EVALUATION OF THE GROWTH PERCENTILES OF CHILDREN WITH CONGENITAL HEART DISEASE[1]

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The purpose of this study was to evaluate the correlation between anthropometric measures of children with congenital heart disease with percentiles that represent their growth indicators. Anthropometric evaluations of 135 hospitalized children with congenital heart disease were performed in a hospital specialized in cardiac diseases in Fortaleza, CE, Brazil. For the growth evaluation, percentiles of height by age, weight by height and weight by age were calculated. Children's average age was 4.74 months (± 3.78) and 66.7% of the children were male. The medians of the three percentiles presented values below percentile 10, indicating a high proportion of values considered of risk. The subscapular thickness presented positive correlation with the three percentiles. The values of percentiles studied indicated growth delay.

DESCRIPTORS: Heart defects, congenital; Anthropometry; Continuity of patient care

EVALUACIÓN DE LOS PERCENTILES DE CRECIMIENTO EN NIÑOS CON CARDIOPATÍAS CONGÉNITAS

El propósito del presente estudio fue evaluar la correlación entre las medidas antropométricas de niños con cardiopatías congénitas con los percentiles que representan los indicadores de crecimiento. Se realizaron 135 evaluaciones antropométricas de niños con cardiopatías congénitas internados en un hospital especializado en enfermedades cardíacas de la ciudad de Fortaleza / Ceará. Para evaluar el crecimiento fueron calculados los percentiles de talla por edad, peso por talla y peso por edad. La media de edad de los niños fue de 4,74 meses (± 3,78), siendo que 66,7% de los niños eran del sexo masculino. Las medianas de los tres percentiles presentaron valores por debajo del percentil 10, lo que indica una gran proporción de valores dentro del grupo considerado de riesgo. El pliegue subescapular estuvo correlacionado de forma positiva con los tres percentiles. Los valores de los percentiles estudiados indicaron retraso en el crecimiento.

DESCRIPTORES: cardiopatías congénitas; antropometría; continuidad en la atención al paciente

AVALIAÇÃO DOS PERCENTIS DE CRESCIMENTO DE CRIANÇAS COM CARDIOPATIAS CONGÊNITAS

O propósito do presente estudo foi avaliar a correlação entre as medidas antropométricas de crianças com cardiopatias congênitas com os percentis que representam seus indicadores de crescimento. Foram realizadas 135 avaliações antropométricas de crianças com cardiopatias congênitas, internadas num hospital especializado em doenças cardíacas da cidade de Fortaleza / Ceará. Para avaliação do crescimento, foram calculados os percentis de altura por idade, peso por altura e peso por idade. A média de idade das crianças foi de 4,74 meses (± 3,78) e 66,7% das crianças eram do sexo masculino. As medianas dos três percentis apresentaram valores abaixo do percentil 10, indicando grande proporção de valores na faixa considerada de risco. A prega subescapular esteve correlacionada de forma positiva com os três percentis. Os valores dos percentis estudados indicaram atraso de crescimento.

DESCRITORES: cardiopatias congênitas; antropometria; continuidade da assistência ao paciente

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INTRODUCTION

Anthropometric measures are important health indicators to assess children's growth. For Brazil, in growth assessment based on weight/length, weight/age and age/length percentiles, values above 10 are considered normal, while children with percentile values between 3 and 10 are considered as the risk range for growth deficit[1]. In children with congenital heart disease, the hemodynamic changes they present provoke nutritional alterations, growth deficit and complications related to post-surgical survival[2].

In this context, adequate nursing care to children with congenital heart disease is needed before, during and after surgery. Special emphasis is put on nursing care in the first part of treatment, directed at the early detection of decompensation signs and at the maintenance of optimal conditions for surgery. The nursing process applied to children with congenital heart disease supports the identification of nursing diagnoses, the establishment of goals and a care plan to solve the surveyed problems, as well as the implementation and assessment of the care plan[3].

Possible nursing diagnoses in children with congenital heart disease hospitalized at clinical and surgical units include: Altered nutrition, Risk for infection, Ineffective airway clearance, Impaired gas exchange, Hyperthermia, Acute pain, Altered growth and development, Sleep pattern disturbance, Risk for constipation and Impaired skin integrity[3-4].

The nursing diagnoses related to nutrition and growth and development remarkably present high proportions and important clinical and statistical associations. Moreover, the investigation of collaborative problems these children present has demonstrated a strong statistical relation between the potential complication: Pneumonia and the nursing diagnosis Altered growth and development[4].

In addition, many children with congenital heart disease present nutritional difficulties during the first year of life, with vomiting as one of the most common problems[5].

This leads to increased morbidity and mortality rates when heart transplantations are realized in children with congenital heart disease, because of their poor nutritional state and the consequent final damage to the organ[6].

Thus, anthropometric measures are important health status indicators when assessing the nutritional state, growth and development of these children, as they help to diagnose nutritional alterations, to assess individual morphological characteristics and to determine the prognosis of baseline defects and their complications. In Brazil, commonly used indicators include the calculation of length/age, weight/length and weight/age percentiles, besides head, thoracic and abdominal perimeter and subscapular and triceps fold measures[1].

Although they exert a global influence in the treatment of children with congenital heart disease, the exact relation between growth and food difficulties is not very clear yet[2]. It should be added that few studies assess the relation between anthropometric measures and growth indicators in this population. Moreover, the hospitalization process is reported as an aggravating factor of child development[7]. Therefore, this study aimed to assess the correlation between the anthropometric measures of children with congenital heart disease and the percentiles representing the growth indicators. More specifically, we attempted to describe their growth indicators, anthropometric data and differences according to gender and type of heart disease.

MATERIAL AND METHODS

In this cross-sectional study, we carried out 135 serial anthropometric assessments of children with congenital heart disease hospitalized at an institution specialized in heart diseases in Fortaleza / Ceará, Brazil. This is a census of children hospitalized between June and December 2004, with the following inclusion criteria: age up to 12 months; confirmed medical diagnosis of acyanotic or cyanotic heart disease; and not having been submitted to definitive or palliative heart surgical correction. The following exclusion criteria were defined: child's exit from the study unit because of discharge or transference, and follow-up of the child by a person incapable of providing the necessary data. The study period was delimited based on the authors' availability for data collection.

Data were collected through a standardized protocol that considered, besides gender, age (months), type of heart disease (0 - acyanotic, 1 – cyanotic), birth weight (kg) and birth length (cm), anthropometric measures and growth indicators.

For the child's anthropometric assessment, we determined weight (kg), length (cm), head

perimeter (cm), thoracic perimeter (cm), abdominal perimeter (cm), triceps fold (mm) and subscapular fold (mm) measures. In order to minimize the verification bias, triple measures were performed for each of these variables, calculating the respective average. The following measuring instruments were used: Filizola® BP baby scales with a maximum capacity of 15 kg and divisions of 5g, Sanny® adipometer with a measurement scale graded in tens of millimeters, non tightenable measurement tape with a millimeter scale and a scientific anthropometer. Anthropometric measurement techniques for children between zero and 23 months were adopted for weight and length measurements[1]. Perimeter and subcutaneous fold measures followed procedures described in specialized literature[1-8].

To assess growth, we calculated the length/age, weight/length and weight/height percentiles, in accordance with World Health Organization recommendations, based on a standardized version of the growth reference curves by the National Center for Health Statistics (NCHS), issued in 1977[8]. The recommended cut-off point to assess growth deficit is the percentile 3, adopted in this research. Values located between 3 and 10 were considered as a risk range[1].

Data were analyzed in SPSS version 13.0©. NutStat© software was used to calculate percentiles. For descriptive analysis, we considered absolute and percentage frequencies. To compare the percentiles with gender and type of heart disease, data were ordered in posts for the posterior calculation of means, considering that percentiles tend to present asymmetrical distributions, which difficult direct comparisons of their means. For the numerical variables, central tendency, dispersion and separation line measures were presented. Spearman's correlation coefficient (Rho) was used to analyze correlations.

The project was submitted to the Board of the institution in order to authorize data collection, and to its Ethics Committee, with a view to complying with resolution 196/96 on research involving human beings, issued by the National Ethics Council of the Brazilian Health Ministry, and was approved[9]. Data were collected after participants had been fully informed about the secrecy of information and identities, and after the parents / responsibles for the children had signed the free and informed consent term.

RESULTS

The children's average age was 4.74 months (SD ±3.78), with 25% up to one month and 75% up to eight months old. However, the highest frequency occurred in the age range of up to three months (46.7%). From the whole group, 66.7% were male children, corresponding to two boys for one girl. This proportion can be higher and even reach four boys for one girl if we consider the extreme ends of the confidence intervals, where the lowest percentage of female children is 20%, and the highest for boys 80%.

Among the identified medical diagnoses, the most frequent congenital diagnoses were: Interventricular communication (53.3%), Interatrial communication (42.2%), Persistence of the arterial channel (26.7%), Coarctation of the aorta (17.8%), Tetralogy of Fallot (13.3%), Pulmonary stenosis (13.3%) and Total anomalous pulmonary venous drainage (11.1%).

Table1 – Anthropometric characteristics of children with congenital heart disease hospitalized at Fortaleza Hospital - CE

Variables	Mean	SP	Percentiles		
			25	50	75
Age (months)	4,75	3,75	1	4	8
Length (cm)	57,54	7,87	50,5	57	64,4
Weigth (Kg)	4,46	1,49	3,34	4,03	5,9
Birth weigth (kg)	3,11	0,63	2,63	3,13	3,35
Birth length (cm)	48,6	2,34	47	49	50
Abdominal Perimeter (cm)	37,96	3,27	35,2	38,3	40,5
Thoracic Perimeter (cm)	38,65	3,76	35,6	39,8	42,1
Head Perimeter (cm)	38,51	3,28	36,3	38,3	41,3
Triceps Fold (mm)	3,69	1,57	2,2	3,8	4,4
Subscapular Fold (mm)	3,22	1,34	2,3	3,4	4,2
ALP	10,89	17,64	0,48	4,06	13,72
WLP	17,3	24,1	2,79	5,91	22,96
WAP	7,29	16,64	0,12	0,72	5,21

SD – Standard deviation, ALP – Age/Length Percentile; WLP – Weight/Length Percentile; WAP – Weight/Age Percentile

The mean birth length was 48.6 cm. (SD ±2.34 cm), and the mean birth weight 3.11 kg (SD ± 0.63 kg). Although the mean current length can be considered adequate for the sample's mean age (57 cm, SD ±7.87), the mean current weight is remarkably low (4.46 kg, SD ± 1.49), in view of a mean weight gain of only one kg for a mean age of almost five months. The means of the three assessed parameters were mutually very close, with a value of approximately 38.51 cm and a standard deviation between 3.2 and 3.8. The mean values of the cutaneous folds were also mutually very close, i.e.

that of the triceps corresponded to 3.69 mm (SD ± 1.57) and the subscapular fold to 3.22 mm (SD ± 1.34) (Table 1).

Table 2 – Analysis of differences in mean values of anthropometric percentiles in children with congenital heart disease hospitalized at Fortaleza Hospital – CE, according to gender and type of heart disease

Percentiles	Gender	Mean of posts	Heart disease	Mean of posts
ALP	Female	48,69	Acyanotic	70,17
	Male	77,66	Cyanotic	65,52
WLP	Female	66,64	Acyanotic	59,78
	Male	56,73	Cyanotic	59,14
WAP	Female	54,23	Acyanotic	68,76
	Male	74,88	Cyanotic	67,13

ALP – Age/Length Percentile; WLP – Weight/Length Percentile; WAP – Weight/Age Percentile

It is remarkable that the median of the three percentiles is below the percentile 10. This indicates a large proportion of values within the risk range. In the Age/Length percentile, the results of almost half of the assessments are considered low growth signs (46.7%). This percentage rises to 71.1% of the total if we add those children in the risk range with a median close to the percentile 4. Data are similar for the Weight/Length percentile, for which 35.6% was below the percentile 3 and the accumulated total of values below the percentile 10 was 70.4%. The worst indicator was the Weight/Age percentile, with 71.9% of the values below the percentile 3, and an accumulated percentage of 82.2% of the assessments below the percentile 10 and the median below the percentile 1 (Table 1). Particularly the Age/Length and Weight/Age percentiles display a higher mean value of posts for the male gender. However, the type of heart disease showed slight differences according to gender (Table 2).

Table 3 – Correlation (ñ) between percentiles and anthropometric measures of children with congenital heart diseases hospitalized in Fortaleza Hospital – CE

Anthropometric measures	ALP	WLP	WAP
Abdominal Perimeter	0,027	-0,010	-0,148
Thoracic Perimeter	-0,031	-0,212	-0,280
Head Perimeter	-0,060	-0,372	-0,345
Triceps Fold	0,188	-0,083	0,119
Subscapular Fold	0,230	0,202	0,321

ALP – Age/Length Percentile; WLP – Weight/Length Percentile; WAP – Weight/Age Percentile.; ñ – Spearman's Correlation Coefficient

In the non-parametrical correlation analysis, we observed a positive correlation between the subscapular fold and the three percentiles. The best correlation occurred with the Weight/Age percentile (R = 0.321). This percentile also revealed the strongest correlation with almost all anthropometric measures, except for the triceps fold. The negative correlation between the percentiles and perimeters shows that the growth indicators are not developing satisfactorily in line with the child's structures and organs. Hence, while the head, thoracic and abdominal perimeters increase through the growth of internal organs, the relations between the growth indicators worsen (See Table 3).

DISCUSSION

In an epidemiological study of children and adolescents with congenital heart defects, the most frequently found age ranges were the neonatal and breastfeeding periods, corresponding to 71.5% of the total number of participants with defects[10]. An earlier study of infants with congenital heart disease identified a profile similar to this study in terms of age and gender[4]. Despite the greater proportion of male children in our study, the prevalence of congenital heart diseases differs for the various types of defects that are diagnosed. Some of these defects can even show higher proportions in female children[10].

Among the commonly used child assessment measures, weight and length display the highest growth speed, mainly from birth until the first two years of life. However, the decompensation of congenital heart diseases can decrease or interrupt this growth speed. It is emphasized that, after birth, children with congenital heart disease present profiles similar to those found in this study, in which birth weight and length values are close to or even within the normality range and the children generally obtain high Apgar scores[11].

When considering the perimeter measures isolatedly, their means are within the normality range. More specifically, the head perimeter directly assesses head growth and indirectly brain development[1]. In full-term newborns, it amounts to 32-35 cm, but can be lower due to overriding sutures. Its growth is higher in the first months of life: it corresponds to two cm per month in the first term and decreases in subsequent months[8]. When calculating the head perimeter for a child of five months, the result is close to the mean result found in the study sample. A similar fact occurs for the other perimeters.

At birth, the thoracic perimeter is approximately two cm smaller than the head perimeter, gets equal at about six months and becomes larger as from the first year of life onwards[8]. At birth, the abdominal perimeter is about 2-3 cm smaller than the head perimeter. The proportion of its growth speed is similar to the thoracic perimeter. In this study, mutually similar values were found for the three perimeters, possibly due to the presence of thoracic deformities and an expanded abdominal contour in children with congenital heart diseases.

The measures undergoing the greatest loss in children with congenital heart diseases are current length and weight. A fifteen-centimeter growth is expected in the first semester and yet another ten centimeters in the second. The child grows about 3 cm during the first month and between 1 and 2 cm in subsequent months[12]. What weight is concerned, until the third month of life, the child's weight is assessed by the weight gain in grams per day, at a ratio of between 25 and 30 g/day. As from the second term, the daily gain progressively decreases and reaches 10 g/day in the last three months[13]. The mean weight and length values showed a decrease in expected values for the mean age of five months in the assessed children with congenital heart diseases.

It should be highlighted that the anthropometric measures alone have no meaning to assess children's growth. Thus, they need to be associated with gender, age or other anthropometric variables and the construction of indicators. As to the weight/length ratio, literature appoints that, in children with congenital heart diseases, it decreases rapidly in adverse situations, mainly in case of cyanotic heart diseases[1,11], a fact that corroborates our findings. Moreover, the assessed children's weight/age and length/age ratios were close to the lower cut-off points. We also perceived difficulties in these children to perform psychomotor activities characteristic of the studied age range.

However, it has not been clarified yet how the type of heart disease influences the child's growth. A previous study[14] did not find any difference in anthropometric indicators among groups of children with cyanotic and acyanotic heart disease. It should be clarified that we did not find such a difference in this study either.

Some of the findings in our study are corroborated by another research among Australian children, which found that almost all children under study (98%) presented a lower weight/age ratio than the third centile and 41% a lower length/age ratio than this cut-off point[15]. Furthermore, another research indicated that children with congenital heart disease tend to obtain a worse weight/length ratio, especially at the age of six to twelve months[9].

In parallel, a study of Belgian children showed an increase in the frequency and severity of acute and chronic malnutrition after birth, which was more intense in children with multiple defects ($p=0.03$). Chronic malnutrition was found more frequently in children with heart failure, cyanosis or a combination of both ($p=0.01$). The prevalence of malnutrition was influenced neither by gender nor by the reason for hospitalization. However, its consequences for the children's growth could be perceived[11]. In this study, on the other hand, differences between male and female children were identified for the age/length and weight/age percentiles.

Unfortunately, we did not find any studies that correlated perimeters and cutaneous folds with growth percentiles, as used in this study. One important point that should be highlighted, however, is the negative correlation between the head and thoracic perimeters on the one hand and the weight/length and weight/age percentiles on the other, showing the tendency to develop internal organs, particularly the brain and heart structures, as well as the weak progression in growth indicators, mainly those related to weight. Although the folds demonstrated a positive correlation, mainly the subscapular one, their influence on growth indicators reveals to be weak.

This study shows some limitations, which should be taken into account in its application. In the first place, the use of percentiles to analyze children's growth and development, although common in Brazil, makes it difficult to compare research results with international data, which commonly use the Z scores. Moreover, it should be emphasized that the data we presented were not compared with a control group of children without heart diseases, making it impossible to assess the efficacy of using percentiles in practice. The fact that this study was developed with children from an economically poorer region in Brazil may have influenced the low ratios we identified. Moreover, the multiple hemodynamic changes provoked by different heart defects are a factor that should be taken into account when analyzing the lack of differences among the studied percentiles.

It should be highlighted that, what nursing practice is concerned, in Brazil, few studies have

looked at care delivery to children with congenital heart diseases. Brazilian nurses need more accurate information to assess the progression and stage of the heart problem, with a view to identifying human responses and factors related to nutrition and growth and development in this population. This area lacks studies that allow for a more thorough description of these responses and, mainly, research involving interventions that are specifically directed at improving these children's nutritional indicators.

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