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ORIGINAL ARTICLE

Anthropometric evaluation, risk factors for malnutrition, and nutritional therapy for children in teaching hospitals in Brazil

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Abstract

Objective: To evaluate risk factors for malnutrition, nutritional status and nutritional support provided in hospitalized children.

Methods: This longitudinal study prospectively followed, for 3 consecutive months, all children under 5 years of age (n = 907) hospitalized in general pediatric medical wards of 10 Brazilian university-based hospitals. For data collection, a standard questionnaire was used and nutritional condition was evaluated at hospital admission and discharge: weight-for-height, weight-for-age and height-for-age z score.

Results: Only 56.7% of the children had their nutritional classification documented in the medical record. At hospital admission, 16.3 and 30.0% of the children had moderate/severe malnutrition and low stature, respectively. Risk of malnutrition was associated with low birth weight and younger age. A high percentage of nutritional deficiencies was observed in the children analyzed, although child's nutritional condition and the adoption of appropriate nutritional therapy were not documented in the medical records of the malnourished children.

Conclusion: These data underscore the importance of developing qualified hospital medical wards regarding diagnosis and therapeutic approach to malnutrition, based on the conduct guidelines already available in Brazil.

J Pediatr (Rio J). 2009;85(3):223-228: Protein-energy malnutrition, hospitalized children and nutritional therapy.

Introduction

Over recent decades, the prevalence of protein-energy malnutrition (PEM) has expressively decreased among children aged < 5 years worldwide.[1] The same trend has been observed in Brazil; however, data from the latest Brazilian National Demographic and Health Survey (*Pesquisa Nacional de Demografia e Saúde*, PNDS) revealed that 22% of the pediatric population still showed anthropometric indicators consistent with PEM, the height-for-age deficit being the most common form of malnutrition in the country.[2]

Childhood PEM is a multifactorial condition, which involves biological and social determinants, and may occur due to insufficient supply of energy, macro- and

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This study was conducted in the Working Group on Child Malnutrition, Technical Area of Food and Nutrition, Health Policy Secretary (Grupo de Trabalho sobre Desnutrição Infantil, Área Técnica de Alimentação e Nutrição, Secretaria de Políticas de Saúde), Brazilian Ministry of Health, and Brazilian Society of Pediatrics.

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micronutrients (a condition called primary nutrition) or as a result of secondary malnutrition, which is characterized by an inadequate functional and biological use of the available nutrients or by increased energy expenditure in the presence of associated diseases. Regardless of the cause, PEM is related to physiological alterations that have been reported to increase risk of complications and death in children.[3]

Worth mentioning that, despite the decreased prevalence of PEM, death rates due to severe malnutrition in hospital treatment remain high.[4]

In order to reduce mortality rates, the World Health Organization (WHO) released, in 1999, the first version of the protocol for in-hospital treatment of severely malnourished children, which takes the pathophysiological characteristics of this population into consideration. The actual implementation of such protocol in hospital centers of several countries resulted in an expressive decrease in death rates due to severe PEM.[5-7]

Unfortunately, nutritional assessment and follow up of children during hospitalization is not a routine in in-hospital treatment, which might hinder diagnosis and treatment of nutritional deficiencies.[8,9] Another issue concerns the fact that the diagnosis of malnutrition is not always documented in the child's medical record at hospital admission or death certificate, hindering a correct and comprehensive evaluation of the problem.

As a consequence of the seriousness of this issue and little data available in the country, the Brazilian Ministry of Health (BMH) informally established, in 2000, the Working Group on Child Malnutrition. This group, under the shared coordination of BMH, Pan American Health Organization and Brazilian Society of Pediatrics, worked together with the Technical Area of Food and Nutrition, of the BMH Health Policy Secretary, in order to monitor and improve activities related to the implementation of WHO protocol, as well as to provide technical and scientific support to its implementation. However, the creation of this group, which was meant to be an advisory body, was not formally approved by BMH and, thus, worked in an informal manner throughout 1999-2000. The group comprised 13 hospital institutions, among other partners.

Within the strategies to guide and adjust WHO protocol and its implementation in Brazil, this advisory group proposed carrying out the present study. The purpose of this study was to evaluate risk factors for malnutrition, to assess nutritional status and to describe nutritional support provided in hospitalized children, at hospital admission and discharge, in university-based or teaching hospitals of the Brazilian National Health System (Sistema Único de Saúde, SUS), in addition to identify methods and anthropometric indicators used for nutritional assessment of children admitted to these institutions.

Methods

This longitudinal study prospectively evaluated all children, aged between 28 days and 5 years, hospitalized in general pediatric medical wards of 10 university-based or teaching hospitals covering four regions of the country (Northeast, Southeast, Center-West, and South) and a total of nine Brazilian capitals (Fortaleza, Natal, Recife, Salvador, Rio de Janeiro, Belo Horizonte, Brasília, São Paulo, and Porto Alegre). Data collection was performed simultaneously in all the involved institutions for a 3-month period. Data were collected by health professionals, undergraduate or graduate students of all institutions, who were previously trained by members of their institutions, also members of BMH Working Group on Child Malnutrition, on how to correctly fill in the questionnaire and obtain anthropometric data. In order to ensure standardization of anthropometric measurements, a manual with procedures was made available to the person in charge of each unit.

A standard and pre-encoded questionnaire was used for data collection, which should be filled in within 48 hours of hospital admission and, at most, 48 hours before hospital discharge, taking into account discharges during weekends. This questionnaire included patient's identification data (name, birth date, sex, and origin), history (birth conditions, birth weight, gestational age, breastfeeding, and immunization), hospital admission (main diagnosis and lag time, nutritional condition at hospital admission and discharge, presence of edema or dehydration), and nutritional therapy employed (diet, administration route, use of multivitamin supplements, oligoelements and iron).

Anthropometric measurements (weight and height) and classification of nutritional condition were performed by health professionals of each institution, previously trained by the research coordinators, following WHO recommendations.[10] Weight-for-height (ZWH), weight-for-age (ZW) and height-for-age (ZH) indicators were calculated as z scores, based on the reference curve proposed by WHO.[11] Malnutrition and low stature were considered as ZWH < -2 and ZH < -2, respectively.[12] Concerning nutritional support, health care centers followed their own standardized conduct, and no previous training on nutritional therapy was performed in the units involved.

The data collected were entered on databases, with double typing and subsequent validation regarding internal consistency. The Statistical Package for the Social Sciences (SPSS) 13.0 was used for statistical analysis. During the study period, 959 questionnaires were returned; of these, 52 were excluded: five because sex was not informed; four because child weight at admission was not informed; 16 because birth date was not informed; 19 because child was under 28 days of age; and eight because anthropometric measurements were inaccurate and generated, for some indicators, z score values $<$ or $>$ 6. Therefore, our final study sample comprised data on 907 hospitalized children. For

comparative analysis of anthropometric variables, at hospital admission and discharge, we considered for ZWH, ZW and ZH data from 787, 867 and 785 children, respectively.

To compare categorical variables, the chi-square test was used, and risk of association between variables was calculated using relative risk (RR). A stepwise forward logistic regression model was used in the multivariate analysis of risk factors for malnutrition, and Pearson's coefficient was used to evaluate the correlation between time of hospitalization and nutritional condition at hospital discharge. We adopted $\alpha < 0.05$. The study protocol was approved by the Research Ethics Committee of the institutions participating in the study, and the children's parents or legal guardians were explained about all study procedures and signed a free informed consent form.

Results

In the study population, there was male predominance, 517 individuals/907 (56.2%); mean age was 10.5 months (1-59.7 months); and mean hospitalization time was 6.9 days (2-58 days). Prevalence of low birth weight and prematurity was 151/907 (16.6%) and 123/907 (13.6%), respectively. Approximately 241/860 (28%) children were no longer on or had never been breastfed. The most frequent diagnosis at admission was pneumonia, 429/907 (42.3%), followed by diarrheic disease, 156/907 (17.2%) (Table 1). None of the children had malnutrition as the main cause of hospital admission.

The presence of malnutrition at admission, among all children analyzed, was associated with age under 12 months (RR = 2.3; 95%CI 1.63-3.27), low birth weight (RR = 1.66; 95%CI 1.18-2.35), prematurity (RR = 1.69; 95%CI 1.18-2.42), and incomplete immunization (RR = 1.47; 95%CI 1.04-2.09). Prevalence of diarrheic disease, as a diagnosis at admission, was also higher among malnourished children than among those without malnutrition, who had pneumonia as the prevalent diagnosis (RR = 2.48; 95%CI 1.74-3.53). The logistic regression model included age, sex, birth weight, gestational age, immunization, and

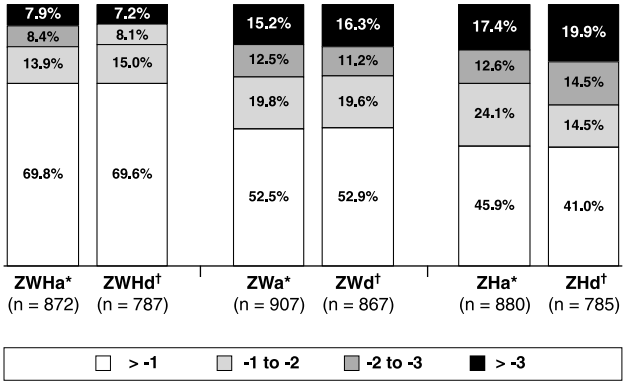
Table 1 - Population characteristics

Variables	ZWH < -2 (n = 142) n (%)	ZWH ≥ -2 (n = 730) n (%)	RR (95%CI)	Adjusted RR (95%CI)*
Age (n = 907)			2.31 (1.63-3.27)†	0.96 (0.95-0.98)
≤ 6 months	66 (46.7)	209 (28.6)		
6 to 12 months	38 (26.8)	160 (21.9)		
12 to 24 months	24 (16.9)	170 (23.3)		
24 to 36 months	8 (5.6)	87 (11.9)		
> 36 months	6 (4.2)	104 (14.2)		
Sex (n = 907)			1.04 (0.77-1.41)	
Male	82 (57.7)	413 (56.6)		
Female	60 (42.2)	317 (73.4)		
Birth weight (n = 777)			1.66 (1.18-2.35)	1.77 (1.09-2.86)
< 2,500 g	35 (28)	107 (17.1)		
≥ 2,500 g	90 (72)	517 (82.8)		
Gestational age (n = 869)			1.69 (1.18-2.42)	
Preterm	29 (21.2)	86 (12.3)		
Term	108 (78.8)	614 (87.7)		
Breastfeeding (n = 860)			1.17 (0.84-1.63)	
No/never	42 (31.1)	189 (27.1)		
Yes	93 (69.8)	507 (72.8)		
Immunization (n = 809)			1.47 (1.04-2.09)	1.50 (0.95-2.37)
Incomplete	36 (29.5)	136 (20.7)		
Complete	86 (70.5)	520 (79.3)		
Diagnosis at admission (n = 907)			2.48 (1.74-3.53)‡	
Diarrheic disease	44 (31)	100 (13.7)		
Pneumonia	52 (36.6)	370 (50.7)		
Sepsis	2 (1.4)	9 (12.3)		
Meningitis	0	10 (13.7)		
Cardiopathy	6 (4.2)	5 (0.7)		
Other	38 (26.7)	236 (32.3)		

95%CI = 95% confidence interval; RR = relative risk; ZWH = weight-for-height indicator.
* Stepwise forward logistic regression and adjusted relative risk taking into account age, sex, birth weight, gestational age, immunization, and diagnosis at admission.
† RR of children with and without malnutrition aged ≤ 12 months vs. > 12 months.
‡ RR of children with and without malnutrition in relation to the presence of pneumonia and diarrhea.

diagnosis at admission. Children with low birth weight were 1.77 times as likely to have malnutrition, and each year old represented a reduction of 4% (RR = 0.96) in the risk for malnutrition, at admission. Regarding classification of nutritional status, 515/907 (56.7%) children were diagnosed with malnutrition, according to information abstracted from their medical records.

Nutritional assessment revealed that 142/872 (16.3%) and 264/880 (30%) children at admission, as well as 121/787 (15.4%) and 270/785 (34.4%) at discharge, were classified as having moderate/severe malnutrition (ZWH < -2) and low stature (ZH < -2), respectively (Figure 1).



ZH = height-for-age z score; ZW = weight-for-age z score;
ZWH = weight-for-height z score.
* ZWHa, ZWa, ZHa = weight-for-height, weight-for-age and height-for-age z score at hospital admission.
† ZWHd, ZWd, ZHd = weight-for-height, weight-for-age, and height-for-age z score at hospital discharge.

Figure 1 - Nutritional diagnosis at hospital admission and discharge

An inversely proportional and statistically significant correlation was observed between ZWH at discharge and hospitalization time ($r = -0.132$; $p < 0.01$). For malnourished children, $r = -0.036$ ($p = 0.760$); and for eutrophic children, $r = -0.085$ ($p = 0.070$) (Figure 2).

Regarding nutritional therapy at admission, oral administration was the most used route, 756/841 (89.9%). Use of non-modified whole cow milk was observed in 77/214 (36%) children under 6 months of age; between 6 and 12 months, 97/143 (67.8%); and in malnourished children under 12 months of age, 28/77 (36.4%) (Table 2).

Malnourished children usually received nutritional therapy via probe ($p = 0.014$), multivitamin supplements ($p < 0.001$), oligoelements ($p = 0.0007$), and iron ($p < 0.001$).

Discussion

This is the first study on the prevalence of child malnutrition, in hospitalized children, conducted

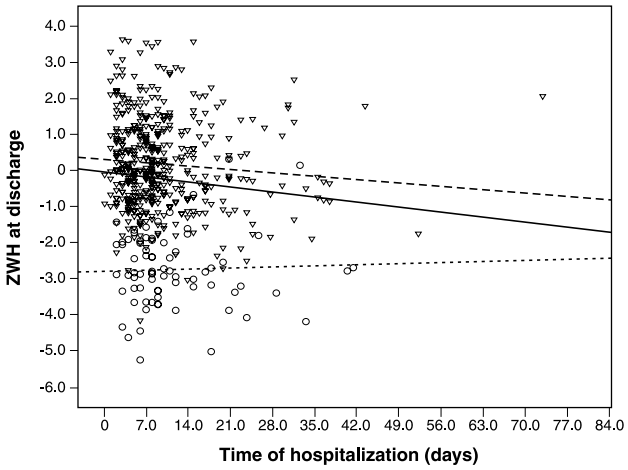


Figure 2 - Correlation between time of hospitalization and weight-for-height z score at hospital discharge of the study children

simultaneously in 10 teaching hospitals in Brazil. A high percentage of moderate/severe PEM (ZWH 16.3%) and stature involvement (ZH 30%) was observed in the study population. These percentages were higher than those observed in a study conducted with children at the public hospital of the city of Fortaleza, State of Ceará, northeastern Brazil, using similar cutoff points: 6.9 and 18.2% for ZWH and ZH, respectively.[13]

Unfortunately, despite the high percentage of PEM, only 56.7% of the children had their nutritional classification documented in the medical record, which indicates a lack of concern with the nutritional diagnosis of hospitalized children. Similar evidence had already been identified in a Brazilian multicenter study with adults. In that study, 81% of medical records did not exhibit information about the patient's nutritional condition, despite the high prevalence of PEM at admission (31%), with a twofold increase after 1-day hospitalization.[14] The findings in the present study become even more relevant if we take into consideration that such information was collected in university-based teaching hospitals – institutions which shape what health professionals are taught. This aspect indicates a need for developing strategies to educate and qualify professionals working in hospitals, in order to enhance the value of current techniques to assess nutritional status in patients attending SUS hospitals, focusing on the pediatric population.

Studies show a consistent association between presence of malnutrition in children < 5 years of age and risk of death due to diarrheic disease and acute respiratory infection.[15] The greater the degree of malnutrition, the higher the risk of death. Since malnourished children are more susceptible to infectious processes and present a series of pathophysiological peculiarities, diagnosis,

Table 2 - Characteristics of nutritional therapy adopted at hospital admission

Variables	< 12 months			≥ 12 months		
	ZWH < -2 n (%)	ZWH ≥ -2 n (%)	p	ZWH < -2 n (%)	ZWH ≥ -2 n (%)	p
Administration route (n = 841)			0.014*			< 0.001*
Oral	83 (87.7)	327 (93.7)		31 (83.8)	315 (97.5)	
Probe	13 (13.3)	21 (6.0)		6 (16.2)	5 (1.5)	
Parenteral	2 (2.0)	1 (0.3)		0	3 (0.9)	
Diet (n = 703)			0.069†			9.024†
NMWCM	28 (36.4)	138 (48.8)		22 (75.9)	195 (85.5)	
IF	44 (57.1)	133 (47.0)		3 (10.3)	25 (11)	
NLPF	2 (2.6)	3 (1.1)		0	5 (2.2)	
SEF	2 (2.6)	4 (1.4)		1 (3.4)	1 (0.4)	
SF	1 (1.3)	5 (1.8)		3 (10.3)	2 (0.9)	
Multivitamins (n = 550)			< 0.001			0.051
Yes	13 (39.4)	20 (8.8)		4 (15.4)	11 (4.7)	
No	20 (98)	206 (91.1)		22 (84.6)	221 (95.2)	
Vitamin A (n = 537)			0.498			0.100
Yes	1 (2)	2 (0.9)		1 (4)	0	
No	48 (98)	223 (99.1)		24 (96)	225 (100)	
Oligoelements (n = 544)			0.007			0.806
Yes	7 (14.3)	4 (1.8)		0	2 (0.9)	
No	42 (85.7)	222 (98.2)		26 (100)	227 (99)	
Iron (n = 534)			0.001			0.084
Yes	12 (23.5)	10 (4.6)		4 (15.4)	13 (5.8)	
No	39 (76.5)	208 (95.4)		22 (84.6)	212 (94.2)	

IF = modified infant polymeric formula; NLPF = no lactose polymeric formula; NMWCM = non-modified whole cow milk; SEF = semielement formula; SF = soy formula.
p = chi-square test.
* Probe vs. oral.
† NMWCM vs. IF.

follow up and care/attention are of utmost importance to reduce time of in-hospital treatment and morbidity and mortality rates.[12]

Factors associated with malnutrition at hospital admission were: age < 1 year, prematurity, low birth weight, absence of breastfeeding, and incomplete immunization. These results are consistent with those found by Lima et al.[16] at hospitals in the city of Recife, northeastern Brazil. PEM is considered a multifactorial condition, which is believed to occur not only due to lack of nutrients or presence of associated disease; a statement that is also corroborated by the findings in the present study.

Acute pulmonary infection was the main cause leading to admission to the hospitals under study, followed by diarrheic disease, and is considered the most important cause of hospitalization and death in individuals < 5 years of age.[17] In Brazil, it is estimated that 5.4 and 12.8% of deaths in children under 1 year of age and aged 1 to 4 years, respectively, are due to pneumonia.[18]

Diarrheic disease is still an important cause leading to mortality and hospital admission in Brazil, despite the decrease observed in its prevalence over the past years.[19] Malnourished children are three times more likely to have diarrheic disease at admission than eutrophic children. This finding is similar to that reported in a study with severely malnourished children admitted to a reference center in the city of São Paulo,[7] southeastern Brazil, and the city of Recife,[4] northeastern Brazil.

The results also demonstrated that child nutritional condition was inversely proportional to time of hospitalization. To date, however, in contrast with the adult population, the percentage of weight loss in relation to time of hospitalization or any association with clinical worsening or mortality increase are yet to be defined for the pediatric population.[20] Since mean time of hospitalization was around 1 week, ZWH was used to evaluate the progression of nutritional condition at the two time points; the short hospitalization period, however, limited the use of the height-for-age indicator.

Despite the high percentage of nutritional deficiencies, only a small number of children were submitted to an adequate nutritional therapy, i.e., according to recommendations by WHO and BMH.[12,21] Our findings also revealed a high percentage of use of non-modified whole cow milk, including use in children with moderate/severe

PEM. WHO and BMH recommend the use of cow milk-based foods, with proper dilution, addition of micronutrients and adjustment of macronutrients, in order to meet the specific needs of children with moderate/severe malnutrition during the nutritional stabilization and recuperation phases.[12,21]

Based on our results, we could detect a high percentage of nutritional deficiencies in the children evaluated. The results also demonstrated that health professionals do not routinely document nutritional status and the nutritional therapy adopted in the medical records of malnourished children. These data underscore the importance of developing qualified hospital medical facilities, including university-based and teaching hospitals, regarding diagnosis and therapeutic approach to malnutrition, based on the conduct guidelines proposed by WHO and adapted by BMH and the Brazilian Society of Pediatrics to the Brazilian reality.

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