relationships that might have biased this work.

Authorship responsibilities: A.M.O.A., L.M.P.S., L.P.M.O., V.A.O., M.S.P., N.S.S., R.C.R.S. and L.R.S. were responsible for the fieldwork and anthropometric data collection. G.S.S.G. and S.M.C.P. performed the statistical analysis and interpretation of data. A.M.O.A., M.L.B. and L.M.P.S. helped to write the first report. All investigators were involved in designing the study, drafting the manuscript, revising and approving the final version to be published.

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