PHYSICAL DEVELOPMENT (WEIGHT AND HEIGHT) IN CHILDREN WITH CONGENITAL HEART DISEASES

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Abstract

Introduction: Children with congenital heart defects (CHD) are prone to malnutrition and growth disorders, both due to reduced food intake, and increases in energy needs. *Objective:* Assessment of physical development in children with CHD and identification of significant factors that influence z scores. *Methods:* Anthropometric data have been registered in a group of children with CHD and z score has been calculated for weight/age, height/age and weight/height. It has been used the Mann-Whitney statistical test to compare the z scores. *Results:* Weight-for-age z-score was $\leq$ -2 for 75 children (44.38%), weight-for-size for 48 children (28.4%) and height-for-age for 72 children (42.6%). Comparing z scores we have identified a significant difference (p <0.01) between averages of height-for-age z-scores and statistically highly significant (p <0.001) for weight-for-age z-scores between children born prematurely and eutrophic children. The presence of heart failure (HF) influenced negatively the physical development in children with CHD, p = 0.0001 in weight-for-age z-score, and p = 0.015 in height-for-age z-score. Inappropriate food selection has been negatively correlated with physical development (p <0.05, 95% CI). *Conclusions:* Physical deficit is frequently found in children with CHD, and chronic malnutrition affects both length and weight in children. Nutrition counseling is an important part of every child's recovery process.

Keywords: physical deficit, congenital heart defect, children.

Introduction

The essential element which distinguishes the adult from the child is the complex process of growth and development, a highly dynamic process, that begins at conception, continues in intrauterine life, and then throughout childhood and adolescence. The growth process is a highly biological energy consumer used in the synthesis of plastic substances, tissue organization, and cell mitosis.

Children with congenital heart defects (CHD) have frequent disturbances of growth and development.

In these children, multiple factors are incriminated in the development of these disturbances and the understanding and control of these factors can prevent the deterioration of nutritional status and therefore increased morbidity. It creates a vicious cycle between malnutrition, heart failure and respiratory infections.

Half of children with CHD require surgery in infancy, and postoperative evolution is negatively influenced by malnutrition.

Objective

The objective of this work is to appreciate the physical development in children with CHD and to identify the significant factors that influence z scores.

Materials and methods

The study included 169 children with CHD hospitalized in Pediatric Clinics I and II of the Emergency County Hospital of Craiova, in January 2007 - December 2010.

In all cases patients were assessed using demographic factors, socioeconomic factors, and history of nutritional intakes. Anthropometric data were recorded and weight-for-age, height-for-age, and weight-for-size z-scores were calculated using as reference values from WHO growth tables (The WHO Child Growth Standards 2007).

An alternative way to express height, weight, and weight for height is z score, which denotes units of standard deviations from the median. It allows the clinician to locate an observation on the normal curve by the number of standard deviations it is from the center of the curve, and thus detect movement toward or away from the median, which is more sensitive than percentile changes.

For the statistical analysis we used the Data Analysis module of Microsoft Excel 2003 (Microsoft Corp., Redmond, WA, USA) together with the XLSTAT 2009 for MS Excel (Addinsoft SARL, Paris, France), to process the data.

The original database was created by using all data of the subjects. From it we extracted only the important aspects for this study.

The actual processing was done using the Pivot Tables, Functions-Statistical, Chart commands and the Data Analysis module of MS Excel and commands for statistical tests from the XLSTAT add-in.

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We used the Mann-Whitney statistical test to compare the z scores.

Results

From 169 children with CHD 97 (57.40%) were boys, and 72 (42.60%) girls (Figure 1).

Distribution by sex
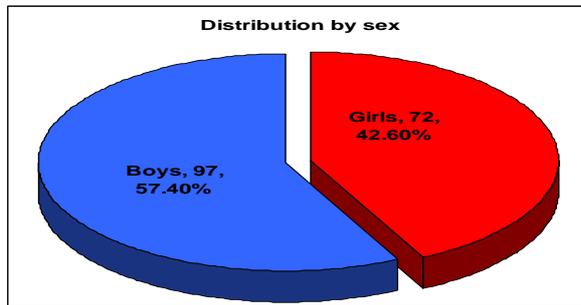
Girls, 72, 42.60%

Boys, 97, 57.40%

Figure 1. Distribution of cases by sex.

Weight-for-age z-score was ≤ -2 for 75 children (44.38%) (Figure 2), weight-for-height for 48 children (28.4%) (Figure 3) and height-for- age for 72 children (42.6%) (Figure 4).
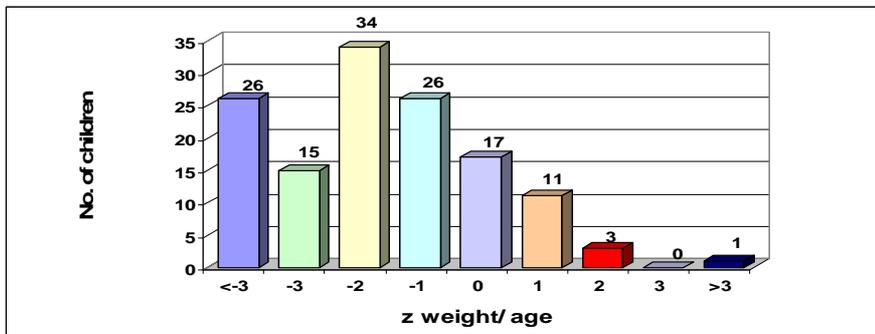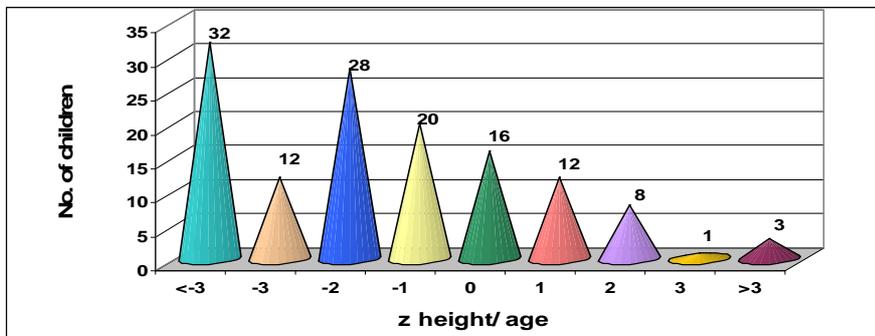
Figure 2. Weight-for-age z-score.

Figure 3. Height-for-age z-score.

Figure 4.Weight-for-height z-score.

Using the statistical test Mann-Whitney we identified a significant difference ($p < 0.01$) between averages height-for-age z-scores and statistically highly significant ($p < 0.001$) for weight-for-age between children born prematurely and eutrophic children (Figure 5).
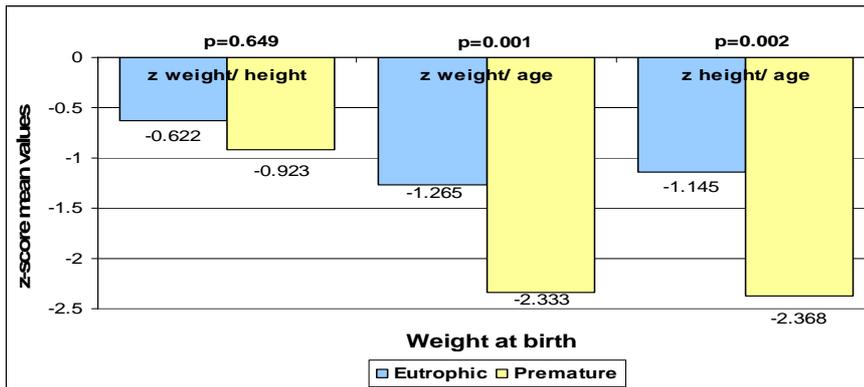
Figure 5. Correlation between birth weight and z score.

The presence of heart failure (HF) influenced negatively the physical development in children with CHD, p = 0.0001 for weight-for-age z-scores, and p = 0.015 for height-for-age z-scores (Figure 6).
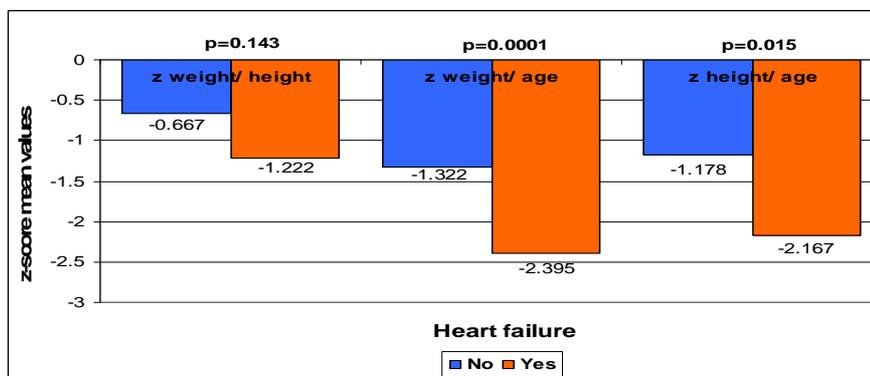

Figure 6. Correlation between z-score and heart failure.

We could not demonstrate any other statistically significant differences in case of surgery, pulmonary hypertension (PH) and cyanosis.

Poor nutrition diet was negatively correlated with physical development, the average value of weight-for-size z-scores in patients who had an improper diet is significantly lower than those that had a proper diet (p = 0.028, 95% CI) (Figure 7).
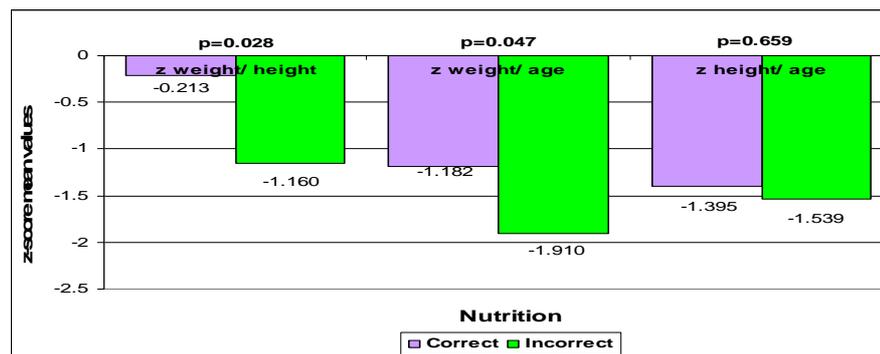

Figure 7. Correlation between z-score and food type.

Discussion

Children with congenital heart defects are prone to poor physical development no matter what are the nature of cardiac malformation and the presence/absence of cyanosis.

In these children there is a degree of functional and structural damage to organs (reduced stomach capacity, anoxia, circulatory congestion, changes in intestinal motility, decreased absorption), but inadequate caloric intake is the major cause of poor growth. Reducing food intake following a strict control of fluid necessities is often associated with inadequate intake of nutrients due to fatigue or tachypnea, or low socioeconomic level of the family.

Hyper catabolic status, given by the increased cardiac and respiratory activity, makes that caloric needs used for optimal growth to be 50% higher than in normal children.

In a study made by Varan, Kurs, Tokel, and Yilmaz regarding children with CHD, 65% were below the 5th percentile for weight, 41% were below the 5th percentile for

both height and weight, 63% of children showed low weight for height. (1,2)

In our study group z score was ≤ 2 in almost half of children with impairment of both waist and weight.

Premature healthy babies have an accelerated growth rate, at 8-9 months catching those children born at term. Also children who were born dysmature, if intrauterine malnutrition was due to maternal causes, after birth they will show an accelerated growth.

Children born with impaired weight and CHD, included in our study, presented poor physical development, the mean Z scores for eutrophic subjects being significantly higher than those for preterm subjects with 99% confidence.

Cardiac malformations associated with cyanosis, pulmonary hypertension and congestive heart failure cause a more severe damage to weight and size, with worsening nutritional deficit. (1,2,3)

In our study the average z scores were lower in children with cyanogen congenital heart diseases, PH and HF, but only in cases with HF the difference between Z scores was statistically significant.

In developing countries, due to limited resources, many times the intervention for correction of CHD is made late, realizing a vicious circle, frequent respiratory infections and heart failure promoting and worsening malnutrition. (4) Several studies have shown normalization of somatic growth if corrective surgery is performed early. (5,6)

Regarding the intervention, we could not demonstrate a significant influence of it in terms of z scores making a correlation between patients with surgery and patients with no surgery. This is explained by the small number of patients who were operated on, only 27, but also by the advanced age when surgery was performed.

A group of doctors from the Instituto Coração do Hospital DAS Clinicas - FMUSP - São Paulo, SP - Brazil, assessed dietary intake in children between 0 and 24 months, with CHD. The results of this study showed inadequate food consumption during hospitalization and the probability of deepening power failures at home. (7,8)

In our study group food history has shown 39% of children with inadequate diet. Average value of weight-for-height and weight-for-age z-scores for patients who had incorrect diet was significantly lower than those who had a proper diet.

Conclusions

1. Physical deficit is frequently found in children with CHD, and chronic malnutrition affects both size and weight.
2. CHD associated with HF causes a more severe damage to weight and size.
3. Birth weight represents a negative prognostic factor for subsequent development of children with CHD.
4. Nutrition counseling is an important part of every child's recovery process.

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