

# Malnutrition in Hospitalized Pediatric Patients: A Comparison of the National Turkish and World Health Organization (WHO) Child Growth Standards

## Hastanede Yatarak Tedavi Gören Çocuklarda Malnütrisyon: Ulusal Türk ve Dünya Sağlık Örgütü (DSÖ) Çocuk Büyüme Standartlarının Karşılaştırılması

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### Abstract

**Objective:** Malnutrition is known to be responsible for mortality especially in hospitalized children. Since there is a controversy regarding the criteria used to define malnutrition worldwide, the World Health Organization (WHO) has recommended using z-scores and has reported that the WHO child growth standards have worldwide validity. The aims of this study were to evaluate the prevalence of malnutrition in hospitalized pediatric patients and compare the Neyzi growth standards used in Turkey with the WHO standards.

**Patients and Methods:** Weight-for-age, weight-for-height, and height-for-age were calculated separately in patients under five years old using the national Neyzi standards and the WHO 2006 standards. The weight-for-age- and height-for-age z-scores were also calculated, and malnutrition was defined as < -2 SD.

**Results:** Among the 100 patients included in the study, 62 were male, and the mean age was 15.9±16.2 months. Twelve percent of the patients were classified as acute malnutrition, 13% were classified as chronic malnutrition, and 11% were underweight. The calculated mean weight-for-age and height-for-age z-scores were significantly different between the two growth standards (p<0.001).

**Conclusion:** Although WHO has reported that the new WHO growth standards are applicable in all countries, there was a discrepancy between the WHO- and country-specific growth charts, and this presents a major problem for the evaluation of malnutrition. (*Marmara Medical Journal 2012;25:128-32*)

**Key Words:** Malnutrition, Child, Hospital, Z-score

### Özet

**Amaç:** Özellikle hastanede yatarak tedavi gören çocuklarda olmak üzere, malnütrisyonun önemli bir mortalite nedeni olduğu iyi bilinmektedir. Tüm dünyada malnütrisyonun tanımlanması açısından bir karmaşa söz konusu olduğundan, Dünya Sağlık Örgütü (DSÖ) z-skorlamasının kullanımını önermiş ve DSÖ büyüme standartlarının tüm ülkelerde geçerli olarak kullanılabilceğini bildirmiştir. Bu çalışmanın amacı, hastanede yatarak tedavi görmekte olan çocuk hastalarda malnütrisyon durumunu değerlendirmek ve Neyzi büyüme standartları ile DSÖ standartlarını karşılaştırmaktır.

**Hastalar ve Yöntem:** Beş yaş altındaki hastalarda, ulusal Neyzi ve DSÖ 2006 standartlarına göre, yaşa-göre-ağırlık, boya-göre-ağırlık ve yaşa-göre-boy yüzdeleri ve z-skorları hesaplandı, <-2 SD olan değerler malnütrisyon olarak tanımlandı.

**Bulgular:** Çalışmaya alınan 100 hastanın 62'si erkek olup ortalama yaş 15,9±16,2 ay idi. Akut malnütrisyon %12, kronik malnütrisyon %13 ve tartı azlığı %11 olarak bulundu. Hesaplanan yaşa-göre-ağırlık ve yaşa-göre-boy z-skorları iki büyüme standartları arasında anlamlı olarak farklı bulundu (p<0,001).

**Sonuç:** Yeni DSÖ büyüme standartlarının tüm ülkelerde kullanılabilceğine ilişkin DSÖ açıklamasına rağmen, DSÖ ile yerel büyüme eğrileri arasında varolan uyumsuzluk, malnütrisyonun değerlendirilmesinde büyük bir sorun oluşturmaktadır. (*Marmara Üniversitesi Tıp Fakültesi Dergisi 2012;25:128-32*)

**Anahtar Kelimeler:** Malnütrisyon, Çocuk, Hastane, Z-skoru

## Introduction

Childhood nutritional and growth status is an important index for the general nutritional status of public health. Malnutrition is reported to affect less than 1% of a well-nourished population<sup>1</sup>. Malnutrition associated with primary illness is known to be responsible for about 50%-60% of the childhood mortality worldwide<sup>2,3</sup>. In addition to increased mortality, malnutrition is known to be associated with mental retardation, a decline in school performance, and intellectual capacity<sup>4,5</sup>. It is suggested that malnutrition developed during fetal life and early infancy may be associated with increased risk of type II diabetes, hypertension, and cardiovascular diseases in adulthood<sup>6</sup>.

Protein-energy malnutrition (PEM) is also seen frequently in hospitalized children regardless of their admission disorder, but it is generally overlooked because of a focus on the main disease. Between 21% to 80% of hospitalized pediatric patients are reported to have PEM depending on their country's level of development<sup>7-9</sup>.

Since there is confusion in defining malnutrition worldwide, the WHO has recommended using three indices in the assessment of malnutrition: the height (length)-for-age z-score (HAZ), the weight-for-height (length) z-score (WHZ), and the weight-for-age z-score (WAZ)<sup>10</sup>. The HAZ shows linear growth retardation among children; those with -2 SD from the median of the reference population were considered to be stunted for their age, which is an index of chronic malnutrition. The WHZ, which evaluates body weight with respect to height (length for children  $\leq 24$  months), is used to identify children -2 SD below the median of the reference population, who were considered to be "wasted", an index of acute malnutrition. The WAZ is used to evaluate both acute and chronic malnutrition and is also often used in the long-term evaluation of nutritional status. Children with a WAZ 2SD below the median were considered underweight<sup>10,11</sup>. According to the WHO criteria, children with a z-score between -1 SD and -2 SD are no longer considered as malnourished<sup>12</sup>. The WHO reported these new standards to evaluate the nutritional status of children below 5 years of age in April 2006. The criteria were developed from European, African, Middle Eastern, Asian, and Latin American childhood growth data and it has been suggested that these standards are internationally applicable<sup>13,14</sup>.

Anthropometric evaluation is important in the early recognition of children at high risk for malnutrition. The aim of this study was to evaluate the prevalence of malnutrition in hospitalized pediatric patients and compare the Neyzi child growth standards used in Turkey with the WHO standards<sup>13,15</sup>.

## Patients and Methods

### Sample selection and data collection

The nutritional status of children from birth to five years of age, admitted for any clinical reason to the Department of Pediatrics between February 1 and September 30, 2010, were evaluated prospectively. Informed consent was obtained from the parents in accordance with the Declaration of Helsinki before enrolment in the study. Weight and height were measured in the first 48 hours of admission. Premature (gestational age  $<37$  weeks) or low birth

weight infants (birth weight  $\leq 2500$  gr), children with congenital syndromes, such as Down's syndrome, and children with chronic diseases such as oncologic disorders, chronic renal disease, or type I diabetes mellitus, were excluded. The weights of patients hospitalized for gastroenteritis and dehydration were measured after hydration. Length was measured with the same infantometer or Stadiometer depending on age and weight was measured with an electronic scale by the same observer. Children below 2 years of age were measured lying on a flat surface, and a stadiometer was used in older children. Weight-for-age (W/A), weight-for-height (W/H), and height-for-age (H/A) were calculated separately using the national Neyzi standards and the WHO 2006 standards. The national Neyzi standards were reported in 1978 and re-evaluated in 2008<sup>15,16</sup>. Since we could not find the SD scores for children lesser than 5 years old in the new national Neyzi growth standards, we used the original standards to calculate the z-scores. The results for the WAZ and HAZ were compared. Since the standard deviation for weight-for-height (W/H) was not present in the national Neyzi standards, the WHZ was calculated only using the WHO standards. Anthropometric calculations were made using the following formulas;

$$W/A: [\text{observed weight} / \text{median weight (same age and sex)}] \times 100$$

$$H/A: [\text{observed height} / \text{median height (same age and sex)}] \times 100$$

$$W/H: [\text{observed weight} / \text{median weight (same height and sex)}] \times 100$$

$$WAZ: [\text{observed weight} - \text{median weight (same age and sex)}] / \text{standard deviation (SD)}$$

$$HAZ: [\text{observed height} - \text{median height (same age and sex)}] / \text{standard deviation (SD)}$$

$$WHZ: [\text{observed weight} - \text{median weight (same height and sex)}] / \text{standard deviation (SD)}$$

According to the WHO definition, WHZ  $< -2$  SD is defined as moderate acute malnutrition, WHZ  $< -3$  SD as severe acute malnutrition, HAZ  $< -2$  SD as moderate chronic malnutrition, WHZ  $< -3$  SD as severe chronic malnutrition. WAZ  $< -2$  SD is defined as underweight.

### Statistics

All analyses were performed using the Number Cruncher Statistical System (NCSS) 2007 and the Power Analysis and Sample Size (PASS) 2008 Statistical Software (Utah, USA). The Chi-square test or Student's t-test were used, where appropriate, and  $p < 0.05$  was used to determine statistical significance. Z scores of weight for age, height for age and weight for height were given as means  $\pm$  standard deviations.

## Results

Sixty-two of 100 patients evaluated were male, and the male to female ratio was 1.6. The mean age of the patients was  $15.9 \pm 16.2$  months ranging from 1 month to 60 months. The mean age of the male patients and female patients was  $16.9 \pm 16.1$  months and  $14.2 \pm 16.5$  months, respectively ( $p: 0.041$ ). Patients were evaluated in two groups, those  $\leq 24$  months ( $n=78$ ) and those between 25 and 60 months ( $n=22$ ).

The mean z-scores based on the national Neyzi standards were  $-0.30 \pm 1.03$  for W/A and  $+0.08 \pm 1.31$  for H/A. The mean z-scores based on the WHO standards were  $-0.53 \pm 1.28$  for W/A,  $-0.30 \pm 1.63$  for H/A, and  $-0.27 \pm 1.41$  for W/H. The differences between the values for the WAZ and HAZ according to the

national Neyzi and WHO standards were statistically significant ( $p < 0.001$ ). When the mean z-scores were evaluated by age groups ( $\leq 24$  months versus older than 24 months), there were significant variances for all parameters ( $p < 0.001$ ) except the z-score for W/A ( $p: 0.232$ ) of children older than 2 years (Table I).

When patients with malnutrition were evaluated based on the WHO and national Neyzi standards, the mean z-scores of malnourished patients were significantly divergent according to the WAZ and HAZ indices (Table I). Based on the WHO and national Neyzi standards, 11 and eight patients, respectively, were found to be underweight (WAZ  $< -2$  SD), and 13 and six patients, respectively, had

chronic malnutrition (HAZ  $< -2$  SD). Twelve patients had  $< -2$  SD for W/H based on the WHO standards (Table II). There was an agreement between the WHO and Neyzi growth standards with respect to the number of cases with malnutrition according to the WAZ index ( $p > 0.05$ ). By using the Neyzi index, malnutrition was found in eight out of the 11 patients who had malnutrition according to the WHO index (Table III). However, there was no agreement between the WHO and Neyzi growth standards with respect to the number of cases having malnutrition according to the HAZ index ( $p < 0.05$ ). By using the Neyzi index, we found malnutrition in only eight out of the 13 patients that had malnutrition according to the WHO index (Table IV).

**Table I.** Z-scores of patients based on national Neyzi and WHO standards

Cases		Weight for age			Height for age			Weight for height WHO
		WHO*	Neyzi	p	WHO	Neyzi	p	
All cases	n=100	-0.53±1.28	-0.30±1.03	0.001**	-0.30±1.63	0.08±1.31	0.001**	-0.27±1.41
$\leq 24$ months	n=78	-0.56±1.31	-0.30±1.10	0.001**	-0.30±1.75	+0.13±1.39	0.001**	-0.24±1.39
$>24$ months	n=22	-0.41±1.17	-0.30±0.82	0.232	-0.31±1.14	-0.08±0.98	0.001**	-0.40±1.51
Malnourished children		-3.00±0.80	-2.50±0.50	0.001**	-3.00±1.20	-3.10±1.00	0.001**	-3.12±0.79

Paired Samples t-test \*World Health Organization \*\* $p < 0.01$

**Table II.** The number of malnourished children according to the weight-for-age z-score, height-for-age z-score, and weight-for-height z-score indices using two growth standards

	Weight for age			Height for age			Weight for height		
	total	n moderate	severe	total	n moderate	severe	total	n moderate	severe
WHO* standard	11	6	5	13	8	5	12	9	3
Neyzi standard	8	7	1	6	3	3			

\*World Health Organization

**Table III.** The consistency between the WHO and Neyzi standards in malnourished patients according to the weight-for-age z-score (WAZ) index.

WAZ	Malnutrition ( <sup>a</sup> WHO)			Total n (%)	McNemar p value
	Negative n (%)	Positive n (%)	Total n (%)		
Malnutrition (Neyzi)	Negative	89 (89%)	3 (3%)	92 (92%)	0.250
	Positive	0 (0%)	8 (8%)	8 (8%)	
	Total	89 (89%)	11 (11%)	100 (100%)	

McNemar's test

<sup>a</sup>World Health Organization

**Table IV.** The consistency between the WHO and Neyzi standards in malnourished patients according to the height-for-age z-score (HAZ) index.

HAZ	Malnutrition ( <sup>a</sup> WHO)			Total n (%)	McNemar p value
	Negative n (%)	Positive n (%)	Total n (%)		
Malnutrition (Neyzi)	Negative	87 (87%)	7 (7%)	94 (94%)	0.016*
	Positive	0 (0%)	6 (6%)	6 (6%)	
	Total	87 (87%)	13 (13%)	100 (100%)	

McNemar's test

<sup>a</sup>World Health Organization

\* $p < 0.05$

## Discussion

In developing countries, malnutrition is known to be one of the primary reasons for mortality in children under five years of age<sup>17</sup>. The mortality risk due to infectious diseases is directly associated with the severity of the malnutrition. In fact, it is 8.7 times greater in patients with severe malnutrition than in children without malnutrition. The risk is reduced to 4.2 times for those with moderate malnutrition and is two times higher for those with mild malnutrition<sup>18</sup>.

Acute and chronic malnutrition among hospitalized patients for any reason is being reported more frequently, especially in developing countries. However, studies from developed countries, which included mildly malnourished patients, also reported the rate of malnutrition as 15-20%. The situation is even worse in underdeveloped countries where the prevalence rate of malnutrition reaches 80%<sup>19</sup>. Ferreira et al.<sup>19</sup> reported a 40.4% moderate to severe prevalence rate of malnutrition in 52 children between zero and 10 years of age according to the WAZ. A 12% prevalence rate of severe acute malnutrition was reported in another study from Kenya which included 7869 hospitalized children<sup>20</sup>. Furthermore in a Brazilian study published in 2008 with 426 hospitalized children, acute and chronic malnutrition (z-score  $\leq -2$ ) were reported as 10% and 21%, respectively<sup>21</sup>. Sanabrina et al.<sup>22</sup> reported the prevalence rate of malnutrition as 31% and 13%, respectively based on W/A and W/H, in children below five years of age. Finally, Pawellek et al.<sup>23</sup> reported from Germany that 6.1% of 475 hospitalized children had a malnutrition prevalence rate below 80% based on the Waterlow scale. As these various studies show, the prevalence of malnutrition frequency varies in a wide range depending on the development of the country and the definition of malnutrition used. In particular, the diversity of growth standards and various classifications makes it difficult to identify and make comparisons between data.

The majority of the population in Turkey consists of young people, about 27% of the population are under 15 years of age<sup>11</sup>. Data from the 2008 Turkey Demographic Health Survey showed that one of every 10 children under the age of five is stunted (10.3%) and one-third of them were seriously stunted. In Turkey, the deterioration of nutritional status begins in the first years of life, and that is why early recognition of malnutrition and treatment is important for our country.

In a study by Doğan et al.<sup>24</sup> from Turkey, it was found that the malnutrition (moderate and severe) in hospitalized children according to the median W/A, W/H, and H/A were reported as 36.6%, 27.7%, and 27% in order of frequency while the rates were 19.3% and 20.6% according to the WAZ and HAZ, respectively. In another study by Öztürk et al.<sup>25</sup>, the malnutrition rate in hospitalized pediatric patients was reported as 31.8% when W/A below 80% is used as a criteria for malnutrition. In our study, based on the WHO standards, the prevalence of acute malnutrition (WHZ) was reported as 12%, chronic malnutrition (HAZ) as 13%, and underweight (WAZ) patients as 11%. According to our results, the prevalence of malnutrition in hospitalized children was lower than in the other two studies.

Most of the children in our study suffered from acute diseases resulting from the fact that our study mainly included mildly malnourished children (z-score between -1 to -2) but in the study done by Doğan et al., 68.4% of the patients had chronic illnesses. The WAZ and HAZ results in children suffering from acute diseases in their study were 10.2% and 10.8% which were similar to the figures in our study. Also the high malnutrition rate observed in the study by Öztürk et al can be due to the patient selection and different malnutrition indices used.

It has been shown that when the national Neyzi and WHO standards were compared, there was a statistically significant difference in the mean WAZ and HAZ. The numbers of malnourished children also varied significantly (Table I). The mean z-scores of the study group and of malnourished patients were greater for the national Neyzi growth standards than for the WHO growth standards. The small sample sizes used in our study limits the interpretation of the study results and longitudinal, multicenter studies are needed, to better assess the situation. Neyzi et al.<sup>16</sup> found that the mean scores of the W/A and W/H were greater for the newly obtained national growth charts than for the old ones. They also compared their new data with the growth standards reported from Kuczmarski et al.<sup>26</sup> in the USA, W/A and H/A in the young children were found higher with the new national growth standards. Similarly, in studies which compared the WHO child growth standards and the widely-used National Center for Health Statistics (NCHS) growth references, it was reported that the number of children 3 SD below the mean was 2-4 times higher based on the WHO standards<sup>27,28</sup>.

In conclusion, because it is well known that mortality associated with malnutrition is a major problem in hospitalized patients, in order to decrease the mortality rate, the nutritional status of the hospitalized children should be evaluated carefully. Also, because the prevalence rates of malnutrition differ according to which growth chart standards are used, it is important to use the same malnutrition classification reported by WHO in 2006. Although WHO reported that the new WHO growth standards are applicable to all countries, we think, that in order to identify the number of malnourished children more accurately, future studies, including larger series, are needed to compare the national and the WHO standards.

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