Journal of Nutrition and Food Security
Shahid Sadoughi University of Medical Sciences
School of Public Health
Department of Nutrition
Nutrition & Food Security Research Center

eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2022; 7(3):311-318 Website: jnfs.ssu.ac.ir

Evaluation of Growth Indices and Nutritional Status in Children Hospitalized at the Pediatric Ward of Shahid Sadoughi Hospital in Yazd, Iran in 2020

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ARTICLE INFO

ORIGINAL ARTICLE

Article History:
Received: 15 May 2021
Revised: 28 Aug 2021
Accepted: 15 Sep 2021

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ABSTRACT

Background: Malnutrition is one of the most important health issues especially in developing countries that can have adverse effects on physical and mental health of children, resulting in various infections. This study aims to evaluate the growth indices and nutritional status in children hospitalized at the pediatric ward of Shahid Sadoughi Hospital in Yazd, Iran in 2020. **Methods**: In this cross-sectional and descriptive-analytical study, the anthropometric indices of 100 children older than 1 month hospitalized in the pediatric ward of Shahid Sadoughi Hospital in Yazd, Iran in 2020 were determined. Children's information, including age, sex, cause of hospitalization, and duration of hospitalization were extracted from the patients' medical files and recorded in a checklist. Nutritional status was assessed using weight-for-age, weight-for-height, and height-for-age criteria. **Results**: The prevalence of malnutrition among the studied children was 40% (18% acute malnutrition and 22% chronic malnutrition). The prevalence of wasting, underweight, and stunting status were 28%, 27%, and 20%, respectively. There was no significant difference in the malnutrition frequency and also the malnutrition type based on sex, age, cause of hospitalization, and duration of hospitalization ($P > 0.05$); however, the type of malnutrition was significantly associated with age ($P < 0.05$). **Conclusion**: Considering the high prevalence of malnutrition in this study and the fact that malnutrition can lead to infections and increase the chances of hospitalization, it is recommended that all hospitalized children be evaluated and treated for malnutrition using anthropometric criteria and nutritional classifications.

Keywords: *Malnutrition; Anthropometric index; Pediatric*

Introduction

Malnutrition is the most important leading cause of death in children under 5 years worldwide and it is also one of the most serious health problems in developing countries (Darvishi *et al.*, 2009). Malnutrition is a term used to describe a wide range of mild to severe clinical manifestations caused by insufficient energy and protein intake to meet the body's nutritional needs (Wickramasinghe *et al.*, 2010). Malnutrition involves a wide range of different nutritional

This paper should be cited as: Edalatkhah R, Karimi M, Parand M, Aflatonian M. ***Evaluation of Growth Indices and Nutritional Status in Children Hospitalized at the Pediatric Ward of Shahid Sadoughi Hospital in Yazd, Iran in 2020.*** *Journal of Nutrition and Food Security (JNFS),* 2022; 7(3): 311-318.

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[DOR: 20.1001.1.24767417.2022.7.3.2.5]
[DOI: 10.18502/jnfs.v7i3.10196]

conditions, such as deficiency of certain nutrients, including protein, vitamins, and minerals, or increase or decrease of weight gain (Sullivan, 2010). Adverse consequences of malnutrition in children include impaired mental and physical development, increased costs of treatment and medical care, academic failure and heavy costs to the country's education, and the loss of working days by parents, which put a heavy financial burden on the economy of the society both in the public and private sectors (Khor, 2003). There are several factors involved in malnutrition, such as inadequate food intake, both in terms of quantity and quality, including famine, extreme poverty, or ignorance. Moreover, in cases, such as diarrhea, anorexia, severe vomiting, and celiac disease, where the child is unable to absorb and use of food, malnutrition can be observed in children (Dipasquale *et al.*, 2020).

The three main indicators of nutritional situation commonly used in research studies are underweight, stunting, and wasting (Aurangzeb *et al.*, 2012). According to the World Health Organization (WHO) in 2019, 21.3% of children under the age of 5 years (around 144 million children) worldwide, have stunting criteria and 47 million children (14.3%) have wasting criteria. The prevalence of overweight and obesity was 11% in the Middle East and North Africa, 10.8% in Eastern Europe and Central Asia, and 8.9% in North America (Dipasquale *et al.*, 2020).

Despite numerous studies conducted on the prevalence of malnutrition in children, the nutritional status of hospitalized children is often overlooked. Studies have shown that 16% to 34% of hospitalized children have some degree of malnutrition or are at risk of malnutrition (Berkley *et al.*, 2005). Hospital malnutrition or nosocomial malnutrition can decrease growth, and increase mortality, the number of various infections, the length of hospital stay, the need for readmission, and as a result it can cause adverse problems in the treatment process and increase the cost on patients (Hecht *et al.*, 2015). Meanwhile, children are more prone to malnutrition due to their certain characteristics, including the development of organs and dependence on others for nutrition. Malnutrition in these children, in addition to the early complications mentioned, leads to problems, such as mental and physical retardation. Therefore, if left untreated, it can lead to smaller bodies and less mental strength (Beheshti *et al.*, 2010). Determining the growth indicators of hospitalized children can be a useful and effective tool for rapid identification of malnourished children and as a result, more accurate interventions and better quality nursing care programs can be adopted (Aurangzeb *et al.*, 2012). According to the mentioned issues, this study was designed to determine the growth indicators and nutritional status of children hospitalized in the pediatric ward of Shahid Sadoughi Hospital in Yazd, Iran.

Materials and Methods

Study design and participants: This descriptive cross-sectional study was conducted on 100 children older than one month hospitalized in the pediatric ward of Shahid Sadoughi Hospital in Yazd, Iran from April 2019 to October 2020. The sample size of 100 patients was determined with 95% confidence level, 80% test power, 5% alpha error, P (ratio of hospitalized children with malnutrition based on previous studies) and a value of D equal to 10%. The easy sampling as a non-random method was used. The inclusion criteria included age over 1 month and less than 15 years and hospitalization in Shahid Sadoughi Hospital in Yazd, Iran. Children with edema for other reasons than malnutrition were excluded.

Measurements: Data, including age, sex, height, weight, duration of hospital stay and reason for hospitalization were collected from the medical record of patients. The height of the children was determined by a tape measure with an accuracy of 0.1 cm and weight by a Seca scale (Germany) with an accuracy of 0.1 kg. Depending on a child's age and ability to stand, the child's length or height was measure. If a child is less than 2 years old, recumbent length was measured (a child's length is measured lying down). Children's body mass index (BMI) was calculated by dividing weight (kg) by height (m^2). Then, data related to age, sex,

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[DOI: 10.18502/jnfs.v7i3.10196]

height, and weight of children were entered in WHO AnthroPlus software, and after calculating the z-score of the relevant indicators and recording them, the data were compared and evaluated. In this study, weight-for-age and height-for-age indices were calculated for children aged ten years and younger. In addition, the weight-for-height index was used for children aged 5 years and younger and the BMI-for-age index was used instead for children over the age of 5 years.

For underweight index, weight-for-age z-score between -2 and -3 was defined as underweight and weight-for-age z-score less than -3 was defined as severely underweight. For stunting index, height-for-age z-score between -2 to -3 was defined as stunted and height-for-age z-score lower than -3 was considered as severely stunted. Based on weight-for-height z-score and BMI-for-age z-score, the children were divided to severely wasted, wasted, normal, overweight, and obese groups.

If the z-score for each of the indicators of weight-for-age, BMI-for-age, and weight-for-height was less than -2, it would be considered as moderate acute malnutrition and if the z score for each of these indicators was less than -3, it would be considered as severe acute malnutrition. If z-score of height-for-age index was less than -2, moderate chronic malnutrition and if it was less than -3, severe chronic malnutrition was considered.

Results

In the present study, 100 children (59 boys and 41 girls) hospitalized at the pediatric ward of Shahid Sadoughi Hospital in Yazd, Iran, were included in the study. The results of growth indices and duration of hospital stay in the studied children are shown in **Table 1**.

Of the 100 studied children, 40 children had malnutrition, of whom 18 children (45 %) had acute malnutrition and 22 children (55 %) had chronic malnutrition. The frequency of malnutrition did not show any significant ($P > 0.05$) difference by gender among the studied children (**Table 2**).

According to BMI and weight-for-height indices, 64 children were normal, 3 children were obese, 5 children were overweight, 14 children were wasted, and 14 children were severely wasted. According to weight-for-age index, of 100 studied children, 27 children were underweight, of whom 16 children (59.3%) were underweight and 11 children (40.7%) had severely underweight status. Moreover, 20 children had stunted status, of whom 13 children (65%) had stunted status and 7 children (35%) had severely stunted status. The statistical analysis did not show any significant relationship ($P > 0.05$) between stunted, wasting, and underweight/obesity status with gender among the studied children (**Table 3**).

As shown in **Table 4**, no significant relationship was observed between the presence or absence of malnutrition and age ($P > 0.05$) and length of hospital stay ($P > 0.05$) in the studied children. However, a significant relationship was observed between the type of malnutrition and age ($P < 0.05$) of the studied children; so that children with severe chronic malnutrition had a higher mean age. In addition, the length of hospital stay of malnourished children by acute or chronic status did not show any significant difference ($P > 0.05$).

The most common causes of hospitalization of the studied children were neurological (30%), gastrointestinal (14%), and infectious (13%) agents. **Table 5** reveals no significant relationship between the presence or absence of malnutrition and the cause of hospitalization ($P > 0.05$). However, the prevalence of malnutrition was higher in children with congenital defects, heart, metabolic, and neurological disorders.

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[DOI: 10.18502/jnfs.v7i3.10196]

Table 1. Results of growth indices and length of hospitalization of studied children.

Variables	Mean ± Standard deviation	Minimum	Maximum
Age (day)	2076.94 ± 1304.03	269	5657
Weight (kg)	17.55 ± 9.70	4.30	70
Height (cm)	106.02 ± 20.86	63	165
Head circumference (cm)	49.31 ± 2.22	42.50	58
Body mass index (kg/m^2)	14.67 ± 2.54	9.89	25.71
Z-score of weight-for-age	- 1.13 ± 1.45	- 4.99	2.37
Z-score of height-for-age	- 1.03 ± 1.24	- 5.23	1.05
Z-score of body mass index-for-age	- 1.19 ± 1.73	- 5.29	2.97
Z-score of weight-for-height	- 1.17 ± 1.40	- 4.00	3.00
Length of hospital stay (day)	2.87 ± 1.78	1	10

Table 2. Distribution of different types of malnutrition in studied children.

Type of malnutrition	Male	Female	Total
Moderate acute	7 (30.4)[a]	15 (29.4)	12 (30.0)
Severe acute	3 (13.0)	3 (17.6)	6 (15.0)
Moderate chronic	8 (34.8)	7 (41.2)	15 (37.5)
Severe chronic	5 (21.7)	2 (11.8)	7 (17.5)
Total	23 (100)	17 (100)	40 (100)
P-value[b]	0.84		

[a:] n (%);[b:] Chi-square test.

Table 3. Frequency distribution of studied children according to indicators of body mass index-for-age, weight-for-height, weight-for-age and height-for-age.

Variables	Male	Female	Total	P-value[b]
Body mass index-for-age				
Obesity	1 (1.7)[a]	2 (4.9)	3 (3.0)	0.51
Overweight	4 (6.8)	1 (2.4)	5 (5.5)	
Normal	35 (59.3)	29 (70.7)	64 (64.0)	
Weight-for-age				
Underweight	12 (60.0)	4 (57.1)	16 (59.3)	0.89
Severely underweight	8 (40.0)	3 (42.9)	11 (40.7)	
Height-for-age				
Stunted	7 (58.3)	6 (75.0)	27 (100.0)	0.44
Severely stunted	5 (41.7)	2 (25.0)	7 (35.0	

[a]: n (%);[b]: Chi-square test.

Table 4. Relationship between children age and the presence/absence of malnutrition and malnutrition type among the studied children.

Variables	Age (day)	P-value[a]	Length of hospital stay (day)	P-value
Malnutrition				
Yes	2186.80 ± 1360.76	0.45	2.69 ± 1.46	0.55
No	2000.59 ± 1269.28		3.12 ± 2.15	
Type of malnutrition				
Moderate acute	1614.41 ± 942.21	0.034	2.83 ± 2.12	0.26
Severe acute	1781.66 ± 1197.00			
Moderate chronic	2277.46 ± 1305.02		3.45 ± 2.19	
Severe chronic	3415.42 ± 1695.65			

[a]: independent t-test.

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[DOI: 10.18502/jnfs.v7i3.10196]

Table 5. Frequency distribution of the presence or absence of malnutrition in the studied children based on the cause of hospitalization.

Cause of hospitalization	With malnutrition	No malnutrition	Acute	Chronic
Congenital defects	0 (0.0)[b]	3 (5.0)	-	-
Endocrine.	3 (7.5)	6 (10.0)	2 (11.1)	1 (4.5)
Immunology	1 (2.5)	6 (10.0)	0 (0.0)	1 (4.5)
Pulmonary	1 (2.5)	3 (5.0)	0 (0.0)	1 (4.5)
Infectious	2 (5.0)	11 (18.0)	1 (5.6)	1 (4.5)
Heart	1 (2.5)	0 (0.0)	0 (0.0)	1 (4.5)
Kidney diseases	2 (5.0)	3 (5.0)	1 (5.6)	1 (4.5)
Gastrointestinal diseases	6 (15.0)	8 (13.0)	5 (27.8)	1 (4.5)
Metabolic	3 (7.5)	5 (8.0)	2 (11)	1 (4.5)
Neoplastic	1 (2.5)	0 (0.0)	1 (5.6)	0 (0.0)
Neurology	19 (47.5)	11 (18.0)	6 (33.3)	13 (59.1)
Hematology	1 (2.5)	4 (6.6)	0 (0.0)	1 (4.5)
P-value[b]	0.11		0.38	

[a]: n (%);[b:] Chi-square test.

Discussion

According to the UNICEF annual report, the prevalence of underweight, stunting, wasting, and moderate and severe overweight in the world was 15%, 25%, 8%, and 7 %, respectively. In the Systematic Review and Meta-Analysis by Mohammad Mohseni et al., the prevalence of malnutrition, in terms of wasting, stunting, and underweight was 7.8%, 12.4%, and 10.5%, respectively (Mohseni *et al.*, 2018). Out of 100 children hospitalized at Shahid Sadoughi Hospital in Yazd, Iran during 2020, using the weight-for-age index, 27 children (27%) were underweight (16 cases were underweight and 11 cases were severely underweight) and using the height-for-age index, 20 children (20 %) were stunted (13 cases were stunted and 7 cases were severely stunted). In the study by Taheri et al., the prevalence of malnutrition in children hospitalized in Kerman, Iran were respectively 68.6% and 58.6% based on underweight and stunting indices and most cases of malnutrition were mild (Taheri *et al.*, 2006).). In another study by Vahidi et al. on 560 children aged 6 to 24 months hospitalized in Kerman, Iran, the prevalence of malnutrition was 76.2% based on the method of Gomez (weight-for-age) and 40.7% based on the method of Waterloo (height-for-age). Also, 22.67% of infants showed moderate malnutrition and 21.96% showed severe malnutrition (Vahidi *et al.*, 2001) . In the study by Ghaljaei et al. on 360 children aged 1-36 months hospitalized in the pediatric ward of Imam Ali Hospital in Zahedan, Iran, the prevalence of malnutrition based on underweight and stunting indices was 68.6% and 60.1%, respectively (Ghaljaei *et al.*, 2009). However, in a study by White et al. on 832 children hospitalized at eight tertiary pediatric hospitals and 570 children hospitalized at eight regional hospitals across Australia, the prevalence of underweight and stunting was 15% and 13.8%, respectively (White *et al.*, 2015), that is lower than the mentioned studies.

The differences observed among the studies are probably due to the differences in the studied population, the type of hospital, the way of managing children's nutrition and etc. In general, in most studies as well as in the present study, underweight is more common than stunting. Underweight is actually a sign of present and past malnutrition, while stunting is a sign of acute malnutrition. That is why underweight is more common in most studies than the other two criteria.

In the present study, in another classification based on BMI and weight-for-height indices, out of 100 studied children, 64% were normal, 8% were overweight and obese, and 28% had wasting or severely wasting status. In the study by Imanzadeh

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et al. conducted on 1186 children (aged 1 month-18 years) hospitalized at the medical and surgical wards of Mofid Children's Hospital from 2015 to 2016, based on the z-score for BMI in children over 2 years, 9% were overweight or obese, 54% were normal, and 37% were underweight, which is similar to the present study (Imanzadeh *et al.*, 2018). In a study by Aurangzeb et al. on 157 children hospitalized in Australia, the prevalence of underweight, overweight, and obesity was 4.5%, 15.1%, and 10.4%, respectively (Aurangzeb *et al.*, 2012).

In the present study, out of 100 studied children, 40 children had acute or chronic malnutrition, of whom 18 children (45%) had acute malnutrition and 22 children (55%) had chronic malnutrition. The prevalence of acute and chronic malnutrition in hospitalized children in previous studies was 19% (Joosten *et al.*, 2010), 9.9 % (Moeeni *et al.*, 2013), 13.3 % (Groleau *et al.*, 2014), and 11 % (Marteletti *et al.*, 2005). In a study by Cameron et al. (1995) on 160 children hospitalized due to potential heart failure at Ann Arbor Hospital in Michigan, the prevalence of acute and chronic malnutrition was 33% and 64%, respectively (Cameron *et al.*, 1995). In the study by Hendricks et al. (1995) on children hospitalized in Boston, the prevalence of acute and chronic malnutrition was 24.5% and 27.2%, respectively (Hendricks *et al.*, 1995). In the study by Matsuyama et al. (2017) conducted on 110 hospitalized infants aged 31 days to 12 months, the prevalence of infants with acute malnutrition and chronic malnutrition was 16.4% and 3.6% , respectively (Matsuyama *et al.*, 2017). The difference in the values reported in different studies is likely due to the difference in the studied population (in terms of age, socio-economic variables), the type of disease, the way of managing malnutrition in the hospital, the used measures, and etc. The prevalence of malnutrition in hospitalized children in the present study is higher than studies in other countries, which requires more attention to this issue.

In the current study, the presence or absence of malnutrition, type of malnutrition and wasting status did not show any significant difference according to gender, but stunting status was significantly different based on gender. In the study by Imanzadeh et al. the prevalence of stunting status (weight-for-height z-score: -2) was 14.6% in hospitalized girls and 6.5% in hospitalized boys (Imanzadeh *et al.*, 2018). In the study by Ghaljaei et al. on 360 children hospitalized at the pediatric ward of Imam Ali Hospital in Zahedan, Iran, the prevalence of malnutrition in boys (28.3%) was lower than girls (42.6%) (Ghaljaei *et al.*, 2009). In the study by Taheri et al. on children hospitalized at the pediatric ward of Vali-E-Asr Hospital in Birjand, Iran, no significant difference was observed in underweight and stunting status by children gender; however, wasting was higher in girls (Taheri *et al.*, 2006). In contrast, the study by Vahidi et al. on children aged 6 to 24 months hospitalized in Kerman showed that the rate of malnutrition based on Waterloo standard in boys (80.13%) was significantly higher than girls (65.43%)(Vahidi *et al.*, 2001).

Based on the present findings, the prevalence of malnutrition did not differ significantly with age, but the type of malnutrition differed significantly with age and children with chronic malnutrition were older. In the study by White et al., the prevalence of malnutrition in hospitalized children was significantly different based on age (White *et al.*, 2015). In the study by Hendricks et al. on hospitalized children in Boston, it was found that the prevalence of malnutrition was higher in children under 2 years and also in children aged over 18 years (Hendricks *et al.*, 1995).

In the present study, the prevalence of malnutrition was higher in children with congenital malformations, heart, metabolic and neurological problems; however, no significant difference was observed between the prevalence of malnutrition and the cause of hospitalization. In the study by White et al. (White *et al.*, 2015) and Hendricks et al.(Hendricks *et al.*, 1995), the prevalence of malnutrition in hospitalized children was significantly different depending on the type of disease. However, Kapçı et al. reported that the prevalence of malnutrition was 23.9% in children

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with acute diseases and 21.1% in children with chronic diseases, indicating no significant difference (Kapçı *et al.*, 2015). The lack of significant difference in malnutrition according to the cause of hospitalization is probably due to the small sample size and it is recommended that further studies be performed with a larger sample size.

Other results showed that the prevalence of malnutrition and its type did not significantly differ according to the length of hospital stay. In the study by Groleau et al., the NS index (weight-for-height percentile) was associated with long-term hospitalization in children aged three years or younger (Groleau *et al.*, 2014). In another study, it was found that longer hospital stay increased medical costs and weight loss in children (Cao *et al.*, 2014).

Given the important role of suitable dietary regimen, including diets containing seafood in the prevention of malnutrition, as well as the beneficial effects of these diets on human health (Bogard *et al.*, 2019, Khezri *et al.*, 2016, Rabiei *et al.*, 2019, Torres-León *et al.*, 2018). It is suggested to evaluate the frequency of malnutrition in families with different diets in future studies, so that important steps can be taken to prevent malnutrition by modifying the diet.

Conclusion

The prevalence of malnutrition in 100 children hospitalized at Shahid Sadoughi Hospital in Yazd, Iran was 40% (18% with acute malnutrition and 22% with chronic malnutrition). The prevalence of wasting, underweight and stunting status were 28%, 27 %, and 20 %, respectively. Given the high prevalence of malnutrition and the fact that malnutrition can lead to infections and increase the chances of hospitalization, it is recommended that all hospitalized children should be evaluated and treated for malnutrition using anthropometric criteria and nutritional classifications.

Acknowledgment

We would like to thank our collaboration in pediatric ward of Shahid sadoughi hospital for doing this work.

Authors' contributions

Rohollah Edalatkhah: Editing the article

Majid Aflatonian: Writing the article

Mehran Karimi, Maryam Parand: Collecting data

Conflict of interest

The authors declare no conflict of interest.

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