Evaluation of nutritional status in children hospitalized in Mofid Children's Hospital, Tehran, Iran

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Prz Gastroenterol 2013; 8 (2): 120–125
DOI: 10.5114/pg.2013.34837

Key words: failure to thrive, dysphagia, vomiting, children, hospital-acquired malnutrition.

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Abstract

Introduction: Children who are admitted to the hospital are at high risk of developing malnutrition. Malnutrition may cause complication during and after hospitalization.

Aim: To determine the frequency of weight reduction among children hospitalized in a tertiary referral hospital in Tehran.

Material and methods: Patients aged ≥ 1 month and length of hospital stay > 48 h were included in this study. Duration of this study was 3 months from 1st November 2006. Age, sex, disease severity, respiratory difficulty, calorie intake, diarrhea, vomiting, dysphagia, length of hospital stay, and type of disease (surgical vs. medical) were assessed during admission. Children with weight reduction < 2% were placed in group I. Data were analyzed by SPSS ver. 14.0 (Chicago, IL, USA).

Results: In this study 322 cases were included. Group I included 156 patients (48.44%) and group II included 110 patients (51.56%). One hundred and fifty patients (46.6%) had caloric intake less than 50% and 172 (53.4%) had caloric intake ≥ 50%. Analysis showed that calorie intake equal to or less than 50%, disease grade 2 and 3, duration of hospital stay, diarrhea, and dyspnea had a significant correlation with weight reduction ≥ 2% ($p < 0.05$).

Conclusions: Calorie intake < 50%, disease severity, length of hospital stay, diarrhea, and dyspnea were significantly higher among cases with weight reduction ≥ 2% than cases with weight reduction < 2%.

Introduction

Malnutrition is the imbalance between the supply of nutrition and energy and the body's demand for these to ensure growth, maintenance, and specific function [1]. Children who are admitted to the hospital are at high risk of developing malnutrition, especially children with underlying disease [2]. In Asian, Latin American, Near Eastern and African countries, hospital-acquired malnutrition continues to be an important co-morbidity in children, affecting their outcome [3]. In different countries, 21% to 80% of children showed malnutrition following hospital admission [4]. It is known that mortality and morbidity rates are greater in undernourished patients [5-7]. Around 70-80% of malnourished patients enter and leave the hospital without identification and treatment of their malnutrition [8, 9]. However, hospital-based malnutrition has been described with increasing frequency in hospitalized and chronically ill children in economically advantaged countries such as the United States and European countries [3]. In a tertiary hospital in France, Sermet-Gaudelus *et al*. found that 62% of children had lost weight during their hospital stay [10]. The nutritional status of children often declined after admission to the hospital, resulting in early and serious consequences, such as slowing of growth and increased susceptibility to various infections [10-12]. Although hospital-acquired malnutrition is frequently associated with a risk of adverse clinical events and longer hospital stay leading to higher health care costs [12], it is a problem that remains largely underestimated and often unrecognized [13].

Aim

The aim of this study was to evaluate nutritional status among children hospitalized in our tertiary hospital.

Material and methods

This prospective study was carried out in Mofid Children's Hospital, a referral children's hospital in Tehran, Iran. Duration of the study was 3 months during 2006. Children aged > 1 month with duration of admission > 48 h were included in this study. Exclusion criteria were severe liver or kidney disease, severe fluid and electrolyte imbalance, special diet regimen (diabetic, ketogenic), and patients without parental agreement. Age, sex, weight, % of body weight reduction, disease intensity, type of disease, diarrhea, vomiting, calorie intake, dyspnea, dysphagia, severity of malnutrition, and duration of hospital admission were recorded for each patient.

A digital baby scale (Seca, Germany, ±5 g) was used for weight measurement in children < 15 kg and an analog scale (Rasa, Iran, ±100 g) was used for children > 15 kg. Height was measured in a recumbent position in children < 3 years. A stadiometer was used for height measurement for children > 3 years in a standing position.

Waterlow criteria and NCHS (National Center for Health Statistics) tables were used for determination of acute or chronic malnutrition at the moment of hospitalization.

Weight for height (wasting) was used to define acute malnutrition. Height for age (stunting) was used to determine chronic malnutrition. Acute hospital malnutrition in this study was defined as more than 2% weight reduction after admission. This endpoint criterion was obtained from the Sermet-Gaudelus study [10]. Weight reduction was calculated from the formula WR = (Wad – Wd)/Wad × 100, where Wad – weight at admission, Wd – weight at discharge.

According to WR patients were divided into two groups. Group I consisted of patients with WR < 2% and group II included cases with WR ≥ 2%.

According to the classification of disease by the American Academy of Pediatrics and the American Nutrition Association, patients were classified in 3 groups (1 – mild, 2 – moderate, 3 – severe) [14-16]. Grade I conditions include mild stress factors, e.g., admission for diagnostic procedures, minor infection, other episodic illnesses, or minor surgery. Grade II conditions include moderate stress factors, e.g., severe but not life-threatening infection, routine surgery, fracture, chronic illness without deterioration, or inflammatory bowel disease. Grade III conditions include severe stress factors, e.g.; acquired immunodeficiency syndrome, malignancy, severe sepsis, major surgery, multiple injuries, acute deterioration of chronic disease, or major depression.

Statistical analysis

Analysis was done by SPSS ver. 14 (SPSS Inc, Chicago, IL, USA). Fisher exact test and Pearson χ^2 test were used for correlation.

Results

In this study, 173 (53.7%) male and 149 (46.3%) female patients were included ($p = 0.058$, $\chi^2 = 3.58$). Two hundred and sixty-six patients (70.2%) were admitted in medical wards and 92 (29.8%) in surgical wards ($p = 0.00001$, $\chi^2 = 104.97$).

Acute malnutrition was noted in 27% of cases. Chronic malnutrition was found in 40.1% of cases (Table I). Chronic malnutrition was significantly more common than acute malnutrition ($p = 0.0004$, $\chi^2 = 12.29$). There was no significant difference between prevalence of mild acute and mild chronic malnutrition ($p = 0.56$) (Table I). Of 322 patients, duration of hospital staying was 1 week in 168 (61.5%) cases ($p = 0.00001$). Weight loss ≤ 2% was noted in 156 (41.44%) cases ($p = 0.000001$) (Table II).

Cases according to minor, moderate and severe risk factors were classified into 3 categories (Table III). Minor surgery, gastroenteritis, and urinary tract infection were the most common minor risk factors ($p < 0.05$). Usual surgery was the most common moderate risk factor ($p = 0.00001$, $\chi^2 = 58.8$). Major surgery was the most common major risk factor ($p = 0.00001$, $\chi^2 = 67.1$) (Table III).

In our study, severe risk factors (25.16%) were the least common risk factors among hospitalized children compared to minor (35.40%) and moderate risk factors (39.44%).

There was a significant correlation between weight loss and disease severity, duration of hospitalization,

Table I. Characteristics of cases according to sex, ward of admission, type of malnutrition, and calorie intake

Parameter	Results		Significance
Sex	Male (173, 53.7%)	Female (149, 46.3%)	$p = 0.058$, $\chi^2 = 3.58$
Ward of admission	Medical (226, 70.2%)	Surgical (96, 29.8%)	$p < 0.0001$, $\chi^2 = 104.97$
Malnutrition	Acute (87, 27.01%) Mild (64, 19.9%) Moderate (15, 4.6%) Severe (8, 2.5%)	Chronic (129, 40.06%) Mild (70, 21.8%) Moderate (46, 14.3%) Severe (13, 4%)	$p = 0.0004$, $\chi^2 = 12.29$ $p = 0.56$, $\chi^2 = 0.34$ $p = 0.00003$, $\chi^2 = 17.4$ $p = 0.26$, $\chi^2 = 1.23$
Calorie intake	< 50% (150, 46.6%)	> 50% (172, 53.4%)	$p = 0.08$, $\chi^2 = 3.01$

Table II. Duration of hospitalization and weight loss during hospitalization

Parameter	*N* (%)	Value of *p*
Duration of hospitalization [weeks]		
1	168 (61.5)	0.00001
2	87 (27)	
3	21 (6.5)	
≥ 4	16 (5)	
Total weight loss (during hospitalization) [%]		
0 - < 2	156 (41.44)	0.000001
2-5	103 (31.98)	
> 5-10	51 (15.88)	
> 10	12 (3.72)	

and calorie intake, diarrhea, and dyspnea (Table IV). Acute malnutrition and chronic malnutrition had a significant correlation with acute hospital weight loss (Table IV).

Discussion

In the current study, 87 (27.01%) and 129 (40.06%) cases had acute (W/H) or chronic malnutrition (H/A) with varying degrees, respectively. Of all cases, 51.55% of cases showed weight loss ≥ 2% during hospitalization. In the study by Mahdavi *et al*. on 140 children, 48.6% of cases were underweight according to Waterlow criteria [17]. Our findings were similar to the study by Mahdavi *et al.* [17]. But, in their study, weight was assessed at the moment of hospitalization. In our study, weight was assessed at the moment of hospitalization and during hospitalization.

In the study by Marek *et al.,* BMI < 10% percentile was found in 19.3% of cases [18]. They concluded that undernutrition among children admitted to hospital is relatively frequent.

In the Hendricks *et al*. study, the prevalence of acute protein-energy malnutrition (weight for height) based on the Waterlow criteria was as follows: severe (1.3%); moderate (5.8%); mild (17.4%), and none 75.5% [19]. In our study, the prevalence of acute malnutrition using the same criteria was as follows: severe (2.5%); moderate (4.6%); mild (19.9%); and none (73%). The results of the two studies were similar.

In the Hendricks *et al*. study, the prevalence of chronic malnutrition (height for age) was as follows: severe (5.1%); moderate (7.7%), mild (14.5%), and none (72.8%) [19]. In our study, the following results were obtained: severe (4%); moderate (14.3%); mild (21.8%); and none (59.9%). The results of both studies were similar.

In the Dogan *et al*. study on 528 cases, evaluation of weight for age showed that 52.4% of cases had acute

Table III. Frequency of risk factors among our patients

Class I: Minor risk factor	**114 (35.40%)**
Minor surgery	34 (10.55%)*
Gastroenteritis	31 (9.62%)*
Urinary tract infection	20 (6.22%)*
First seizure	14 (4.34%)
Diagnostic procedure	6 (1.87%)
Bronchiolitis	5 (1.56%)
Others	4 (1.24%)
Class II: Moderate risk factor	**127 (39.44%)**
Usual surgery	43 (13.35%)*
Non-fatal infection	26 (8.07%)
Non-intensive chemotherapy	19 (5.9%)
Intractable seizure	15 (4.66%)
Non-progressive chronic disease	8 (2.49%)
Chronic diarrhea	6 (1.87%)
Others	10 (3.10%)
Class III: Severe risk factor	**81 (25.16%)**
Major surgery	43 (13.37%)*
Progressive chronic disorder	19 (5.90%)
Severe infection	9 (2.79%)
Intensive chemotherapy	6 (1.86%)
Others	4 (1.24%)
Total	322

**p < 0.05*

malnutrition [4]. In our study, 27.1% of cases had acute malnutrition using the same criteria.

In another study from Turkey, malnutrition rates varied between 55.1% and 56.6% in different regions of the country [20, 21]. In the Özer *et al*. study, acute malnutrition was noted in 18.9%, chronic malnutrition in 15.4%; acute and chronic malnutrition was 20.8% [20].

In Thailand, 55% of patients aged 1-15 years suffered from acute malnutrition [22]. The rate of acute malnutrition in our study (27.01%) was less than Thailand [22]. In Mexico, varying degrees of malnutrition were reported in 72.7% of hospitalized children [23]. In our study, varying degrees of acute or chronic malnutrition were present in 67.07% of cases, similar to Mexico [23].

This study showed that factors related to weight reduction during hospital stay in children were disease severity, calorie intake < 50%, presence of acute or chronic malnutrition at the moment of hospital admission, presence of diarrhea and dyspnea, and length of hospital stay.

In the study by Oztürk *et al*., on 170 children admitted to hospital, they did not find a correlation between duration of hospital stay and the difference between

Table IV. Correlation between possible factors and weight reduction

Parameter	Group I (n = 156)	Group II (n = 166)	Significance
Sex			$p > 0.05$
Male	84 (53.84%)	89 (57.05%)	
Female	72 (46.16%)	77 (46.38%)	
Age distribution [month]			$p = 0.75$, $\chi^2 = 1.17$
1-3	13 (8.33%)	16 (9.63%)	
4-12	36 (23.08%)	41 (24.69%)	
13-72	74 (47.44%)	69 (41.56%)	
72	33 (21.15%)	40 (24.09%)	
Calorie intake [%]			$p < 0.001$, $\chi^2 = 82.66$
≤ 50	32 (20.51%)	118 (71.09%)	
> 50	124 (79.48%)	48 (28.91%)	
Duration of hospital stay [weeks]			
1	120 (76.93%)	78 (46.99%)	$p = 0.00001$, $\chi^2 = 30.43$
2	27 (17.31%)	60 (36.15%)	$p = 0.0001$, $\chi^2 = 14.47$
3	6 (3.84%)	15 (9.03%)	$p = 0.059$, $\chi^2 = 3.55$
≥ 4	3 (1.92%)	13 (7.83%)	$p = 0.014$, $\chi^2 = 5.95$
Acute malnutrition			
Total	22 (14.10%)	65 (39.14%)	$p < 0.00001$, $\chi^2 = 25.60$
Mild	18 (11.53%)	46 (27.71%)	$p = 0.0002$, $\chi^2 = 13.21$
Moderate	4 (2.56%)	11 (6.62%)	$p = 0.08$, $\chi^2 = 2.99$
Severe	0	8 (4.81%)	$p = 0.01$, $\chi^2 = 5.85$
Chronic malnutrition			
Total	34 (21.8%)	95 (57.22%)	$p < 0.00001$, $\chi^2 = 42.05$
Mild	24 (15.38%)	46 (27.71%)	$p = 0.007$, $\chi^2 = 7.18$
Moderate	7 (4.49%)	39 (23.49%)	$p = 0.0001$, $\chi^2 = 23.73$
Severe	3 (1.93%)	10 (6.02%)	$p = 0.06$, $\chi^2 = 3.49$
Ward of admission			$p = 0.11$, $\chi^2 = 2.52$
Medical	116 (74.36%)	110 (66.26%)	
Surgical	40 (25.64%)	56 (33.73%)	
Dysphagia	2 (1.29%)	3 (1.81%)	$p > 0.05$
Vomiting	24 (15.39%)	15 (9.04%)	$p = 0.08$, $\chi^2 = 3.04$
Diarrhea	21 (1.67%)	25 (15.06%)	$p < 0.0001$, $\chi^2 = 17.48$
Dyspnea	8 (5.13%)	21 (12.65%)	$p = 0.01$, $\chi^2 = 5.55$
Disease grade			$p < 0.0001$, $\chi^2 = 141.37$
I	101 (64.76%)	13 (7.83%)	$p < 0.0001$, $\chi^2 = 113.90$
II	52 (33.33%)	75 (45.18%)	$p = 0.02$, $\chi^2 = 4.79$
III	3 (1.93%)	78 (46.98%)	$p < 0.0001$, $\chi^2 = 86.75$

admission and discharge [24]. Most of the cases in their study were admitted to a non-surgical ward, but in our study 29.8% of cases were admitted to a surgical ward. The pattern of disease in the two studies was different and may be the cause of the different result.

We used criteria similar to those of the Sermet-Gaudelus *et al*. study [10]. In contrast to the Sermet-Gaudelus *et al*. study, there was no cardiac surgery in our hospital and there was no neurology ward in their hospital. In Sermet-Gaudelus's study, 71% of cases were

admitted to a non-surgical and 29% to a surgical ward, similar to our study. For weight reduction (< 2%, 2-5%, > 5-10%, > 10%), in our study the results were as follows: 48.44%, 31.98%, 15.88%, and 3.72%. In the Sermet-Gaudelus *et al*. study they were 19%, 28.7%, 14.5%, and 2%. There was a difference between the studies for WR < 2%.

In the Rocha *et al*. study, 51.6% of cases had weight reduction during hospitalization [25]. In our study 51.58% of children had lost body weight ≥ 2%. This finding is similar to the Rocha *et al*. study. In Rocha's study, nutritional status was classified in accordance with WHO criteria: malnutrition was severe if Z-scores were less than –3 SD, moderate from –2 SD to –3 SD, and mild from –1 SD to –2 SD. In our study, 70.2% of cases were admitted to non-surgical and 29.8% to surgical wards. Although there was a difference in pattern frequency of disease between our study and the Rocha *et al*. study [25], the rate of weight loss was similar. They excluded surgical disease from the study, but we included surgical cases in our study.

Intensive chemotherapy is grade III and is associated with bodyweight loss during hospitalization. Because of the confounding effect of tumor mass, use of body weight to assess nutritional study in pediatric cases has been misleading [26]. This confounding factor may explain why other authors have suggested that children with malignancy are at lower risk of malnutrition than children with other conditions [27].

As shown in most studies, there was a relatively high frequency of malnutrition among children admitted to hospitals around the world [10, 22, 23, 25]. Most studies used NCHS and WHO/CDC values for calculating W/A, H/A, and W/H. There were studies showing that local growth parameters may be more accurate for each country [28-30]. There is a lack of research using local growth parameters for calculating W/A, H/A, and W/H among hospitalized children.

Conclusions

Calorie intake < 50%, duration of hospital stay, disease grade, diarrhea, and dyspnea had a correlation with acute hospital malnutrition. Minor, usual, and major surgery were the most common risk factors. Avoidance of unnecessary prolonged hospitalization may help to reduce the frequency of body weight loss among patients. Pediatric patients hospitalized in surgical wards should receive treatment by a pediatrician and a nutritional specialist.

Acknowledgments

We acknowledged all nurses in Mofid Children's Hospital.

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