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Length of stay is associated with incidence of in-hospital malnutrition in a group of low-income Brazilian children

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Length of stay is associated with incidence of in-hospital malnutrition in a group of low-income Brazilian children


Abstract
Objective. To test the hypothesis that increased length of stay and anthropometric status at admission are significant factors associated with in-hospital malnutrition (IHM).

Material and methods. Prospective study with two weight (admission and discharge) and one height (admission) measurements per child at the Instituto de Puericultura e Pediatria Martagão Gesteira (IPPMG), Rio de Janeiro, Brazil. The study included 456 children of low socioeconomic status under 10 years of age admitted to the IPPMG during 1997. Statistical analysis involved calculation of in-hospital malnutrition (IHM) prevalence by covariates. The length of hospital stay varied from 1 to 69 days. Association of IHM with gender, age category, length of stay, presence of wasting, and stunting, was tested by calculating odds ratios using multivariate logistic regression.

Results. Logistic regression showed that after adjusting for gender, age category, length of stay, presence of wasting, and stunting, was tested by calculating odds ratios using multivariate logistic regression. Results. Logistic regression showed that after adjusting for gender, age category, and presence of stunting at admission, presence of wasting at admission (OR= 0.07, CI 95% 0.01 - 0.55) and length of stay from 17 to 69 days (OR= 4.68, CI 95% 2.00 - 10.95) resulted statistically associated with IHM in the final model.

Conclusions. As intervention measures, the authors suggest implementation of an early identification system for children at risk of developing IHM, along with a review and implementation of in-hospital feeding protocols.
Anthropometry to monitor nutritional status is considered a basic procedure for various public health purposes. From a clinical perspective, knowledge of the nutritional status of a hospitalized child is an indispensable strategy for establishing an adequate approach to the maintenance and/or recovery of nutritional status during the hospital stay. Jeopardized nutritional status is known to have an important impact on the course of underlying diseases, such as diarrhea and respiratory illness, among others. These patients are thus exposed to a longer stay, which in turn deteriorates their nutritional status.

No studies focusing on the evolution of nutritional status over the course of hospitalization were identified in Brazil, although some studies on the nutritional status of hospitalized children are available. However, there is a vast international literature on the topic. The development of studies focusing on this topic in Brazil would be important to define more precisely clinical protocols for nutritional management during admission and hospitalization.

An important methodological question is the absence of specific criteria for the definition of in-hospital malnutrition (IHM), thus making direct comparisons difficult across studies. In general, such studies report that hospitalization per se constitutes a major risk factor for IHM and that the greater the length of stay, the higher the probability that the child will develop IHM.

This article presents data on factors potentially associated with the incidence of IHM in a sample of low-income children under 10 years of age, admitted over the course of year 1997 to the Instituto de Puericultura e Pediatria Martagão Gesteira (IPPMG) at the Universidade Federal do Rio de Janeiro (UFRJ), Brazil.

Material and methods

The study was performed using a database produced by the Clinical Nutrition Service at the IPPMG, a tertiary public health care unit at the Universidade Federal do Rio de Janeiro, Brazil, with information on 753 children ranging from 1 to 144 months of age, hospitalized during the year 1997. Length of stay varied from 1 to 69 days of hospitalization.

Eligibility criteria for this study were defined as age under 10 years, use of anthropometry data only from the first admission in 1997, clinical diagnoses that were not cancer, leukemia, and other chronic disease such as AIDS and renal problems, height-for-age Z-score (HAZ) values from -5 to +3, weight-for-height (WHZ) from -4 to +5, and weight-for-age (WAZ) from -5 to +5. These Z-score ranges were defined according to World Health Organization guidelines and are considered the biologically plausible ranges. Chronic diseases were eliminated as a tentative to control for the potential association between this type of diseases and greater length of stay and thus greater exposure to IHM. Finally, this age range was selected, since the classic anthropometric indicators (WAZ, HAZ, and WHZ) are appropriate for use with children younger than 10 years. A total of 116 children (15.4%) were excluded because they did not meet the age criteria, 84 (11.2%) had more than one admission, 52 (6.9%) had cancer, leukemia, and other chronic disease, and 45 (5.9%) were excluded because of implausible Z-score values. The final sample included 456 children with complete weight and height data.

Anthropometric data were collected according to standard procedures by two nutritionists from the Clinical Nutrition Division of the IPPMG, as a routine hospital procedure. For weight data (at admission and discharge), an infant scale was used (Filizola Model 30, Indústrias Filizola S/A, Brazil) for children under 24 months, accurate to 10 grams (in the recumbent position and undressed) and a platform scale (Filizola Model 31, Indústrias Filizola S/A, Brazil) for children over 24 months (standing, with as little clothing as possible), accurate to 0.1 Kg. Data on length (for children under 24 months) were obtained using an infantometer made at the hospital, accurate to 0.1 cm. Children over 24 months had their height measured in the orthostatic position using a stadimeter (Filizola Model 31, Indústrias Filizola S/A, Brazil), accurate to 0.5 cm.

Assessment of nutritional status at admission was performed using traditional anthropometric indicators.
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Predictors (independent variables) potentially associated with IHM (dependent variable) were assigned values of 1 and 0 for the exposed and unexposed categories, respectively. The multivariate model was performed based on bivariate associations displaying statistical significance with \( p < 0.05 \). To construct the models and select the best one, we used the logistic regression technique estimating odds ratios with 95% confidence intervals and adjustment for confounding. The final model was adjusted for age categories, gender and for the presence of stunting at admission. Weight for age was not included in the final model to avoid colinearity both with weight for height and height for age. All statistical significance analyses used \( p < 0.05 \). All of the procedures were performed with the SPSS/PC+ software, version 8.0.

Results

Of the 456 children studied, 59% were males and 41% females. The age distribution was relatively uniform. Table I presents prevalence data for stunting, wasting, and underweight. Prevalence of malnutrition at admission was 17.1% for stunting, 10.7% for wasting, and 20.4% for underweight. Z-score means were systemat-
ically negative and consistent with the observed prevalences.

Results for prevalence for each indicator evaluated by sex and age category, demonstrated that the prevalence of stunting was higher among children from 0.0 to 5.9 months of age and lower among children from 60.0 to 119.9 months in both sexes. We also observed that prevalence of low height-for-age among girls tended to decrease with age, which was not observed in boys (analyses not shown). Prevalence of low weight-for-height did not differ statistically among age categories. When the mean Z-scores were compared for the two sexes across age categories, we observed that boys showed slightly higher values than girls, but that the difference was only statistically significant in the 24.0-59.9 month category ($p=0.051$) (analyses not shown). As for weight-for-age, both for the children as a whole ($p=0.008$) and for boys only ($p=0.012$), the prevalence decreased with age. When comparing the sexes there was no statistically significant difference between prevalences in any age category.

Data on incidence of IHM by length of stay and sex revealed that the greater the length of stay, the higher the incidence of IHM. Values for boys increased from 9.6% (1-5 days) to 26.6% amongst those hospitalized for a longer period (17–69 days). Among girls the incidence reached 33.9% in the group with the greatest length of stay. These differences were statistically significant both for boys ($p=0.026$) and girls ($p=0.001$). As for incidence of IHM in the two sexes, we noted that it was always slightly higher among girls, except for the length of stay category from 1 to 5 days. However, these differences were not statistically significant for any length-of-stay group (results not shown).

Data in Table II include univariate analysis for incidence of IHM, odds ratio, and 95% confidence intervals for selected variables. We observed that greater length of stay was an important risk factor for IHM, since the OR for developing IHM during hospitalization was 4.20 times higher (CI 95% 1.82 - 9.69, $p<0.001$) for children with greater length of stay (17-69 days). With regard to anthropometric status at admission, children admitted with wasting and underweight were less likely to develop IHM during hospitalization than those not malnourished at admission, with odds ratios of 0.10 (CI 95% 0.01 - 0.73, $p=0.024$) and 0.38 (CI 95% 0.16 - 0.86, $p=0.020$), respectively. No association was found between IHM and gender, age, or stunting at admission.

Table III presents the results of logistic regression analysis, using IHM as the dependent variable. We observed that the variables that remained statistically associated with IHM in the model after adjusting for confounders (age, gender, and anthropometric status at admission) were: wasting at admission (OR= 0.075, CI 95% 0.010 - 0.566, $p=0.012$) and length of stay from 17 to 69 days (OR= 4.682, CI 95% 2.001 - 10.953,

### Table II

<table>
<thead>
<tr>
<th>Selected variables</th>
<th>Prevalence</th>
<th>OR</th>
<th>CI (95%)</th>
<th>p value</th>
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<td>17.2</td>
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<td>0.0 to 5.9</td>
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<td>6.0 to 11.9</td>
<td>16.7</td>
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<tr>
<td>12.0 to 23.9</td>
<td>24.3</td>
<td></td>
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<td>24.0 to 59.9</td>
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<tr>
<td>60.0 to 119.9</td>
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<td>0.91</td>
<td>(0.77 - 1.08)</td>
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<td>6 to 9 days</td>
<td>10.5</td>
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<td>10 to 16 days</td>
<td>13.6</td>
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<tr>
<td>17 to 69 days</td>
<td>29.4</td>
<td>4.20</td>
<td>(1.82 - 9.69)</td>
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<td>Underweight at admission</td>
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<tr>
<td>No</td>
<td>17.8</td>
<td>0.38</td>
<td>(0.16 - 0.86)</td>
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<td>Stunting at admission</td>
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<tr>
<td>Yes</td>
<td>14.1</td>
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<tr>
<td>No</td>
<td>15.9</td>
<td>0.87</td>
<td>(0.43 - 1.74)</td>
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<td>Wasting at admission</td>
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<td>Yes</td>
<td>2.0</td>
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<tr>
<td>No</td>
<td>17.2</td>
<td>0.10</td>
<td>(0.01 - 0.73)</td>
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</table>

* Reference category

### Table III

<table>
<thead>
<tr>
<th>Independent variables*</th>
<th>OR</th>
<th>CI (95%)</th>
<th>p value</th>
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<td>0.075</td>
<td>(0.010 - 0.566)</td>
<td>0.012</td>
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<td>Length of hospitalization</td>
<td>1.167</td>
<td>(0.459 - 2.969)</td>
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<td>6 to 9 days</td>
<td>1.567</td>
<td>(0.633 - 3.845)</td>
<td>0.333</td>
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<tr>
<td>10 to 16 days</td>
<td>4.682</td>
<td>(2.001 - 10.953)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* Note: Final model adjusted for age, gender, and presence of stunting at admission.
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Length of stay and incidence of in-hospital malnutrition

Most of the studies published in Brazil on the nutritional status of hospitalized children are based on the classifications by Gomez and Waterlow and the percentile system, which are no longer recommended because of a number of drawbacks. This methodological difference makes it difficult to compare the results of such studies with ours. In addition, we found no studies that actually focus on incidence of IHM.

The occurrence of IHM was quite high in this sample, and several factors are known to contribute to it. Dickerson identifies the following possible causes of IHM: the type of diseases affecting patients, which often interfere with appetite and the patient’s ability to handle meals; the appearance or palatability of the meal itself; and the hospital routine, which in some cases interferes with the patient’s feeding habits, such as nursing procedures performed around meal times.

Unfortunately we could not determine the dietary intake of children in this study, which would have greatly improved the strength of the investigation. We suggest that future studies along the same line should include dietary analysis.

One would expect that malnourished children would have their nutritional status aggravated while hospitalized, since they are more susceptible to infection due to their debilitated immune state. Using logistic regression, this study indicates that wasting at admission was a protective factor against the occurrence of IHM (OR= 0.07, CI 95% 0.01 - 0.56, p= 0.012). This finding can be explained in part by the fact that children found to be malnourished at admission have little body mass reserves to be depleted, while those admitted in satisfactory nutritional condition have available body mass for catabolism. Another possible argument is that more attention is given to children with a greater nutritional deficit as compared to eutrophic children, who are more prone to being overlooked by the health team. However, these results should be interpreted with caution, since from the public health point of view this situation is neither desirable nor recommendable.

Another factor potentially associated with incidence of IHM observed in the current study was length of stay in the hospital. Results of logistic regression showed that incidence of IHM increased with length of stay. We observed that children hospitalized for longer periods of time (17-69 days) showed an OR for developing IHM of 4.68 (CI 95%: 2.00 - 10.95) as compared to children who stayed less time in the hospital (1-5 days). This indicates the need, within constraints, of minimizing length of stay in the hospital for these children. Possible explanations for increased incidence of IHM with length of stay involve greater...
exposure to hospital infections and emotional disorders caused by separation from the family environment, which may reduce appetite.\textsuperscript{12}

Another hypothesis is that greater length of stay is associated with more serious and complex diseases and consequently greater exposure to IHM. One limitation concerning the current study is the lack of reliable information on admission diagnoses. One can suspect that length of stay could be partially confounded by diagnoses; thus, considering that the type of disease itself may contribute to the incidence of IHM, we eliminated from analysis chronic diseases as leukemia, cancer, AIDS, and renal problems. Based on this procedure we conclude that the above hypothesis is not plausible. Various studies have also shown a worsened or even seriously deteriorated nutritional status with increased length of stay.\textsuperscript{2-4,7,25}

The importance of IHM as a public health problem should be recognized in order to implement intervention strategies.\textsuperscript{26} One initial strategy is the formation of a multidisciplinary team with recognized expertise on the issue, allowing for the provision of adequate nutritional support for hospitalized children.\textsuperscript{4} A second strategy consists of implementing an efficient system for identifying all children at risk of IHM at admission, including their characteristics (sex, age, and socioeconomic conditions),\textsuperscript{2,3,6} thereby facilitating the implementation of intervention strategies such as adequate preparation and serving of meals. A firm policy to deal with the problem of IHM is thus indispensable to reduce hospital mortality rates, length of stay, financial costs, and above all the occurrence of the problem itself.

In short, we conclude by underscoring the scarcity of available studies on IHM. The few existing studies focus on nutritional status at admission and fail to evaluate incidence of IHM. Finally, IHM deserves greater attention from health care professionals and researchers, not only because of its financial and health impact, but also to foster a better understanding of its causes, since numerous factors like the underlying disease, quality of hospital care, and even the absence of a specific policy to deal with the problem, can contribute to worsen nutritional status during hospitalization.

References