ORIGINAL ARTICLE

Retrospective Evaluation of Serum Zinc Levels in Patients with Protein-Energy Malnutrition

Protein-Enerji Malnutrisyonu Olan Hastalarda Serum Çinko Seviyelerinin Retrospektif Değerlendirilmesi

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ABSTRACT

Aim: In this study, we aimed to investigate the frequency of serum zinc deficiency in children with protein-energy malnutrition and to show the relationship between the degree of malnutrition and serum zinc level.
Methods: Methods: This retrospective study was conducted at the Pediatric Gastroenterology, Hepatology, and Nutrition clinic in Selçuk University Hospital, and included 506 patients aged between 1 and 18 years who were diagnosed with protein-energy malnutrition according to the Waterlow classification.
Results: The prevalence of serum zinc deficiency was 61.1% in patients with protein-energy malnutrition. The mean serum zinc levels of patients aged 1-5 were significantly lower than those of patients aged 5-12 and 12-18. There was no difference between malnutrition degrees calculated according to Waterlow criteria and mean serum zinc levels. Although the relationship between the degree of malnutrition calculated according to the BGA scale and the mean serum zinc level was not statistically significant, the mean decrease in serum zinc levels was remarkable in contrast to the increase in the level of malnutrition.
Conclusion: It is important to routinely measure serum zinc levels in patients with PEM and to provide zinc supplementation if deficiency is detected.

Keywords: Zinc; Prevalence; Protein-energy malnutrition

ÖZ

Amaç: Bu çalışmada, protein-enerji malnütrisyonu olan çocuklarda serum çinko eksikliği sıklığını araştırmayı ve malnütrisyon derecesi ile serum çinko düzeyi arasındaki ilişkiyi göstermeyi amaçladık.
Yöntemler: Selçuk Üniversitesi Hastanesi Pediatrik Gastroenteroloji, Hepatoloji ve Beslenme kliniğinde retrospektif olarak gerçekleştirilen bu çalışmaya, Waterlow sınıflamasına göre protein-enerji malnütrisyonu tanısı almış, yaşları 1-18 arasında değişen 506 hasta dahil edildi.
Bulgular: Protein-enerji malnütrisyonu olan hastalarda serum çinko eksikliği prevalansı %61,1 olarak bulundu. 1-5 yaş arasında hastaların ortalama serum çinko düzeyleri, 5-12 yaş ve 12-18 yaş arası hastaların ortalama serum çinko düzeylerinden anlamlı derecede düşük bulundu. Waterlow kriterlerine göre hesaplanan malnutrisyon dereceleri ile serum çinko düzeyi ortalamaları arasında fark yoktu. BGA skalasına göre hesaplanan malnutrisyon derecesi ile serum çinko düzeyi ortalamaları arasındaki ilişki istatistiksel olarak anlamlı derecede olmasa da PEM düzeyindeki artışın aksine serum çinko düzeylerindeki ortalama düşüş dikkat çekiciydi.
Sonuç: PEM'li hastalarda serum çinko düzeylerinin rutin olarak ölçülmesi ve eksiklik saptanırsa çinko desteğine başlanması önemlidir.

Anahtar Kelimeler: Çinko; Prevelans; Protein-enerji malnütrisyonu

Introduction

Various factors that cause poor health status in childhood can hinder children's growth and development (1). Protein-energy malnutrition (PEM) is a major health problem due to inadequate and unbalanced nutrition, especially during the pre-school period. Although nutritional disorders are a global sociomedical problem, they are more critical in developing countries (2). Infants and children are most affected by nutritional deficiencies as they are constantly growing and developing (3). To evaluate the nutritional status of children, various classification systems such as Gomez, Waterlow, or World Health Organization classification are used basing on the comparison of the values obtained by anthropometric measurements (body weight, height) with the median value according to age and gender (4).

Zinc deficiency continues to be a fundamental health problem, particularly in developing countries. It is believed to affect many systems of the body, such as a history of recurrent infections due to zinc deficiency, a decrease in neurosensory functions, delayed wound healing, deterioration in hormonal and immune system functions, pause or regression in growth and development, diarrhea, and sensory and cognitive deficiencies. If one or more of these conditions are observed, it is necessary to determine whether the zinc level is sufficient and the zinc requirement of the body (5). Additionally, zinc deficiency can cause a decrease in appetite due to decreased food intake, leading to lag or stagnation of growth (6).

This study aimed to investigate the frequency of serum zinc deficiency in children with PEM and to determine the relationship between the severity of PEM and serum zinc levels.

Materials and Methods

The study included 506 patients diagnosed with PEM between the ages of 1-18 years old, and who visited the Pediatric Gastroenterology, Hepatology, and Nutrition Polyclinic at Selçuk University Faculty of Medicine between October 2012 and July 2017. The Waterlow classification (height for age and weight for height) was used to diagnose PEM, determine its type (acute, chronic, or acute on the chronic background), and grade its severity (mild, moderate, or severe) (7). The data were collected retrospectively.

The study investigated the relationship between the degree and type of PEM, demographic characteristics (age, gender) of the patients, and serum zinc levels. The patients were classified into three groups based on age and PEM grade: group 1 included 1-5 years old, group 2 included 6-12 years olds, and group 3 included 13-18 years olds. Those in the range of 90-95% height for age were classified as having mild chronic PEM, those in the range of 85-90% were classified as having moderate chronic PEM, and those below 85% were classified as having severe PEM. Those in the range of 80-90% in weight for height were classified as having mild acute PEM, those in the range of 70-80% were classified as having moderate acute PEM, and those below 70% were classified as having severe PEM. If a patient had a decrease in both classifications, they were classified as having acute PEM on a chronic basis.

The study was approved by the Selcuk University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee.

Statistical Analysis

Descriptive statistical analysis was performed to determine the frequency, percentile, minimum, maximum, and mean ± standard deviation values using the SPSS (IBM SPSS Statistics V22.0, SPSS Inc., USA) package program. The Chi-square test was applied for cross tables. After evaluating the data for normal distribution using the Kolmogorov-Smirnov test, the homogeneity of the variances of the groups was tested with the Levene test. One-Way Analysis of Variance (ANOVA) was used to test for differences between the means of more than two groups. The difference between the means of two independent groups was analyzed with the Independent Samples T-Test for independent groups. $p < 0.05$ was accepted as statistical significance level.

Results

A total of 506 patients, including 257 (50.8%) females and 249 (49.2%) males, were included in the study. The demographic characteristics of the patients are shown in Table 1. Of the cases, 213 (42.1%) were between the ages of 1-5, 209 (41.3%) were between the ages of 6-12, and 84 (16.6%) were between the ages of 13-18. When evaluated according to the Waterlow BGA classification, 219 cases (43.4%) were mild, 98 (19.4%) were moderate, and 16 (3.2%) were severe PEM (Table 1). According to the Waterlow PDD classification, 237 cases (46.9%) were mild, 77 cases (15.2%) were moderate, and 31 cases (6.1%) were severe PEM (Table 1). Of the cases, 163 (32.2%) were acute, 172 (34%) chronic, and 171 (33.8%) chronic PEM (Table 1).

Table 1: The demographic and clinical characteristics of patients

	n	%
Sex		
Famele	257	50,80
Male	249	49,20
Age (Years)		
1-5 (Group 1)	213	42,10
6-12 (Group 2)	209	41,30
13-18 (Group 3)	84	16,60
Waterlow (BGA)		
Mild	219	43,40
Moderate	98	19,40
Severe	16	3,20
Normal	173	34,00
Waterlow (YGB)		
Mild	237	46,90
Moderate	77	15,20
Severe	31	6,10
Normal	161	31,80
PEM type		
Acute malnutrition	163	32,2
Chronıc malnutrition	172	34,0
Acute on chronic background	171	33,8
Total	506	100,00

When the serum zinc levels of the patients were evaluated, no statistically significant difference was found according to gender. The comparison of serum zinc levels of the patients participating in the study is shown in Table 2. When serum zinc levels were examined according to age groups, it was determined that they were the lowest in children aged 1-5, while the highest in children aged 13-18. When evaluated statistically, serum zinc levels were significantly lower in children aged 1-5 years (Table 2).

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Table 2: Comparison of patient's zinc levels

		Mean±SD (Min-Max)	p
Sex	Famele (n=257)	10.57±1.74 (5.15-14.93)	0.129
	Male (n=249)	10.80±1.69 (6.14-15.06)	
Age groups	Group 1 (n:213)	10.38±1.78 (5.15-15.069	**0.003***
	Group 2 (n:209)	10.87±1.67 (6.26-14.99)	
	Group 3 (n:84)	10.97±1.56 (7.57-14.89)	
Waterlow (BGA)	Mild (n=219)	10.81±1.65 (6.39-14.99)	0.055
	Moderate (n=98)	10.59±1.69 (5.15-14.89)	
	Severe (n=16)	9.83±1.38 (6.97-12.49)	
Waterlow (YGB)	Mild (n=237)	10.53±1.70 (6.69-14.93)	0.285
	Moderate (n=77)	10.86±1.77 (6.14-14.72)	
	Severe (n=31)	10.82±1.93 (7.48-14.70)	
PEM Type	Acute PEM	10.77±1.68 (5.15-15.06)	0.715
	Chronic PEM	10.66±1.81 (6.14-14.93)	
	Acute on chronic background	10.62±1.67 (6.39-14.89)	

p1 (Group 1-Group 2): 0.003; p2 (Group 1-Group 3): 0.007; p3 (Group 1-Group 2): 0.644

When the serum zinc level of the patients participating in the study was evaluated, serum zinc levels were low in 61.1% (n:309) of the patients and normal in 38.9% (n:197).

When the serum zinc levels of the patients with mild, moderate, and severe PEM levels were evaluated according to the Waterlow BGA classification, no statistically significant difference was observed (p:0.055) (Table 2). When the serum zinc levels of patients with mild, moderate, and severe malnutrition were compared according to the Waterlow PDD classification, no statistically significant difference was found (p:0.285) (Table 2). There was no statistically significant relationship between serum zinc levels and the type of PEM (acute, chronic, or acute on the chronic background) (p:0.776) (Table 2).

When the patients participating in the study were examined in terms of other diseases, 84 patients had comorbid disease, and serum zinc levels were low in 76.2% of these patients. This situation was considered statistically significant (p:0.002).

Discussion

Protein-energy malnutrition (PEM) is a significant health problem, especially in developing countries, and affects the growth and development of children. Inadequate and unbalanced nutrition can lead to various health problems in children. The Gomez, Waterlow, and World Health Organization classification systems are used to evaluate the nutritional status of children based on anthropometric measurements such as body weight and height (4). Zinc is an essential mineral for growth and development and is involved

in many body systems such as immune, neurosensory, and hormonal systems. Zinc deficiency can cause various health problems including decreased appetite, growth retardation, and cognitive and sensory deficiencies (5, 6).

In this study, the prevalence of serum zinc deficiency in PEM patients was 61.1%. This finding is consistent with previous studies showing that zinc deficiency is common in children with PEM (8, 9). The results of this study show that routine measurement of serum zinc levels in children with PEM is important to detect and treat deficiency. Zinc supplementation can improve growth and cognitive functions in children with zinc deficiency (10).

The mean serum zinc levels of patients aged 1-5 years old were significantly lower than those of patients aged 5-12 and 12-18 years old. This finding suggests that younger children with PEM are more likely to have zinc deficiency than older children. The younger age group may have a higher zinc requirement due to their rapid growth and development. Therefore, younger children with PEM should be monitored more closely for zinc deficiency.

There was no significant difference between PEM grades calculated according to BGA and YGB criteria and serum zinc level averages. However, the decrease in serum zinc levels with an increase in PEM grade was noteworthy. This finding suggests that zinc deficiency may worsen as PEM becomes more severe. Therefore, early detection and treatment of zinc deficiency may be important in preventing the progression of PEM.

This study has some limitations. Firstly, the study is retrospective and relies on medical records, which may not include all relevant information. Secondly, the study only measured serum zinc levels and did not evaluate other factors that may affect zinc absorption and utilization. Finally, the study did not evaluate the effectiveness of zinc supplementation in treating zinc deficiency in children with PEM.

Conclusion

This study highlights the high prevalence of serum zinc deficiency in children with PEM and the importance of routine measurement of serum zinc levels in these patients. Younger children with PEM may be more susceptible to zinc deficiency, and early detection and treatment may be important in preventing the progression of PEM. Further studies are required to evaluate the effectiveness of zinc supplementation in treating zinc deficiency in children with PEM.

Author Contributions: Concept – HÖ,HHE; Design - HÖ; Supervision – HÖ,HHE; Resources – HÖ,HHE; Materials – HÖ,HHE; Data Collection and/or Processing – HÖ,NA; Analysis and/or Interpretation – HÖ,ME,AY; Literature Search – ME,HHE; Writing Manuscript - AY; Critical Review – HHE,AY

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

The study was approved by the Selcuk University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee.

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