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Comparison of Micronutrient Levels of Children with and without Congenital Heart Diseases

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Abstract

Background: Micronutrients are dietary substances and trace elements necessary for growth, metabolism, and normal functions of the immune system. Children with congenital heart diseases (CHD) have increased tendency to malnutrition due to inadequate intake, altered metabolism, increased oxidative stress, and malabsorption. Therefore, in this study we planned to compare the micronutrient levels of children with and without CHD.

Material and Methods: 180 children with CHD and 120 healthy controls, followed in the pediatry and pediatric cardiology outpatient clinics of Kartal Koşuyolu Research and Training Hospital between January 2021 and July 2021, were enrolled in this prospective study. The children were excluded from the study if they received iron or vitamin supplements in the last year or if they had any gastrointestinal malabsorption syndrome. The medical histories of the children were recorded. Their serum iron, ferritin, vitamin D, folate, zinc and vitamin B12 levels were analyzed and the results were compared statistically.

Results: The mean age of children was 9.5 ± 4.2 years in the CHD group and 8.6 ± 3.4 years in the control group. Iron, ferritin, vitamin D, folate, and vitamin B12 levels of CHD group were lower than the controls (18.4 ± 8.6 *vs* 21.6 ± 9.2 µg/dl, 19.4 ± 8.3 *vs* 22.1 ± 9.8 µg/L, 12.3 ± 5.3 *vs* 14.2 ± 6.4 µg/L, 3.4 ± 1.9 *vs* 4.5 ± 2.6 µg/L, 185.4 ± 55.8 *vs* 255.7 ± 72.8 ng/L, respectively) with a moderately significant statistical difference, but the zinc levels were within the normal limits in both groups.

Conclusion: Children with CHD should be more closely monitored for micronutrient deficiencies and drug supplements should be given when necessary.

Keywords: Congenital heart diseases; Micronutrient levels; Children

Introduction

Micronutrient is term used to represent essential vitamins and minerals required in small amounts in diet, but essential to sustain virtually all normal cellular and molecular functions [1]. Micronutrient deficiency (MND) is only one form of undernutrition. As other forms of undernutrition are more readily visible, MND is often referred to as "hidden hunger" [2]. The most common MND exist for vitamin A, folate, iron, vitamin B12, iodine, and zinc; which may have wide-range negative health impacts that will ultimately result in death if untreated. The severity, timing, comorbidities and the extent of the deficiency will determine its sequelae [3]. Patients with CHD may be more susceptible to the effects of MND because of increased oxidative stress, impaired skeletal muscle function (possibly exacerbated by vitamin D deficiency), and impaired myocardial contraction. Some severe MND can cause heart failure and, therefore, it is likely that less severe deficiency may exacerbate existing cardiac dysfunction [4]. Therefore, we planned this study to determine the micronutrient levels of children with CHD in our follow-up.

Materials and Method

A 180 children with CHD (92 females, 88 males) and 120 healthy controls (64 females, 56 males) followed in the pediatry and pediatric cardiology outpatient clinics of Kartal Koşuyolu Research and Training Hospital between January 2021 and July

2021, were enrolled in this prospective study. The CHD of these children were evaluated by transthoracic echocardiography (Philips iE33 with 5 MHZ transducer). The exclusion criteria of the study were not taking vitamin supplements in the last year and not having intestinal malabsorption syndrome. Medical histories of the children were inquired and the written consents were received from their parents. Venous blood samples were obtained from the children and transferred immediately into the tubes without any anticoagulant agents. The blood cells and plasma samples were separated by centrifugation (10 min, 3000 rpm). Plasma samples were stored at -20°C, until serum folate, zinc, iron and vitamin B12 measurements were performed. The results were evaluated according to the American Academy of Pediatrics (APA) criteria and were compared statistically. The study was approved by the Ethics committee of the Institute [5].

Statistical Analysis

Statistical Package for the Social Sciences version 22.0 software was used for the statistical analysis. Chi-square test was used for categorical data and Mann-Whitney U test to compare averages in the case and control groups, when necessary. P values < 0.05 were accepted as statistically significant.

Discussion

Malnutrition has been implicated in two-thirds of childhood mortality globally, which has formed the basis of nutritional management for common childhood illnesses [6]. Despite the growing evidence of MND in children, nutritional management is still focused mainly on PEM, with little or no emphasis on micronutrients. Children with CHD are at increased risk of MND because of their inadequate intake, altered metabolism, increased oxidative stress and malabsorption as a result of intestinal mucosal edema. In the present study, the children with CHD were found to have lower micronutrient levels than the control group with a moderate statistical significance. Morever, the children with CHD have tendency to have chronic hypoxia and congestive heart failure with a requirement for anticongestive drugs that may impair appetite, induce anorexia and feeding intolerance [7, 8]. Anticongestive drugs have been shown to increase urinary excretion of micronutrients, including thiamine, calcium, selenium and zinc, while other medications such as angiotensin converting enzyme inhibitors, angiotensin receptor antagonists and thiazides induce mainly zinciuria and hypozincemia [9]. Despite using one or more anticongestive therapy, our patients had moderately low micronutrient levels which could be corrected with a short period of vitamin and iron supplementation. This may be due to the close follow up of these patients in our pediatry and pediatric cardiology outpatient clinics and the increased consciousness of the parents about the importance of vegetables, fruits, whole grain and meat consumption of their children regularly [10]. In a recent study involving 41 children with CHD in Benin, south Nigeria, serum zinc levels were lower in children on diuretic therapy compared to those not on diuretics, with some of the children having zinc levels below 70µg/dl [11]. Zinc is involved in monocyte/macrophage development and regulates its phagocytic functions and cytokine production [12]. The zinc levels in our study were within the normal limits in both groups and the statistical difference was not significant. Although we excluded the children using iron or vitamin supplements in the

Results

The mean age of children with CHD was 9.5 ± 4.2 years and 8.6 ± 3.4 years in the control group. The iron, ferritin, vitamin D, folate, and vitamin B12 levels of the children with CHD were 18.4 ± 8.6 µg/dl, 19.4 ± 8.3 µg/L, 12.3 ± 5.3 µg/L, 3.4 ± 1.9 µg/L, and 185.4 ± 55.8 ng/L, respectively. Despite the higher levels of iron, ferritin, vitamin D, folate, zinc and vitamin B12 levels of the children without CHD (21.6 ± 9.2 µg/dl, 22.1 ± 9.8 µg/L, 14.2 ± 6.4 µg/L, 4.5 ± 2.6 µg/L, 255.7 ± 72.8 ng/L, respectively), the statistical difference was moderately significant. However, zinc levels were within the normal limits (84.5 ± 37.2 µg/dl in CHD group and 85.4 ± 39.2 µg/dl in the control group) and there was no statistically significant difference between the two groups (Table 1).

Table 1: *Comparison of the micronutrient levels of the children with and without CHD.*

Micronutrient levels	Children with CHD (n:180)	Without CHD (n:120)	p-value*
Iron (µg/dl)	18.4 ± 8.6	21.6 ± 9.2	0.04
Ferritin (µg/L)	19.4 ± 8.3	22.1 ± 9.8	0.04
Folate (µg/L)	3.4 ± 1.9	4.5 ± 2.6	0.04
Zinc (µg/dl)	84.5 ± 37.2	85.4 ± 39.2	0.6
Vitamin D(µg/L)	12.3 ± 5.3	14.2 ± 6.4	0.03
Vitamin B12(ng/L)	185.4 ± 55.8	255.7 ± 72.8	0.03
*p-value <0.05 is accepted as statistically significant			

last year, most of these children had been given zinc supplementation by their parents in the previous year either to strengthen their immunity or to increase their appetite. Micronutrient deficiencies are prevalent among children, but the data on the magnitude of these deficiencies in children with CHD are insufficient. Micronutrient supplementation is not regarded as a part of normal protocol in the management of children with CHD. However, it is crucial to create awareness of the prevalence of nutritional deficiencies and give drug supplements if necessary in these children. Well-structured studies should be conducted to document the magnitude of MND and the effects of micronutrient supplementation on the clinical, electrocardiographic and echocardiographic parameters in the children with CHD.

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