



## The nutritional status of hospitalized children: Has this subject been overlooked?

### NUTRITION

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### ABSTRACT

**Background/Aims:** To determine the nutritional status of hospitalized children at the time of admission and to investigate the relationship between diagnosis and nutritional status.

**Materials and Methods:** Body weight, height, triceps skinfold thickness, and mid-arm circumference were measured on admission and percentages of weight-for-age, weight-for-height, body mass index, mid-arm circumference, and triceps skinfold thickness were calculated. The nutritional status was evaluated using the Waterlow, Gomez, and other anthropometric assessments.

**Results:** A total of 511 patients were included in the study with a mean age of  $5.8 \pm 4.9$  years. Malnutrition was determined in 52.7% of patients according to the Waterlow classification. Mild malnutrition was determined in 39%, moderate in 12%, and severe in 1.7%, with the characteristics of acute malnutrition in 23.9%, acute-chronic in 7.3%, and chronic in 21.5%. The highest rate of malnutrition was in the 0–2 years age group (62.3%). According to the Gomez classification, malnutrition rate was determined as 46.8%. The rates of malnutrition in malignant, gastrointestinal, and infectious diseases were 60%, 59.8%, and 54.5%, respectively.

**Conclusion:** The prevalence of malnutrition in hospitalized children was noticeably high. The nutritional evaluation of all patients and an early start to nutritional support could provide a significant positive contribution.

**Keywords:** Hospitalized children, malnutrition, undernutrition

### INTRODUCTION

Malnutrition is still a significant health problem, particularly, in undeveloped and developing countries (1). Although the term malnutrition is considered to include both undernutrition and overnutrition, it is known that mortality and morbidity rates are greater in undernourished patients. According to World Health Organization (WHO) reports, undernutrition-related factors contribute to approximately 45% deaths in children below five years (2). In terms of public health, undernutrition is an important social problem, which is observed in all age groups, but the most affected are children between the ages of 6 months and 5 years (2).

Children than in children in the community because of different disease states (3-5). Most patients enter and leave hospital without any assessment of nutritional status. Different prevalence rates have been reported for malnutrition in various countries around the world (6-8). Lower rates have been reported in developed countries such as Germany (6.1%) and France (21%); higher rates in developing countries such as Romania (37%), Vietnam (19%), and Turkey (31.8%); and the highest rates in undeveloped countries such as Iran (67.07%) (6-11). Although a significant reason for the difference is the socio-economic status of the different countries, different research methodology makes comparisons difficult.

Although there are many factors affecting children with malnutrition, higher rates are seen in hospitalized chil-

Contrary to expectations, studies have shown that the nutritional status of hospitalized children does not im-

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prove but worsens during hospitalization (11). This condition, which is often ignored, extends the hospital stay and negatively affects the response to treatment (5,12). Therefore, the nutritional status of hospitalized children must not be ignored, and it is necessary to be aware that malnutrition may be exacerbated by hospitalization in particular (10,13).

In terms of reducing morbidity and mortality, early diagnosis of malnutrition in hospitalized patients and planned treatment are just as important as the disease for which they are hospitalized. This was reflected in a study conducted in the Marmara and Aegean region of Turkey approximately 10 years ago (10,13). The aim of this current prospective study was to investigate the relationship between nutritional status on admittance and the diagnosis of children admitted to our hospital in the Mediterranean region of Turkey within the last year.

## MATERIALS AND METHODS

### Patients and design

This prospective study was conducted in a tertiary hospital between October 2012 and November 2013. During the study period of 1 year, 27,505 children were admitted to the outpatient department and 2,378 patients were hospitalized. The study comprised children aged 1 month–18 years who were admitted to the pediatric clinic. Patients with neurological sequelae, newborns, and those admitted to the intensive care unit were not included in the study as there may have been several factors affecting malnutrition. Those with recurrent hospitalizations or a hospitalization of less than 24 h were excluded. Finally, the study was conducted with 511 patients. The patients were separated into age groups of 0–2 years (1–23 months), 2–6 years (24–71 months), 6–10 years (72–119 months), and 10–18 years (120–216 months). Within the first 24 hours of admittance to the hospital, measurements were taken of body weight, height, mid-arm circumference (MAC), and triceps skinfold thickness (TSF). To maintain standard anthropometric measurements, they were all taken by the same person. The patients were separated into groups according to diagnosis as infection, gastrointestinal, endocrine, genitourinary, collagen tissue, chronic respiratory system, malignancy, and non-malignant hematological diseases and other.

Approval for the study was granted by the Local Clinical Research Ethics Committee. Informed consent was obtained from the parents of each patient.

**Weight and height measurements:** Children aged below 2 years were weighed unclothed on a 16 kg capacity baby scale with 10 g sensitivity (Seca 334, Hamburg, Germany). Children aged over 2 years were weighed on an adult scale with 100 g sensitivity (Seca 769, Germany). The height of children aged below 2 years was measured with a 1 m measurement scale of 0.1 cm sensitivity, with the child supine on a flat surface, the head held still and the feet together. Those aged over 2 years

were measured standing upright with a fixed measurement scale of 0.2cm sensitivity.

**MAC and TSF measurements:** TSF and MAC were measured in the subset of children aged over 6 years.

Mid-arm circumference was measured with a non-elastic measuring tape with 1 mm gradations, with the left elbow joint in mild flexion from the acromion notch to the center of the olecranon notch. TSF was measured with a Holtain Skinfold Caliper (Holtain Ltd., Crymch, SA41 3UF, UK) with 0.2 mm sensitivity at the exact midpoint between the acromion notch and the olecranon notch.

Weight-for-height (WFH) and body mass index (BMI) were calculated and evaluated according to age and gender data published in 2000 by the Centre for Disease Control (CDC) (14).

Percentages of weight-for-age (WFA), height-for-age (HFA), WFH, BMI, MAC, and TSF were calculated. All the cases were evaluated according to the Waterlow and Gomez classification (15,16). For the evaluation of acute and chronic malnutrition, classification was made taking HFA and WFH into consideration on the Waterlow classification. Cases below WFH 90%–110% and HFA 95% were evaluated as chronic malnutrition and those below WFH 90% and HFA 95% were evaluated as acute-chronic (acute on a chronic base).

The statistical analyses of the study were made using Statistical Package for the Social Science for Windows (SPSS) v. 15.0 statistics program (SPSS Inc, Chicago, IL, USA, 2006). By calculating the mean and standard deviation values for the distribution of measureable variables, comparison of the grouped data with defined numbers was made with the Chi-square test and comparison of the mean values of the measurements of the independent two groups was made using the Mann–Whitney U test. A value of  $p < 0.05$  was accepted as statistically significant.

## RESULTS

A total of 511 patients met the study criteria and completed the evaluation. The patients included 231 (45.2%) female and 280 (54.8%) male with a mean age of  $5.8 \pm 4.9$  years (range, 1 month–18 years). No statistically significant difference was determined between the mean ages and age groups and gender ( $p > 0.05$ ). The distribution of the malnutrition status of the age groups according to all the methods used is shown in Table 1.

According to the Gomez classification, malnutrition of different degrees was determined in 239 (46.8%) cases, and according to the Waterlow classification, malnutrition was determined in 269 (52.7%) cases. Malnutrition was determined as mild in 199 (39%) cases, moderate in 61 (12%), and severe in 9 (1.7%) cases, and acute in 122 (23.9%), acute-chronic (acute on a chronic base) in 37 (7.3%), and chronic in 110 (21.5%) cases (Table 2,3).

**Table 1.** Malnutrition rates in age groups according to different assessments

Assessment	Age groups			
	0–2 years	2–6 years	6–10 years	10–18 years
	%	%	%	%
Waterlow	62.3	48.7	44.4	48.7
Gomez	46.8	42	39.6	58.1
BMI	-	37.8	19.6	15.4
MAC	-	-	8.5	12.0
TSF	-	-	13.2	25.6

BMI: body mass index, MAC: mid-arm circumference, TSF: triceps skinfold thickness.

**Table 2.** The degree of malnutrition according to the Waterlow classification

Malnutrition degree	Age groups (year) n (%)				Malnourished children n (%)
	0–2	2–6	6–10	10–18	
Mild	80 (40.2)	45 (22.6)	41 (20.6)	33 (16.5)	199 (100)
Moderate	26 (42.6)	13 (21.3)	5 (8.2)	17 (27.9)	61 (100)
Severe	1 (11.1)	0 (0.0)	1 (11.1)	7 (77.8)	9 (100)
Total	107 (39.8)	58 (21.5)	47 (17.5)	57 (21.2)	269 (100)

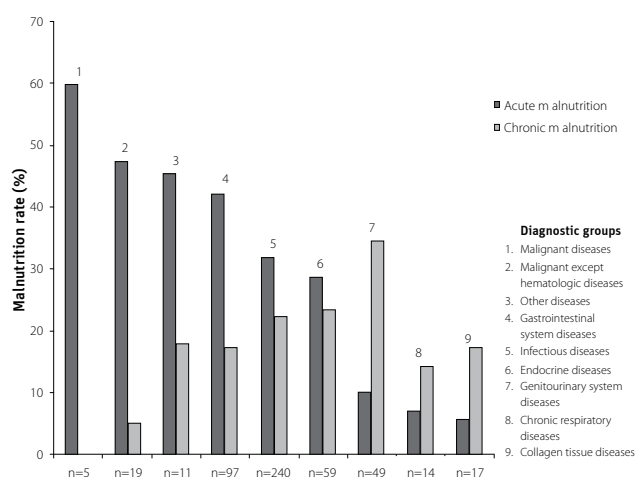
**Table 3.** The nutritional status according to the Waterlow classification

Status	Age groups (year), n (%)			
	0–2	2–6	6–10	10–18
Normal	62 (36.7)	61 (51.3)	59 (55.7)	60 (51.3)
Acute	35 (20.7)	36 (30.3)	32 (30.2)	19 (16.2)
Acute-chronic	15 (8.9)	7 (5.9)	4 (3.8)	11 (9.4)
Chronic	57 (33.7)	15 (12.6)	11 (10.4)	27 (23.1)
Total	169 (100)	119 (100)	106 (100)	117 (100)

A statistically significant difference was determined in the malnutrition rates according to the age groups. Chronic malnutrition in the 0–2 years age group at 33.7% was greater than that in the other groups ( $p < 0.001$ ).

When the nutritional status of the 342 patients aged over 2 years was evaluated according to BMI, both undernutrition and overnutrition were seen in 135 (39.5%). While 26.4% were evaluated as undernutrition, 14.9% were evaluated as overnutrition (7.6% overweight and 7.3% obese). According to this evaluation between the age groups, malnutrition was seen at a greater rate in the 2–6 years group ( $p < 0.05$ ).

When the nutritional status of the 223 patients aged over 6 years was evaluated according to the MAC measurement, malnutrition was determined in only 23 (10.3%) cases. No statistically significant difference was determined in the distribution according to gender and age group ( $p > 0.05$ ).

**Figure 1.** Malnutrition rates in different diagnostic groups.

When the nutritional status of the 223 patients aged over 6 years was evaluated according to the TSF measurement, malnutrition was determined in 44 (19.7%) cases. A statistically significant difference was determined according to the age groups, with higher rate of malnutrition seen in the 10–18 years age group than in the 6–10 years age group ( $p < 0.05$ ).

In the grouping of patients according to diagnosis, the leading diagnosis was infectious disease in 240 (47.0%) patients. The other diagnoses were gastrointestinal diseases in 97 (19.0%), endocrine diseases in 59 (11.5%), genitourinary system diseases in 49 (9.6%), non-malignant hematological diseases in 19 (3.7%), collagen tissue diseases in 17 (3.3%), chronic respiratory system diseases in 14 (2.7%), malignant diseases in 5 (1.0%), and others in 11 (2.2%).

When the malnutrition status of the patients was examined according to the diagnosis groups, malnutrition according to the Waterlow classification system was determined most in the malignant diseases group (60%), followed by the gastrointestinal disease group (59.8%) and the infectious diseases group (54.5%). There was no significant correlation between the nutritional status and type of disease ( $\chi^2$ : 15.50,  $p = 0.05$ ). Acute and acute-chronic malnutrition rates were determined to be greater in the malignant diseases group, acute-chronic malnutrition in the non-malignant hematological diseases and chronic malnutrition in the genitourinary system diseases groups. The malnutrition classification of the patients in the diagnosis groups is shown in Figure 1.

## DISCUSSION

The rates of malnutrition in hospitalized children are greater than those in the normal population due to the negative effect on the nutritional status as a result of hospitalization (3,13,17). Although this is known world-wide, in practice it is usually overlooked. By evaluating the status of our own hospital in this study, it was aimed to draw attention to this extremely important subject.

In this study, in addition to the evaluation of malnutrition with the Waterlow and Gomez classification systems, measurements were taken of the BMI, MAC, and TSF. When evaluating the results, the Waterlow classification was taken into consideration as the most widely used system which best shows malnutrition.

According to the Waterlow classification, in the current study, malnutrition was determined in 52.7% of the patients. These results were found to be much higher than the 31.8% and 45.7% of studies performed 10 years ago in a different region of Turkey (10,13). In a recently performed study, malnutrition rate was reported as 36% (18). In addition, the result of the current study was found to be higher than the 37% of a study in Romania, where the geography and socio-economic status are similar to Turkey (9) and the results of studies in other developed European countries and America (7,8,19). However, the results of the current study are similar to those of Thailand (50%–60%) and lower than those of Honduras (67.3%) (20,21). The reasons for these different results can be listed as differences in patient profiles accepted for hospitalization, the methodology used in the studies, and socio-economic differences between countries and regions. As the hospital where the current study was conducted is a tertiary hospital, relatively more complicated cases are admitted; and thus, it is natural that the nutritional status of the patient profile would be negatively affected.

In the current study, according to the Waterlow classification of the hospitalized children, the highest rate of nutrition was seen in the 0–2 years age group at 63.3%. According to the Gomez classification, malnutrition was found at a rate of 46.8% in that age group. In a study conducted approximately 15 years ago, in the Marmara region of Turkey, the rate of malnutrition in this age group, according to the Waterlow and Gomez classification systems was found to be 58.0% and 45.7%, respectively (3). In another study, again in the Marmara region of Turkey, the rate of malnutrition in children below 3 years was found to be 47.3%. In that study, all the children with severe malnutrition were below 1 year (4). When comparison was made according to age groups in the current study, the highest rate was seen in the 0–2 years age group.

In the current study, malnutrition was determined at 48.7% in the 2–6 years age group according to the Waterlow classification and at 42% according to the Gomez classification. These results for this age group are higher than the results reported by Özer et al. (3). In a study by Öztürk et al. (10), malnutrition was seen most in the 2–6 years age group.

According to the results of the TSF measurement, while malnutrition was determined in the 6–10 years and 10–18 years age groups at a total rate of 19.7%, there was a higher rate in the 10–18 years age group (25.6%). Although TSF is a good method to show the body energy stock and whole body fat deposits, it is not viewed as a sufficient indicator of malnutrition (22).

Almost all of the patients determined with malnutrition according to the MAC measurement (10.3%) had malnutrition according to the Waterlow and Gomez classifications. The MAC measurement is a simple method which can be used when anthropometric measurements such as age, height, and weight are not known (10). However, some patients with malnutrition who are determined by frequently used classifications such as Waterlow and Gomez, cannot be determined by this method.

More than half of the patients in the current study (66%) were diagnosed with infectious or gastrointestinal diseases. According to the diagnosis groups, malnutrition was observed most in gastrointestinal diseases (59.8%) and in comparison with the other diagnosis groups, the rate of acute malnutrition was greater. In a study by Pawellek et al. (7), malnutrition was determined at a rate of 23.6% in gastrointestinal diseases of which 17.6% were cases of mild malnutrition. In the current study, although the rate of acute malnutrition was high in this group, 58.5% of these cases were mild.

In the current study, chronic malnutrition was seen most in the genitourinary system diseases group. According to the Waterlow classification, the total rate of 44.9% comprised 4.1% acute, 6.1% acute-chronic, and 34.7% chronic cases. Pawellek et al. (7) determined a rate of 10.3% malnutrition in a similar patient group.

In this study, the malnutrition status was determined only at the point of hospital admission. In literature there are several studies which have reported that contrary to expectations, malnutrition is worsened during hospitalization. The factors related to weight reduction during hospital stay in children have been determined as disease severity, calorie intake <50%, presence of acute or chronic malnutrition at the time of hospital admission, presence of diarrhea and dyspnea, and length of hospital stay (9,11,13,19,23). In addition, hospitalization of malnourished children may negatively affect treatment results, the hospitalization period is extended, hospital costs are increased, and the morbidity and mortality risks are greatly increased (24).

Another important point that was noticeable during the current study was that there is still no simple and close to excellent calculation method which can be used on all age groups. In fact, this point has been emphasized in many studies (6,9,25–27). In Turkey, previous studies have used both the Waterlow and Gomez classification systems. In the current study, calculations were made using the Waterlow, Gomez, BMI, MAC, and TSF methods (Table 1). From this it was seen that the results may be very different according to the method applied. As it is believed to show more accuracy, the Waterlow classification was taken as the basis for the evaluations in the current study. The main limitation of this method is that it is not sufficient to show nutritional disorders in overweight and obese children. Therefore, evaluation made using the classification system together with BMI values is recommended.

It can be considered that as a result of the primary disease for which the child is hospitalized, the cytokines, chemokines, and mediators which are formed shift the metabolism towards the catabolic or reduce the appetite with insufficient calorie intake. Calorie deficit may also develop with an increase in loss or decreased absorption from the gastrointestinal system.

In conclusion, the results of this study showed that malnutrition was determined at the high rate of 52.7% in hospitalized pediatric patients. The highest rate of malnutrition was in the 0–2 years age group and the malnutrition rate was most prevalent in malignant disease. To provide optimal patient support, reduce morbidity and mortality rates, and shorten hospital stay, thereby making a positive contribution both financially and psychologically, all hospitalized patients should be considered for nutritional assessment and support.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Süleyman Demirel University Faculty of Medicine.

**Informed Consent:** Written informed consent was obtained from parents of children who participated in this study.

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