

Excess body weight in children may increase the length of hospital stay

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OBJECTIVES: To investigate the prevalence of excess body weight in the pediatric ward of University Hospital and to test both the association between initial nutritional diagnosis and the length of stay and the in-hospital variation in nutritional status.

METHODS: Retrospective cohort study based on information entered in clinical records from University Hospital. The data were collected from a convenience sample of 91 cases among children aged one to 10 years admitted to the hospital in 2009. The data that characterize the sample are presented in a descriptive manner. Additionally, we performed a multivariate linear regression analysis adjusted for age and gender.

RESULTS: Nutritional classification at baseline showed that 87.8% of the children had a normal weight and that 8.9% had excess weight. The linear regression models showed that the average weight loss z-score of the children with excess weight compared with the group with normal weight was -0.48 ($p = 0.018$) and that their length of stay was 2.37 days longer on average compared with that of the normal-weight group ($p = 0.047$).

CONCLUSIONS: The length of stay and loss of weight at the hospital may be greater among children with excess weight than among children with normal weight.

KEYWORDS: Excess Weight; Pediatrics; Hospitalization.

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■ INTRODUCTION

The relevance of assessing the nutritional status of patients at admission and during their hospital stay is widely acknowledged in the literature and in clinical practice. A very close relationship is known to exist between the patient's nutritional status and the acquisition of diseases, the length of stay and the likelihood of in-hospital complications (1-2).

Many of the studies devoted to nutritional status have been based on the assumption that the out-of-hospital prevalence of malnutrition is high, leading to an augmented number of hospital admissions and longer hospital stays (3-4). However, the latest studies conducted in Brazil found progressive increases in excess body weight and obesity among children. These numbers are alarming and show that there is currently a true epidemic of excess body weight. Data from the Family Budget Survey (2008) (5) indicate that 33% of children aged 5 to 9 years exhibit excess body

weight, of whom 15% are obese. The prevalence of excess body weight among children aged 0 to 5 years detected by the National Demography and Health Survey (Pesquisa Nacional de Demografia e Saúde, PNDS-2006) was 6.6% (6).

The international literature indicates a high prevalence of children with excess body weight at hospital admission (7-8). For children and adolescents presenting excess body weight, the length of stay tends to be proportional to their age, i.e., the older that they are, the longer the length of stay is due to comorbidities associated with excess body weight (9-10). This situation imposes a greater financial onus on healthcare services (11), not only due to an increased length of stay but also because such children seek care at all levels of the healthcare system (12).

The main focus of in-hospital nutrition in Brazil is malnutrition (13). No data on this new epidemiological reality relative to the hospital setting are yet available. We do not know the prevalence of children with excess body weight at hospital admission, the causes of admission, or whether their stay in the hospital is long.

Based on this new scenario, characterized by a predominance of excess body weight among children and adolescents in Brazil, we conducted the present study to investigate the prevalence of excess body weight and the association of this excess body weight with the length of stay and in-hospital weight variation of children admitted to University Hospital of University of São Paulo - HU/USP.

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METHODS

Study design

Retrospective cohort study based on data collected from clinical records corresponding to admissions to University Hospital in 2009.

Sampling

A total of 798 hospital admissions in 2009 met the inclusion criteria. A convenience sample consisting of the first 162 consecutive patients on a list of last names in alphabetical order was selected. A total of 48 cases were excluded due to a lack of data (body weight and/or height data) and an additional 23 were excluded because they met the exclusion criteria. Therefore, the final sample comprised 91 participants.

Statistical power of the sample

Assuming a prevalence of excess body weight of 10%, the average length of stay in the obese group was 2.0 days longer than that in the normal-weight group. The standard deviation was 2.7 and there was a 5% chance of alpha error. Therefore, the statistical power of the sample comprising 91 individuals was estimated to be 80%.

Inclusion criteria: Children aged 1 to 10 years.

Exclusion criteria

Children with chronic diseases were excluded. These diseases included progressive or non-progressive encephalopathy, lung disease (cystic fibrosis, bronchiolitis obliterans, congenital malformations of the tracheobronchial tree), heart disease (congenital anomalies, except for atrial or ventricular septal defects without hemodynamic repercussion; any degree of heart failure; conditions requiring use of digital drugs or diuretics), liver disease (all diseases, whethereither congenital or infectious), renal disease (nephrotic or nephritic syndrome, acute or chronic kidney failure, congenital renal anomalies), infection with human immunodeficiency virus (HIV), genetic syndromes and cancer.

Variables

To address the first aim of the study, i.e., calculation of the prevalence of children with excess body weight at admission, the nutritional diagnosis at admission was defined as the outcome variable.

To address the second aim of the study, namely, investigation of associations, the length of stay (in days) and the in-hospital change in the nutritional status were defined as the outcome variables. Nutritional diagnosis (excess body weight, normal body weight, or malnutrition) was set as an independent variable and age and gender were considered as confounding variables.

Assessment of nutritional status

Children aged 1 to 3 years were classified based on z-scores according to the weight/age (W/A) ratio, as follows: excess body weight was defined as $W/A \geq 2$ z-scores; malnutrition, as $W/A < -2$ z-scores; and normal weight, as the interval from -2 to $+2$ z-scores (14-16). Children aged 3 to 10 years were classified based on body mass index (BMI), as follows: excess body weight and the risk of excess body weight were defined as $BMI \geq 1$ z-score (this group of

children is hereafter called the excess-weight group), malnutrition was defined as $BMI < -2$ z-scores and normal weight was defined as BMI from -2 to $+1$ z-score (15-16). The W/A and BMI values were compared with the values in the growth charts elaborated by the World Health Organization (WHO/2006) (15-16).

Statistical analysis

The data related to the sample characteristics are presented in a descriptive manner (means, frequencies) and as a function of the nutritional status at baseline. Mean values were subjected to analysis of variance (ANOVA) and frequencies were analyzed using the chi-square test. Additionally, we elaborated two multivariate linear regression models to assess the effect of the explanatory variable on the outcome variables adjusted for age and gender.

The study was approved by the research ethics committee of University Hospital (Comitê de Ética do Hospital Universitário - CEP-HU/USP: 1116/11- SISNEP CAAE: 0018.0.198.000-11).

RESULTS

The data that characterize the sample are described in Table 1. The children with malnutrition were the oldest (7.29 ± 3.45 years; normal weight: 3.37 ± 2.58 years; excess weight: 5.55 ± 3.04 years). In all three groups, the number of boys was greater than the number of girls (normal weight: 50.6% vs. 49.4%; malnutrition: 100% vs. 0%; excess weight: 87.5% vs. 12.5%). The main reason for hospital admission was lung problems (bronchopneumonia and wheezing) among the children with normal or excess weight. Pulmonary problems were also predominant among diagnoses before admission in all three nutritional categories. An initial assessment of nutritional status showed that most children had a normal weight (87.8%); however, the proportion of children with excess weight was noteworthy (8.9%), whereas only 3.3% of the sample exhibited malnutrition. The children with excess weight exhibited the longest length of stay (5.5 ± 6.23 days) and the greatest weight loss (-0.38 ± 0.81) during their stay in the hospital. The clinical severity was assessed based on parameters such as oxygen use and the need for intensive care. Use of oxygen was similar in all three nutritional categories, namely, eight hours on average and no child required intensive care.

The linear regression models are described in Table 2. Following adjustment for age and gender, the average weight loss z-score of the group of children with excess weight compared with the groups with normal weight and malnutrition was -0.48 ($p = 0.018$). The length of stay of the children with excess weight was 2.37 days longer on average than that of the children with normal weight or malnutrition ($p = 0.047$).

DISCUSSION

This work was the first Brazilian study that sought to assess the prevalence of children with excess weight at hospital admission, their length of stay in the hospital and their in-hospital body weight variation.

The prevalence of children with excess weight at admission was 8.9%, which does not reflect the overall Brazilian prevalence of excess weight in children, which is 33% (5). In this regard, it is worth noting that studies that

**Table 1** - Descriptive and clinical variables according to the nutritional status of children admitted to University Hospital.

	Normal weight (N = 79)	Malnutrition (N = 3)	Excess weight (N = 8)	p
Age (years)	3.37 (2.58)	7.29 (3.45)	5.55 (3.04)	0.00
Gender ♂	50.6%	100%	87.5%	0.04
♀	49.4%	0	12.5%	
Diagnosis at admission				
Bronchopneumonia	43%	0	62.5%	
Asthma	19%	33.3%	0	
Skin diseases	10.1%	0	0	
Varicella	5.1%	0	0	
Appendicitis	1.3%	0	12.5%	0.31
Fractures	3.8%	0	0	
Other	17.7%	66.7%	25%	
Previous diagnosis				
Bronchopneumonia	42.8%	0	100%	
Asthma	42.8%	100%	0	
Appendicitis	4.7%	0	0	0.69
Other	9.7%	0	0	
Initial nutritional classification	87.8%	3.3%	8.9%	-
Final nutritional classification	88.4%	4.7%	6.9%	-
Initial W/A (z-score)	-0.12 (0.95)	-2.14 (1.52)	1.37 (0.69)	-
Final W/A (z-score)	-0.18 (0.94)	-2.13 (1.24)	1.19 (0.57)	-
Initial BMI (z-score)	-0.32 (0.90)	-2.35 (0.19)	2.36 (0.72)	-
Final BMI (z-score)	-0.25 (0.83)	-2.57 (0.75)	2.17 (0.72)	-
Δ weight (z-score)	0.04 (0.45)	-0.2 (0.87)	-0.38 (0.81)	0.06
Length of stay (days)	3.72 (2.61)	4.33 (3.21)	5.5 (6.23)	0.29
Use of oxygen				
No	75.9%	66.7%	62.5%	0.67
Yes	24.1%	33.3%	37.5%	
Length of oxygen use (days)	0.35 (0.80)	0.33 (0.57)	0.37 (0.51)	0.99
ICU	0	0	0	-

*Tests: ANOVA for means and chi-square tests for frequencies.
ICU: Intensive care unit.

have assessed the nutritional status of inpatient children in Brazil reported high prevalence rates of moderate malnutrition, namely, 10.9% in São Paulo (13), 18.7% in Ceará (1) and 16.3% in 10 Brazilian university-based hospitals (17). In contrast, none of the studies made any mention of children with excess weight. The percentage of children with malnutrition that we found, 3.3%, is lower than the percentage reported in the Brazilian literature and 87.8% of the children assessed in the present study had a normal weight.

As in other Brazilian and international studies, we had difficulty in collecting all of the data needed to assess nutritional status (18-19). Whereas the children's weight was registered in all of the clinical records, height was most often registered only for children older than 3 years. For that reason, we selected the W/A ratio to assess the nutritional

status of children younger than 3 years old. The availability of data allowed us to use BMI as a parameter to assess children older than 3 years, as BMI is being increasingly used to assess nutritional status in children and is also recommended by the WHO (15).

In the present study, the group of children with excess weight who were younger than 5 years also included children with BMIs >1 z-score, which, according to the cutoff points formulated by the WHO, strictly corresponds to a risk of excess body weight. We chose to include those children in the excess-weight group because certain authors have questioned the WHO cutoff points based on the argument that as obesity currently represents a true epidemic, the risk of excess body weight should be considered the same as actual excess body weight, as in the case of children older than 5 years old (20).

According to our results, the main cause of hospital admission was lung problems (bronchopneumonia and wheezing). These findings agree with the overall situation in Brazil, as respiratory diseases accounted for 38.4% of hospital admissions of children aged 0 to 9 years from 2002 to 2006 (21). Although we detected no difference in the main diagnosis among the groups in this study, the length of stay and weight loss were greater in the group of children with excess weight. The average weight loss z-score of the group of children with excess weight compared with the groups with normal weight and malnutrition was -0.48 ($p=0.018$) and the children with excess weight stayed in the hospital 2.37 days longer ($p=0.047$) than the other children did. These findings indicate that the repercussions of respiratory disease exerted a significant impact on the health status of the sample. We want to highlight that the children with

Table 2 - Multivariate linear regression analysis of the adjusted effect of nutritional status on the length of stay and in-hospital weight variation.

Hospital stay length (days)	Beta	95% CI	p
Malnutrition	1.70	-2.01 to 5.42	0.364
Excess weight	2.37	0.03 to 4.71	0.047
Age (months)	-0.29	-0.54 to -0.05	0.018
Gender (fem)	-0.12	-1.45 to 1.20	0.851
Weight variation (z-score)			
Malnutrition	-0.35	-0.97 to 0.27	0.269
Excess weight	-0.48	-0.87 to -0.09	0.018
Age (months)	0.03	-0.01 to 0.07	0.156
Gender	0.03	-0.20 to 0.25	0.812



excess weight did not present a statistically significant difference in the frequency of previous diseases compared with the eutrophic or malnourished children (Table 1). The existence of an underlying health condition that could justify longer hospitalization does not seem to be a valid alternative explanation.

Certain authors have reported an association between asthma and excess body weight in children (22) and other studies have described an increase in the number of hospital admissions of children with asthma as being associated with excess body weight, resulting in overload of the capacity and finances of the healthcare system (23).

This work was not the first study to determine that the length of hospital stay of children with excess body weight might be longer, as that association was previously reported by several epidemiological studies (9-24). In this regard, we may observe that due to being subjected to a continuous inflammatory state, individuals with excess body weight are more susceptible to infection and to deregulation of the immune system (25). Such an "immune imbalance" may account for the poor response to infection exhibited by individuals with excess body weight, eventually resulting in the increased mortality of obese children with severe diseases (19).

Despite offering relevant results that are comparable to what has been reported in the literature, this study has certain limitations that may reduce its impact. First, it was a retrospective study based on information registered in clinical records. It was difficult for us to obtain data on the children's body weight and height at admission and throughout their stay in the hospital, which made assessment of nutritional status and calculation of BMI, the most appropriate index for children of any age, difficult. A second limitation derives from the use of convenience sampling; a random sample would have been more appropriate, as that type of sample provides a sounder basis for studies. However, in this case, that option was not possible due to the insufficiency of the data in the clinical records.

The third and last limitation is related to the small sample size. If we had calculated the sample size based on the probability of an alpha error of 5% and a power of 80%, we would have analyzed only 8 cases. This fact implies large confidence intervals and low precision estimates.

For those reasons, we believe that prospective epidemiological studies conducted at hospitals are needed to establish the prevalence and cause of the hospital admission of children with excess body weight.

To summarize, in this study, we found that the average weight loss and length of stay in the hospital were greater in children with excess body weight than in children with normal weight or malnutrition.

AUTHOR CONTRIBUTIONS

Fernandes MT was responsible for planning, organization, analysis and manuscript writing. Ferraro AA was responsible for data analysis. Danti GV and Garcia DM were responsible for data collection.

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