

## Assessment of Food Intake in Infants Between 0 and 24 Months with Congenital Heart Disease

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### Summary

**Background:** Children with congenital heart disease are usually malnourished and present some degree of functional and/or structural impairment of organs. There is also deficiency in nutrient intake, due to the control of fluids required by some patients which restrains the nutrient intake of some cardiac children.

**Objective:** To assess the food intake of children with congenital heart disease hospitalized in the pediatric heart unit of a "Public Teaching Hospital".

**Methods:** The intake of food and nutrients was calculated based on the food consumed during three days (direct weighting method) and the calories and nutrients were calculated using the Virtual Nutri software.

**Results:** The intake of calories per kilogram of body weight, of daily proteins, sodium and vitamin A was within the recommended levels ( $p < 0.05$ ). However, the intake of daily calories, fats, fiber, potassium and iron was below the recommended levels ( $p < 0.05$ ) and the intake of proteins per kilogram, carbohydrates, calcium and vitamin C was above the recommended levels ( $p < 0.05$ ).

**Conclusion:** Children with congenital cardiopathy have inadequate diets, and therefore, need nutritional guidance to foster adequate dietary intake and the resulting improvement in growth and weight and height development, guaranteeing better quality of life to the patients. (Arq Bras Cardiol 2007;88(6):624-628)

**Key words:** Heart defects, congenital; feeding/orientation; eating; child.

### Introduction

Congenital cardiopathy is the manifestation of an alteration in a normal cardiovascular structure or its inability to develop fully during the fetal period, thus producing variable degrees of circulatory dysfunction. This condition has a multifactorial etiology, and may result from an interaction between genetic predisposition and intrauterine environmental factors, or between post-natal factors and hemodynamic abnormalities<sup>1-3</sup>.

Congenital cardiopathies occur in approximately 8 out of 1,000 liveborns<sup>3</sup>. Its incidence is low, approximately 1% in Brazil and Latin America. However, congenital cardiopathies are very important, since the numerous possibilities of defects include abnormalities with anatomical and functional alterations that cause mild hemodynamic changes or even more complex conditions<sup>4,5</sup>.

The types of cardiomiopathies are characterized based on pulmonary circulation conditions: blood volume,

flow, venocapillary pressure and resistance<sup>5</sup>. Congenital cardiopathies are usually divided into two major groups: non-cyanogenic and cyanogenic cardiopathies<sup>6</sup>.

Most individuals with congenital heart diseases decompensate early. Twenty per cent of these children develop heart failure (HF) in the first week of life, 18%, between the first and fourth week and 20% between one and twelve months<sup>5</sup>. The survival rate of children with certain congenital heart defects depends on the presence of a competent interatrial communication<sup>7</sup>.

According to several authors, there is a close association between congenital cardiopathies and malnutrition. It has been demonstrated that heart injuries associated with cyanosis, congestive heart failure and pulmonary hypertension lead to greater impairment of growth and weight and height development, giving rise to nutritional aggravation<sup>8-12</sup>.

Children with congenital cardiopathy are usually malnourished and present some degree of functional and/or structural impairment of organs. There is also a deficiency in nutrient intake due to the control of fluids required by some patients. Some children are submitted to special diets and often present clinical alterations, such as reduced gastric capacity, anoxia, circulation congestion, altered intestinal

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Manuscript received September 6, 2006; revised manuscript received April 12, 2007; accepted May 3, 2007.

motility and decreased absorption<sup>13,14</sup>. It is known that these alterations interfere with food intake, which remains below age-specific nutritional requirements and thus may affect calorie and visceral protein reserves<sup>15-19</sup>.

This study assess the food intake in children with congenital cardiopathy over three consecutive days during hospital stay.

## Methods

The study population comprised children between 0 to 24 months, both male and female, hospitalized in the Pediatric Cardiology Unit of a Public Teaching Hospital, as mentioned above. Congenital cardiopathies were divided into two groups: non-cyanogenic and cyanogenic cardiopathies.

To minimize the factors that could potentially cause confusion, we excluded children that for some reason missed three or more meals during one day out of the three days of follow-up, or when it was difficult to quantify the actual food consumed willingly.

As for the intake of food and nutrients, we preferred to use the daily food intake record using the direct weighing method, which provides trustworthy data as it is the gold standard<sup>20</sup>.

The information on the food intake of each child during hospital stay was recorded by the researcher on a specific hospital file card, which includes the time, meal and quantity eaten during 24 hours in the three-day follow-up period.

Each meal was weighed, each food item separately, when the dish was served, and after the child had finished the meal.

The total of each food item actually eaten by the group was obtained by calculating the difference between the quantity offered and/or served and the quantity of leftovers, i.e., the quantity of each food item left in the plate after the child had finished eating.

Children aged from 0 to 12 months were fed with infant food every three hours. The standard unit for infant food includes milk preparations (cow's milk or industrialized formulas), either thickened with flour or similar products (2 to 5%) or not and/or enriched with vegetable oils (1 to 4%) or not; creamy vegetable soup with meat; mashed fruit and natural fruit juice.

Children from 12 to 24 months were fed with diets of different consistency (liquid, light, bland and general), normosodic and divided into six meals per day (breakfast, lunch, dinner and snacks that consisted of cow's milk or fruit).

These patterns varied according to the prescribed diet, dietary prescription, eating habits and degree of development of mastication, swallowing and dyspnea while eating.

To analyze the data, the total daily intake of calories, proteins, carbohydrates, fats, iron, calcium, sodium, potassium, vitamin A and C was calculated for each child with the Virtual Nutri software<sup>21</sup> and the calorie and nutrient intake averages for the three days were calculated to enable a comparison with the recommended allowances described below.

Daily recommended allowances of calories and

macronutrients were established according to those suggested by Sinden & Sutphen<sup>22</sup>. Calorie intake should be above the amount recommended by the RDA- Recommended Dietary Allowances<sup>23</sup>:

- a) 120 to 160Kcal/kg of weight;
- b) Proteins: 10 to 15% of the total calorie value (TCV), 4g/kg of weight for infants and 3g/kg of weight for children;
- c) Carbohydrates: 35 to 60% of the TCV;
- d) Fats: 35 to 50 % of the TCV.

Sodium and potassium allowances were established following the suggestion of Forchielli et al<sup>24</sup>:

- a) Sodium: 2 to 3mEq/kg/day or 46 to 69mg/kg/day;
- b) Potassium: 2 to 3mEq/kg/day or 78 to 117mg/kg/day.

The calcium allowance was established according to the DRI - Dietary Reference Intakes<sup>25</sup> and is 210mg/day for children between 0 and 6 months, 270mg/day for children between 7 and 12 months and 500mg/day for children aged between 1 and 3 years.

Fiber, iron, vitamin A and vitamin C allowances were established according to the RDA<sup>23</sup>:

- a) Fiber: age in years + 5g.
- b) Iron: 6mg/day for infants aged between 0 and 6 month and 10mg/day for children aged between 7 months and 3 years.
- c) Vitamin A: 375µg/day for children aged between 0 and 12 months and 400µg/day for children aged between 1 and 3 years.
- d) Vitamin C: 30mg/day for infants aged between 0 and 6 months; 35mg/day for children aged between 7 and 12 months; and 40mg/day for children aged between 1 and 3 years.

To classify food intake as normal, below or above the allowances, we established 10% intervals relative to the recommended allowances.

Later the data on recommended allowances and the data on the form describing the study population were added to the database using the Access software program, and analyzed using the Stata v 7.0 software program<sup>26</sup>.

For quantitative variables, we calculated: average intake of calories and nutrients for all children; classification of the intake relative to the recommended allowance; and average difference between the children's intake of calories and nutrients relative to the recommended allowance.

To compare the children's intake of calories and nutrients and the recommended allowance, we used Student's t test, with a 5% ( $\alpha < 0.05$ ) level of significance to reject the null hypothesis<sup>27</sup>.

## Results

A total of 38 children were included in the study, of which 53% were female and 76% had non-cyanotic congenital cardiopathy.

As concerns the children's preferred food, 17 were fed with infant food, five were fed with infant food with pasty food

**Table 1 - Average daily intake of children during the three-day follow-up. São Paulo-SP, 2003**

Nutrient	Intake
Total calories	874.22
Calories per kg of body weight	129.33
Protein (%)	12.85
Protein (g) per kg of body weight	4.1
Carbohydrates (%)	52.89
Fats (%)	34.3
Fiber (g)	4.43
Sodium (mg)	399.04
Potassium (mg)	553.31
Calcium (mg)	725.81
Iron (mg)	5.37
Vitamin A (µg)	343.73
Vitamin C (mg)	82.37

items and biscuits, and 16 were fed with a bland or modified general diet (bland-like diet).

The average daily intake of calories and nutrients analyzed for all the children studied can be found in table 1.

Table 2 shows the classification of the children's food intake observed during the follow-up period as compared with the recommended allowance, with calories, fats, fiber, sodium, potassium, iron and vitamin A being below the recommended allowance and protein per kilogram of body weight, calcium and vitamin C above the recommended

allowance. Carbohydrate intake was within the recommended allowance.

There was no statistical significance for the calories per kilogram of body weight and for the following nutrients: proteins, sodium and vitamin A. For all the other items analyzed there was a statistical significance ( $p < 0.005$ ).

## Discussion

No associations were observed between gender or type of cardiopathy (cyanotic and non-cyanotic) and the children's food intake ( $p < 0.10$ ).

We observed that most children who were fed with a bland or general diet consumed the following groups of food with the appropriate frequency but in insufficient quantity: milk and dairy products, meat and eggs, vegetables, grains, bread and roots, oils and fats and sugars and sweets. This was confirmed when the intake of calories and nutrients was measured. The fruit and vegetable group was consumed at lower levels in terms of quantity and quality than expected.

The children had different preferences as regards food, but most of those in the 0 to 12 months age group preferred milk, whereas children above one year of age preferred rice and beans.

The data assessed with Student's t test show a statistical significance in the intake of calories, which was below the recommended allowance ( $p < 0.05$ ); there was no statistical significance for the calories per weight, which were within the recommended allowance ( $p < 0.05$ ). The results found were similar to those of Hansen and Dorup<sup>28</sup> and Albano et al<sup>29</sup>, who obtained calorie intake well below the recommended by FAO/WHO/UN<sup>30</sup> and RDA<sup>23</sup>, thus insufficient to enable growth spurt.

In this study, proteins per kilogram of body weight were

**Table 2 - Classification and distribution of intake in percentage and significance of the difference between actual intake of calories, macronutrients and micronutrients by the children studied and the recommended allowance according to Student's t test. São Paulo-SP, 2003**

Nutrient	Below (%)	Normal (%)	Above (%)	p*
Calories	50	32	18	0.0477
Cal/kg weight	47	34	19	0.2860
Prot./kg weight	29	8	63	0.0328
Carbohydrates	-	71	29	0.0029
Fats	53	39	8	0.0000
Fiber	71	5	24	0.0152
Sodium	50	18	32	0.9832
Potassium	50	29	21	0.0043
Calcium	11	13	76	0.0000
Iron	90	5	5	0.0000
Vitamin A	66	16	18	0.2768
Vitamin C	5	11	84	0.0000

\*  $p < 0.05$

above the recommended allowance, with a 5% level of statistical significance. This is very important when associated with low calorie intake as, because of inadequate energetic intake, a larger amount of dietary protein is deviated from its organic functions to be used to supply energy, which restricts its optimal use.

The results found were also similar to those of Schwarz et al<sup>31</sup>, Unger et al<sup>32</sup>, Hansen et Dorup<sup>28</sup> as regards the protein intake for most children, which was considerably above the recommended allowance defined as "safe intake values". Therefore, for a growth spurt to occur, adequate amounts of proteins and calories are highly required.

We observed that the intake of carbohydrates was above the recommended allowance, with a 5% statistical significance. In a recent paper, Lundell et al<sup>33</sup> studied glucose metabolism and insulin secretion in a group of children with symptomatic ventricular septal defect (SVSD) and compared them with a group of healthy children of the same age and weight. They found no difference regarding glucose tolerance, but observed low insulin levels in children with SVSD. An interesting finding was that low insulin levels did not correlate with low insulin secretion rate. On the contrary, insulin secretion measured by C-peptide in the plasma was indeed elevated, which was interpreted as a result of the destruction of insulin or of the increase in receptor sites.

There was a statistical significance ( $p < 0.05$ ) for fats found below the recommended allowances, but this was expected since the diets, especially infant formulas, were enriched with corn oil. This data makes us think that the recommended allowances of fat might be overestimated.

Fiber intake remained below recommended levels ( $p < 0.05$ ). It should be encouraged given its utmost importance in regulating the functions of the body, including fat metabolism and intestinal absorption.

Sodium intake was within recommended levels, but without a statistical significance ( $p < 0.05$ ). McParland<sup>34</sup> obtained a similar result in patients with chronic cardiopathy, for whom the sodium level was significantly lower than for the group of normal children, although the levels remained normal for both groups.

Potassium was below recommended allowance ( $p < 0.05$ ). It is known that patients should be closely monitored, especially as regards their renal function, when these levels are low. No studies were found on this nutrient, and we were therefore unable to compare our findings.

Calcium levels were found to be above the recommended allowance, with a statistical significance of 5%. Hansen et Dorup<sup>28</sup> found calcium levels below RDA's recommendations<sup>30</sup>.

There was a statistical significance ( $p < 0.05$ ) for iron intake, which was below the recommended allowance in our study. The same result was obtained by Hansen et Dorup<sup>28</sup>, who also found zinc intake levels below RDA's recommendations<sup>30</sup>.

Vitamin A intake was within recommended levels, but there was no statistical significance ( $p < 0.05$ ). We have to consider that approximately 90% of this vitamin is stored in fat deposits, in the lungs and kidneys, which allows the daily intakes of this vitamin to be temporarily redirected.

Beaton et al<sup>35</sup>, Basiotis et al<sup>36</sup> concluded in their studies that, because vitamin A is found in varied quantities in certain food items, its intake levels vary widely from day to day. Several days of assessment are therefore required to obtain a reliable estimate of the usual intake of an individual.

Vitamin C intake was above recommended levels, with a statistical significance ( $p < 0.05$ ). It is important to note that vitamin C is unstable to heat and oxidation, and that its content in fruit and vegetables may vary according to production, storage and preparation conditions. It is not a storable vitamin. It has to be consumed on a daily basis, and is essential for the absorption of the diet's required iron level. Hansen & Dorup<sup>28</sup>, however, found vitamin C intake below RDA's recommendation<sup>30</sup>, which was also the case for vitamins B1, B6, D and E.

Minerals and vitamins were monitored individually and supplemented whenever necessary. There was no sodium restriction for any of the children followed up by medical decision, since sodium was within the recommended levels. Water restriction was also established by the medical team according to the hydroelectrolytic balance of each individual. Water restriction did not greatly impact nutrient intake, but should be always monitored, especially when it is high, so that the offer and absorption of calories and nutrients remains at sufficient levels.

Although there have been breakthroughs in the theories of hunger regulation, psychological, social and other influencing factors should not be ruled out as regards hunger and satiety. In this study we collected data only on food intake during hospital stay, which is certainly a factor that limits more in-depth analysis on daily food intake at home. This is so because there are two different environments for children to maintain the energetic balance between their requirements and food intake: the home and the hospital, which are guided by different principles and have different resources available.

Considering that the offer and intake of food was monitored on an individual basis in the hospital and that even so the offer and intake of food were inadequate, we can conclude that the situation is very likely worse at home, since the children's caregivers (their parents or other) cannot offer a good variety of food items on a regular basis, or even lack guidance on how to feed their children, as has been confirmed by the study of Marques<sup>37</sup>.

Unger et al<sup>32</sup> concluded in their study that children with congenital cardiopathy have inadequate diets, but when they are given nutritional counseling, their dietary intake increases and their anthropometric measurements improve.

## Conclusion

These results indicate that in this group of children with congenital cardiopathy, the intake of calories, fats, fiber, sodium, potassium and vitamin A was below the recommended levels, whereas the intake of carbohydrates was at adequate levels and the intake of proteins, calcium and vitamin C was above the recommended levels. This data show the importance of monitoring the nutritional status of each individual child with cardiopathy to prevent the worsening of the malnourishment that is characteristic of this disease.

## Original Article

Although protein intake is above the recommended allowance low calorie intake was insufficient to ensure a growth spurt. There should be a balance between the amount of calories and proteins offered in the diet.

Family members in charge of these children should receive counseling on how to supplement the calories, vitamins and minerals required when there are deficiencies that cannot be corrected through natural oral feeding, so as not to limit the synthesis necessary for the growth and development of these children.

Additional studies are key to adapt daily allowances to preferences. This would enable diets that are adequate to each age group and to the requirements of heart disease patients, thus optimizing their growth.

The application of current trends in diet therapy to children with congenital cardiopathy will allow them to grow and develop properly, thus ensuring better quality of life to these patients.

There is also the need for training and educating dietitians working in pediatric cardiology units about these new trends. They have to be made aware of their role in clinical practice,

and as educators and multipliers of efforts to adapt the diets offered to patients with cardiopathy.

### Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

### Sources of Funding

There were no external funding sources for this study.

### Study Association

This article is part of the thesis of master submitted by Tais Cleto Lopes Vieira, from Faculdade de Saúde Pública da USP.

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