

# Growth Status of Iranian Children with Hemodynamically Important Congenital Heart Disease

Mohammad Dalili, Seyed Mahmood Meraji, Paridokht Davari, Mohammad Yousef Aarabi Moghaddam, Hooman Bakhshandeh Abkenar, Azar Vahidi, and Akbar Shahmohammadi

Department of Pediatric Cardiology, Shaheed Rajaei Cardiovascular Medical and Research Center, Tehran University of Medical Sciences, Tehran, Iran

Received: 16 Feb. 2009; Received in revised form: 26 Sep. 2009; Accepted: 7 Dec. 2009

**Abstract-** The relationship between congenital heart disease (CHD) and growth retardation is well documented. We investigated the growth condition of Iranian children with several types of congenital heart disease (CHD) and compared it with worldwide researches. Growth condition was investigated in 469 patients with important CHD aged from 1 month to 18 years. The patients were divided into two groups; infants (aged 12 months or less), and children (1-18 yrs of age). Children with hemodynamically unimportant small VSDs or small ASDs were not studied. Other exclusion criteria were prematurity, known genetic disorders and neurologic disease affecting growth. All patients' cardiac diagnoses were made on the basis of clinical and laboratory examinations; including electrocardiography, echocardiography, cardiac catheterization, and angiography. Body weight and height of all patients were measured using conventional methods and compared with standard growth charts. In all patients body weights and heights were significantly lower than normal population. This difference was greater in the weight of female children. Other risk factors for growth failure were large left-to-right intracardiac shunts, pulmonary hypertension and cyanosis. Iranian children with CHD have growth failure somewhat different from other countries. Lower body weights of cyanotic patients and female children indicated that these patients need more nutritional and psychosocial attention.

© 2011 Tehran University of Medical Sciences. All rights reserved.

*Acta Medica Iranica* 2011; 49(2): 103-108.

**Keywords:** Heart Defects; Congenital; Growth; Cyanosis; Hypertension, Pulmonary

## Introduction

The relationship between congenital heart disease (CHD), and growth failure is well documented (1-15). growth failure is more significant in cases with congestive heart failure (CHF), pulmonary hypertension, and cyanotic and heart disease (1). Most authors demonstrated that different types of cardiac defects are associated with different patterns of growth retardation (1-5). The factors contributing to growth impairment and malnutrition in infants and children with CHD may be classified into prenatal and genetic factors, hypoxia and hemodynamic factors, and those relating to nutritional intake, metabolic requirements, and nutrient absorption (1, 4). Some researchers also, paid attention to the psycho-social and hormonal factors (5-7, 9, 16-18). Many of these factors are uncontrollable; however,

there are some important and controllable factors such as nutrition that may vary worldwide. For this purpose, regional evaluation of the growth status of children with CHD is valuable for better recognition and management.

## Patients and Methods

More than five hundred pediatric patients admitted to our hospital for cardiac catheterization between January to July 2007, Four hundred sixty nine of them were included in this study. Patients with a history of prematurity, known genetic syndroms, and neurologic disabilities were excluded. Furthermore, children with hemodynamically unimportant small VSDs or small ASDs following as outpatient were not studied. They were 211 females and 258 males. Age of patients ranged from 1 month to 18 years (mean=4.28, SD=4.3).

**Corresponding Author:** Mohammad Dalili

Department of Pediatric Cardiology, Shaheed Rajaei Cardiovascular Medical and Research Center, Tehran University of Medical Sciences, Tehran, Iran

Tel: +98 21 23922183 , Fax: +98 21 22663212 , E-mail: drdalili@yahoo.com

## Growth status of Iranian children with congenital heart disease

Patients were divided in two sex groups. Each group was sub-divided as infant (age of 12 months or below) and child (above 12 months of age). There were 74 female infants, 84 male infants, 137 female children and 174 male children including the study.

One hundred and ninety four patients were cyanotic (clinical cyanosis was confirmed with oxymetry). One hundred and eighty one patients had congenital heart defects with left to right shunting. One hundred and twenty one patients have undergone palliative or corrective cardiac surgery before admission. Pulmonary hypertension was observed in 62 patients. Complete physical examination was performed for all of the patients by pediatric cardiologists and standardized measurements of weight, and length were made by trained nurses.

Para-clinical examinations included plain chest radiography, electrocardiography, and routine laboratory tests (complete blood count, hemoglobin and hematocrit levels, electrolytes, BUN and creatinine levels, blood group and Rh, serologic screening for HBS and HIV, and urinalysis). Echocardiography was performed for all of the patients before catheterization.

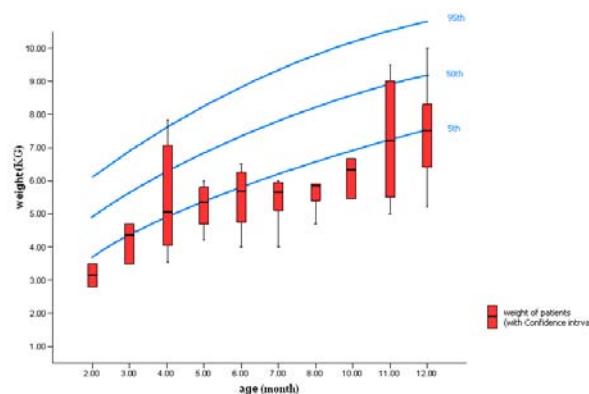
Catheterization was performed via venous with or without arterial access. For those patients in whom arterial catheterization was not performed, femoral artery pressure and saturation were considered instead of those of aorta.

Pressures were measured with Siemens apparatus and saturations were measured with A-VOX 1000 E apparatus by trained staff. Mean pulmonary arterial pressure above 25 mm Hg was considered to indicate pulmonary hypertension.

### Statistical analysis

The patients were divided into two groups; infants (aged 12 months or less), and children (1-18 yrs of age). In each group the data was analyzed based on the gender. Body weights and heights of each group were compared with standard charts for the same age group. Reference charts were modified for Iranian children (19-21).

The data was analyzed with Statistical Package for the Social Sciences (SPSS, Chicago, IL) software (version 15) using conventional methods for mean and SDs. Comparison between the groups was performed by Mann-Whitney U, Fisher's exact and Chi-square tests. *P* value of less than 0.05 was considered significant. Linear regression was used to determine the association between Pulmonary/systemic flow (QP/QS) and other data.



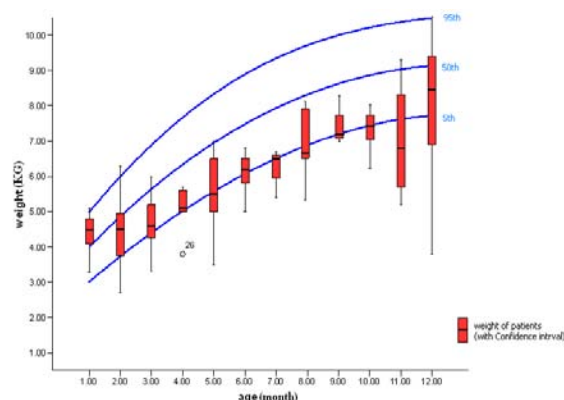
**Figure 1.** Weight for age in infant girls compared with normal chart (total number=74)

### Results

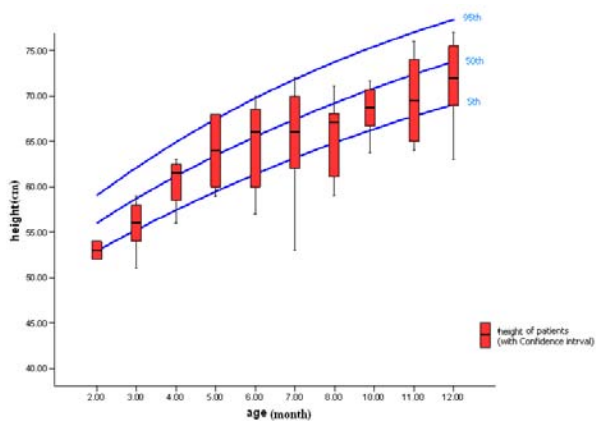
Of the 469 patients, 106 (22.6%) were below the 5th percentile for height (22.1% of males and 23.2% of females). Body weight was affected more, 189 (40.3%) of patients were below the 5th percentile for weight (39.9% of males and 40.8% of females).

In infant group, body weight was about 1.8 of standard deviation (SD) less than normal population. Height was about 0.6 SD less than normal. Growth chart for this group is shown in figures 1- 4. There was no significant difference between the two genders.

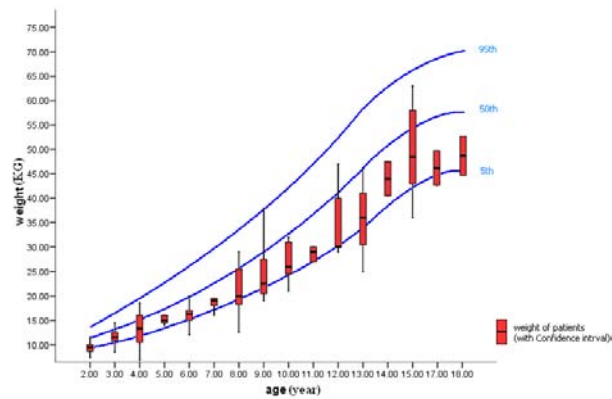
In children group, body weight was about 1.5 SD less than normal for girls and 1.2 SD less than normal for boys. This difference was more significant in patients falling between 5<sup>th</sup> and 50<sup>th</sup> percentile for weight. Height was about 0.4 SD less than normal for both sexes. Growth chart for this group is shown in figures 5- 8.



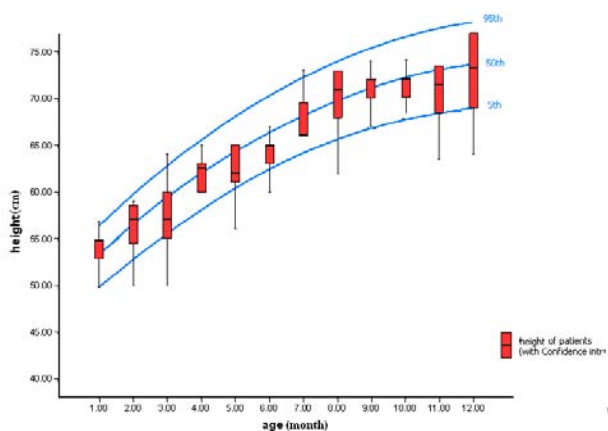
**Figure 2.** Weight for age in infant boys compared with normal chart (total number=84)



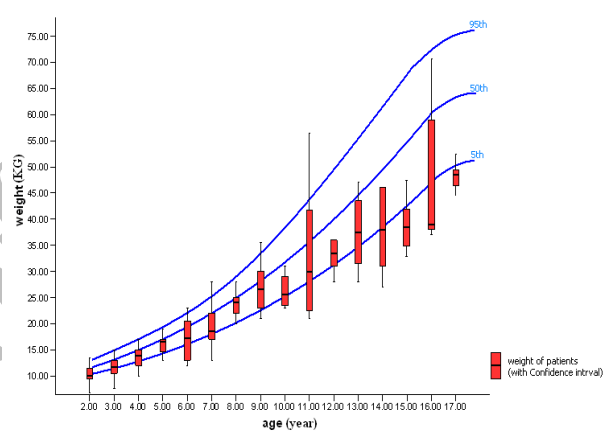
**Figure 3.** Height for age in infant girls compared with normal chart (total number= 74)



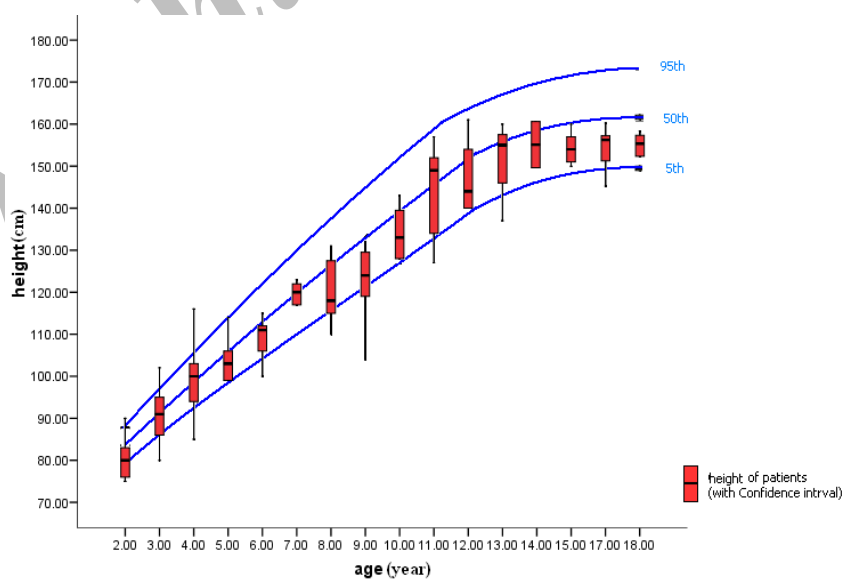
**Figure 5.** Weight for age in girl children compared with normal chart (total number=137)



**Figure 4.** Height for age in infant boys compared with normal chart (total number= 84)



**Figure 6.** Weight for age in boy children compared with normal chart (total number=174)



**Figure 7.** Height for age in girl children compared with normal chart (total number= 137)

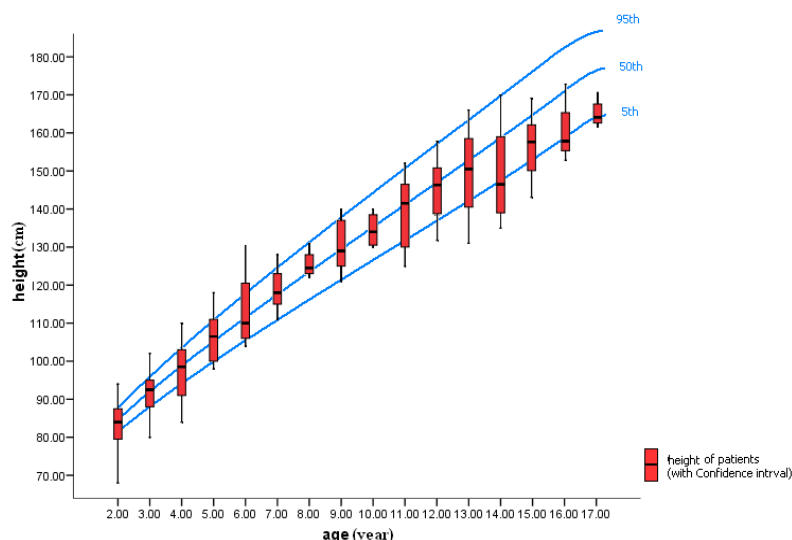


Figure 8. Height for age in boy children compared with normal chart (total number=174)

According to linear regression model, there is a significant negative association between Qp/Qs and body weight ( $\beta = -0.046, P = 0.019$ ). There was also a significant negative association between Qp/Qs and height ( $\beta = -0.023, P = 0.005$ ).

Statistically a significant difference was observed in mean weight between cyanotic and acyanotic patients ( $p$  value = 0.035), cyanotic patients had lower body weight than those were acyanotic. Borderline negative association was observed between height and cyanosis ( $P = 0.062$ ).

Significant negative association was observed between pulmonary systolic pressure and weight ( $P = 0.036$ ) and height ( $P = 0.008$ ). Patients with pulmonary hypertension had lower body weights and height than those with normal PA pressures.

## Discussion

Multiple studies of growth patterns in children with cyanotic and acyanotic CHD revealed the incidence of malnutrition and growth failure in CHD to be quite high.

A large survey evaluating alteration of growth patterns in 890 children with cyanotic and acyanotic CHD (2) revealed that 27% of the children with CHD would fall below the third percentile for height and weight. In our study, 22.6% of our patients (22.1% of males and 23.2% of females) were below the fifth percentile for height. Body weight is affected more, 40.3% of patients (39.9% of males and 40.8% of females) were below the fifth percentile for weight.

Da Silva *et al.* (3) found that boys had greater deterioration in the weight-for-age index, however we found lower weight-for-age index in girls. Although mean weight of girls was significantly lower than boys, this difference was not significant for body weights bellow 5<sup>th</sup> percentile. They also found lower values for the height-for-age index in girls whereas we found no significant difference between the two sexes.

Jacobs *et al.* (11) found 40% subnormal weight and height values in children with CHD. In their research girls were more impaired in weight and weight-for-height than boys. Children with acyanotic lesions were more affected in growth than those with cyanotic lesions. In the study of Mehrizi *et al.* patients with acyanotic heart disease, especially those with large left-to-right shunts and pulmonary hypertension, had a greater growth deficit in weight, and those with cyanotic heart disease had a greater growth deficit in stature as demonstrated by both decreased height and weight

We found that cyanosis, intracardiac left to right shunts, and pulmonary hypertension, can affect body weight and stature in different degrees. In our study, body weight was more affected in all patients. The differences in our findings may be related to the genetic factors and nutritional habits. At the end we should explain some limitations of our studies. Only patients who were hospitalized and underwent catheterization were included in this study, however, growth pattern may be differing in outpatients. Albeit, in our center policy, nearly all patients with congenital heart anomalies are undergo catheterization and angiography before cardiac surgery, only rare cyanotic infants may

undergo surgery for palliative shunt without catheterization.

Sample size was relatively sufficient for global evaluation, but data analyzes will be more accurate with larger patients number in each subgroups. In conclusion, although the relationship between congenital heart disease (CHD), malnutrition, and growth retardation is well documented it seems that there are some regional differences in growth pattern of children with CHD. Lower body weights of Iranian cyanotic children highlight the need for more attention to their nutritional status. Greater growth deficit in weight for Iranian girls indicated that these patients need more nutritional and psychosocial attention.

### Acknowledgment

We want to acknowledge all pediatric cardiology fellowships, catheterization laboratory staff and nurses of the pediatric part of shahid rajaei heart center for their friendly cooperation.

### References

1. Abad-Sinden A, Sutphen JL. Growth and nutrition. In: Allen HD, Gutgesell HP, Eclard EB, Clark EB, Driscoll DJ, editors. Moss and Adams' Heart Disease in Infants and Adolescents. 6<sup>th</sup> ed, Vol. 1. Philadelphia: Lippincott Williams & Wilkins; 2001. p. 325-32.
2. Mehrizi A, Drash A. Growth disturbance in congenital heart disease. *J Pediatr* 1962;61:418-29.
3. da Silva VM, de Oliveira Lopes MV, de Araujo TL. Growth and nutritional status of children with congenital heart disease. *J Cardiovasc Nurs* 2007;22(5):390-6.
4. Davis D, Davis S, Cotman K, Worley S, Londrico D, Kenny D, Harrison AM. Feeding difficulties and growth delay in children with hypoplastic left heart syndrome versus d-transposition of the great arteries. *Pediatr Cardiol* 2008;29(2):328-33.
5. Dinleyici EC, Kilic Z, Buyukkaragoz B, Ucar B, Alatas O, Aydogdu SD, Dogruel N. Serum IGF-1, IGF-1R and growth hormone levels in children with congenital heart disease: relationship with nutritional status, cyanosis and left ventricular functions. *Neuro Endocrinol Lett* 2007;28(3):279-83.
6. Martins da Silva V, de Oliveira Lopes MV, Leite de Araujo T. Evaluation of the growth percentiles of children with congenital heart disease. *Rev Lat Am Enfermagem* 2007;15(2):298-303.
7. Nydegger A, Bines JE. Energy metabolism in infants with congenital heart disease. *Nutrition* 2006;22(7-8):697-704. Erratum in: *Nutrition* 2006;22(10):1073-4.
8. Venugopalan P, Akinbami FO, Al-Hinai KM, Agarwal AK. Malnutrition in children with congenital heart defects. *Saudi Med J* 2001;22(11):964-7.
9. Villasís-Keever MA, Aquiles Pineda-Cruz R, Halley-Castillo E, Alva-Espinosa C. Frequency and risk factors associated with malnutrition in children with congenital cardiopathy. *Salud Publica Mex* 2001;43(4):313-23.
10. Dündar B, Akçoral A, Saylam G, Unal N, Meşe T, Hüdaoğlu S, Büyükgebiz B, Böber E, Büyükgebiz A. Chronic hypoxemia leads to reduced serum IGF-I levels in cyanotic congenital heart disease. *J Pediatr Endocrinol Metab* 2000;13(4):431-6.
11. Jacobs EG, Leung MP, Karlberg JP. Postnatal growth in southern Chinese children with symptomatic congenital heart disease. *J Pediatr Endocrinol Metab* 2000;13(4):387-401.
12. Mitchell IM, Logan RW, Pollock JC, Jamieson MP. Nutritional status of children with congenital heart disease. *Br Heart J* 1995;73(3):277-83.
13. Cameron JW, Rosenthal A, Olson AD. Malnutrition in hospitalized children with congenital heart disease. *Arch Pediatr Adolesc Med* 1995;149(10):1098-102.
14. Combs VL, Marino BL. A comparison of growth patterns in breast and bottle-fed infants with congenital heart disease. *Pediatr Nurs* 1993;19(2):175-9.
15. Tambić-Bukovac L, Malčić I. Growth and development in children with congenital heart defects. *Lijec Vjesn* 1993;115(3-4):79-84.
16. Hirose Y, Ichida F, Oshima Y. Developmental status of young infants with congenital heart disease. *Pediatr Int* 2007;49(4):468-71.
17. Gaynor JW, Wernovsky G, Jarvik GP, Bernbaum J, Gerdes M, Zackai E, Nord A S, Clancy RR, Nicolson SC, Spray ThL. Patient characteristics are important determinants of neurodevelopmental outcome at one year of age after neonatal and infant cardiac surgery. *J Thorac Cardiovasc Surg* 2007;133(5):1344-53, 1353.e1-3.
18. Chang MH, Kuo WW, Li PC, Lin DY, Lee SD, Tsai FJ, Jong GP, Lin YM, Huang CY, Wu WJ. Down regulation of IGF-I and IGF-1R gene expression in right atria tissue of ventricular septal defect infants with right atria hypoxemia. *Clin Chim Acta* 2007;379(1-2):81-6.
19. Vazirian Sh, Sedighnezhad A. Update of growth percentiles for children of an Iranian population. *Arch Iranian Med* 2003;6(3):163-69.

## Growth status of Iranian children with congenital heart disease

20. Majlesi F, Nikpoor B, Golestan B, Sadre F. Growth chart study in children under 5 years old in rural area of Khoramabad province. *Iranian J Publ Health* 2001;30(3-4):107-110.
21. Ayatollahi SM. Age-related weight-for-height charts for south Iranian school children. *J Trop Pediatr* 1995;41(3):181-5.

Archive of SID