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Original Article

Status of Height in Relation to Mid Parental Height of Children Having Congenital Heart Disease

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ABSTRACT

Background: *Globally, the incidence of congenital heart disease is increasing day by day. Congenital heart disease (CHD) is often associated with short stature. The status of height in relation to the mid-parental height of children having congenital heart disease may provide important clues in managing congenital heart disease (CHD) cases.* ***Aim of the study:*** *This study aimed to assess the status of height in relation to the mid-parental height of children having congenital heart disease.* ***Methods and materials:*** *This was an observational cross-sectional study that was conducted in the Out-Patient Department (OPD) and In-Patient Department (IPD), Combined Military Hospital (CMH) from 1st March 2016 to 31st August 2016. In total 50 patients with congenital heart disease (CHD). The data were collected through interviews with a pre-designed questionnaire.* ***Results:*** *In this study, among all the cases, 44% were appropriate in stature of their height in relation to their parental height and another 56% were short in stature in relation to their mid-parental height. It seemed that short stature was strongly associated with haemodynamically important congenital heart disease. The frequency of short stature was more in cyanotic heart disease. Appropriately treated cases gained catch-up growth in spite of having congenital heart disease.* ***Conclusion:*** *The height status of children having CHD is comparatively lower than the expected range. Haemodynamically important CHD is the mainstay of the cause. Cyanotic heart disease affects height more than acyanotic disease. Incidence of short stature is observed more in TOF, large VSD and large ASD.*

Keywords: *Mid-parental height, Children, Congenital heart disease, CHD, Short stature*

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INTRODUCTION

Growth in childhood is considered to be a sensitive indicator of children's health [1]. Height in childhood is a good predictor of height in adulthood [2]. Height is a classic example of an inherited human trait. More than 100 years ago, Francis Galton used height data to study the resemblance between parents and offspring, concluding that 'when dealing with the transmission of stature from parents to children, the average height of the two parents, is all we need the care to know about them [3]. Congenital heart diseases (CHD) represent one of the major groups of birth defects and makeup approximately 1% of human malformations. The incidence of congenital heart disease is 8-10/1000 live birth which is established by many studies carried out in many centers worldwide. In Bangladesh incidence of congenital heart diseases was found up to 25/1000 live birth in one year in a study conducted in CMH Dhaka [4]. In an Iranian study of 905 children having haemodynamically significant congenital heart disease, about 27% of the congenital heart disease had short stature [5]. The mid-parental height, which is the average of both parents' heights, plotted on the height centile chart at age 18 years after adjustment for sex, can be used as a crude prediction of that child's future adult height; the mid-parental height expressed as a centile or standard deviation score (SDS) is commonly used to assess whether a child's current height centile is consistent with genetic expectations [6].Tanner's original paper suggested that the sex adjustment should be made by adding or subtracting 13 cm to/from one parent's height and plotting both on one chart, with the midpoint constituting the mid parental height and a child's adult height would be expected to fall within 8.5 cm of the mid-parental height [7,8]. The parental target height can be readily ascertained by calculating the mean parental height and adding or subtracting 6.5 cm from male or female children respectively [9]. This gives the height expected at 18 years for the child, and this can be plotted on the percentile chart to predict the child's height at the appropriate age. This can normally vary by two standard deviations (SD) each way [10]. The 2-SD range for this calculated parental target height is about ±10 cm [11]. It has been suggested that adults tend to overestimate their height (and underestimate their weight), although a recent British study found the average bias to be less than 1 cm [12]. The objective of this current study was to assess the status of height in relation to the mid-parental height of children having congenital heart disease.

METHODS AND MATERIALS

This was an observational cross-sectional study, that was conducted in the Out-Patient Department (OPD) and In-Patient Department (IPD), Combined Military Hospital (CMH), Dhaka, Bangladesh from 1st March 2016 to 31st August 2016. The study was approved by the ethical committee of the mentioned hospital. Properly written consent was taken from all the participants before data collection. In total 50 patients with CHD, between 3 and 12 years were enrolled in this study as study subjects. Children or parents with a chronic illness, genetic disorders, musculoskeletal dysplasia, chronic lung disease, cases in medications like corticosteroids especially if used in high doses for prolonged periods and cases with

haemodynamically less important CHD were excluded. The data were collected through interviewing with a pre-designed questionnaire. All the demographic and clinical information of the participants was recorded. All data were processed, analyzed and disseminated by using MS Excel and SPSS version 24.0 program as per necessity. In statistical analysis, a P value <0.05 was considered as the indicator of significance.

RESULTS

In this study, among the total participants, 52% were male whereas the rest 48% were female. So, the male-female ratio of the participants was 1.1:1. In total 21 (42%) participants were from the ≤48 years age group. The majority of the participants (62%) were with acyanotic congenital heart disease (CHD) and the majority of the cases (54%) started at their <3 years of age (**Table I)**.

Table I: Clinical characteristics of the studied population (N=50)

Characteristic	Category	n	%
Age in month	Up to 48	21	42
	49-72	12	24
	73-96	11	22
	97-120	6	12
Sex	Male	26	52
	Female	24	48
Presence of cyanosis	Cyanotic	19	38
	Acyanotic	31	62
History of hospital admission		17	34
Treatment completed		10	20
Birth weight (in Kg)	<2.5	10	20
	2.5-3	19	38
	3.1-4	13	26
	>4	5	10
	Unknown	3	6
Age of starting treatment	<3 years	27	54
	3-6 year	20	40
	>6 years	3	6

Among cyanotic CHD cases, 22% were with TOF; on the other hand, among acyanotic CHD cases, 20% were with large ASD and 16% were with large VSD which were noticeable (**Table II)**.

Table II: Pattern and incidence of congenital heart disease (N=50)

Cyanotic (n=19)	n	%	Acyanotic (n=31)	n	%
Tetralogy of Fallot (TOF)	11	22	Large ASD	10	20
TGA	3	6	Large VSD	8	16
TAPVR	2	4	Patent ductus arteriosus (PDA)	4	8
Pulmonary stenosis	2	4	AV canal defect	3	6
Others	1	2	Others	3	6
			Combined ASD & VSD	2	4
			CoA	1	2

TAPVR= Total anomulus pulmonary venous drainage, ASD= Atrial septal defect, VSD= Ventricular septal defect, CoA= Coarctation of aorta

In this study, only 56% of cases were appropriate in height and 44% of cases were short for their mid-parental height. Short stature was more common (57.63%) in children of <48 months of age and less common in the 73–96-month group. Short stature was more common in the early age group (**Table III)**.

Table III: Distribution of status of height in relation to mid-parental height as per age (N=50)

Age in month	n	Status of height	
		Appropriate (%)	Short (%)
Up to 48	21	09 (47.63)	12 (57.63)
49-72	12	06 (50.00)	06 (50.0)
73-96	11	09 (81.16)	02 (18.74)
96-120	6	04 (66.66)	02 (33.33)
Total	50	28 (56)	22 (44)

On the other hand, 52% of cases were male and of them, 58.87% cases were appropriate in height and 41.33% cases were short concerning their mid-parental height. In total 24 cases (48%) were female and of them, 53.33% were appropriate in height and 47.66% cases were short. Here, it was observed that there was no apparent relation between sex and the status of the height of children having congenital heart disease in relation to mid-parental height (**Table IV)**.

Table IV: Distribution of status of height in relation to mid-parental height as per sex (N=50)

Sex	n (%)	Status of height	
		Appropriate (n=28)	Short (n=22)
		n (%)	n (%)
Male	26 (52)	15 (58.87%)	10 (41.33%)
Female	24 (48)	13 (53.13%)	12 (47.66%)
Total	50 (100)	28 (56%)	22 (44%)

In this study, 38% of cases had cyanotic congenital heart disease and among them, 32.15% were appropriate in height, 66.84% were short and but no one is tall with respect to their mid-parental height. That indicated that cyanotic heart disease has a serious impact on a child's height. Among all cyanotic heart diseases, TOF causes 81% were short stature (**Table V)**.

Table V: Distribution of height of children having cyanotic CHD in relation to mid-parental height as per birth order (N=50).

Type of Disease	n (%)	Status of height	
		Appropriate	Short
		n (%)	n (%)
TOF	11 (57.89)	02 (19.25%)	09 (81.75%)
TGA	03 (15.78)	01 (33.33%)	02 (66.66%)
PA	02 (10.52)	00 (50%)	02 (100%)
TAPVR	02 (10.52)	02 (100%)	0 (0%)
others	01 (5.26)	01 (100%)	0 (0%)
Total	19 (100)	06 (32.15 %)	13 (67.84%)

In total 62% of cases had acyanotic congenital heart disease and of them, 70.96% were appropriate in height, 29.84% were short and in respect to their mid-parental height. Short was more frequent (50%) in VSD+ASD and PDA groups and less in CoA group (0%). Here the number of CoA and AV canal defects was very limited (**Table VI)**.

Table VI: Distribution of height of children having acyanotic CHD in relation to mid-parental height as per birth order (N=50).

Type of Disease	n (%)	Status of height	
		Appropriate	Short
		n(%)	n(%)
ASD	10 (32.25)	09 (90%)	1 (10.0%)
VSD	09 (25.78)	06 (66.66%)	3 (33.4%)
VSD+ASD	02 (06.52)	1 (50%)	1 (50.0%)
PDA	04 (12.9)	02 (50%)	2 (50%)
AV Canal defect	02 (9.67)	1 (0%)	1 (50%)
CoA	01 (3.22)	01 (100%)	0 (0%)
Others	03 (9.67)	02 (66.6%)	1 (33.3%)
Total	31(50)	22 (70.96 %)	9 (29.84%)

The status of the height of children having congenital heart disease in relation to the mid-parental height according to the need of hospital admission. Here, overall, 34% (17 cases) child required hospital admission and 66% (33 cases) child not required. In total 76.33% of cases that required hospital admission were short in respect to their mid-parental height. 28.66% (9 cases) were short and did not require hospital admission. Here, it is observed that short stature was more frequent among children who required hospital admission in the past (**Table VII)**.

Table VII: Distribution of status of height in relation to mid-parental height who required hospital admission (N=50)

Hospital admission	n (%)	Status of height	
		Appropriate (n=28)	Short (n=22)
		n (%)	n (%)
Required	17 (34)	04 (23.87%)	13 (76.33%)
Not req	33 (66)	24 (71.13%)	09 (28.66%)
Total	50 (100)	28 (56%)	22 (44%)

DISCUSSION

This study aimed to assess the status of height in relation to the mid-parental height of children having congenital heart disease. A child's height is a great concern to the parents as the height of the generation next is a major concern to the nation. As a developing country, Bangladesh has economic limitations, which can cast a detrimental shadow on the nutrition of the children. This can hamper the growth of children today. Congenital heart disease occurs in almost 1% of live birth [13]. Due to various factors, this incidence is increasing. Haemodynamically important congenital heart disease has a great impact on the height of children [14]. Among all of our respondents, 25 cases were appropriate in the status of their height in relation to their

parental height, whereas only 6 cases were tall in status and another 19 cases were short in status in relation to their parental height. It seemed like short cases comparatively more than the normal population. The mean of "Z" scores of all children under the study was-01.432 and the median was -0.95. In this study, 21(42%) cases were under 2 years and 66% of cases were below 6 years. It indicated that, as a congenital disease, it appears and manifests to cause hospital reporting earlier. Here, only 34% of cases were above 6 years. The disease that manifests relatively later in life is less severe than the disease that appears early in life. About 43.63% (10 cases) of children aged below had stature less than their appropriate range. But children older than 4 years have shorter height in 52.33% of cases. It may be due to prolong hypoxic and nutritional causes which affect their catch-up growth even after successful treatment. Congenital heart diseases were found almost equally among male (52%) and female (48%) children. The number of cyanotic heart diseases was much lesser than acyanotic. Acyanotic heart disease may be symptomatic earlier than cyanotic heart disease. In total 34% of cases had a previous history of admission to the hospital. It also denotes disease severity and complication. In this study, most of the cases (80%) were born with average birth weight. So, prematurity could not have much impact on MPH. Most of the cases (94%) were reported to the pediatric cardiology department for 6 years. In this study, short stature is slightly higher among female children. Females are naturally shorter than males. Maybe females are shorter due to this reason. It was observed in several studies in South Australia. In another study it was reported that boys have a better height for age index in comparison to girls. In this study, 42.1% of boys and 44.66% of girls were below the 3rd centile [15]. In these settings, among congenital cyanotic heart disease, short stature was more frequent 81.75% (5 cases) in TOF. Here 100% short stature was found in PA but the total cases of PA were only two. In TGA, TAPVR and others it was 66.66%, 0% respectively. Some researchers found more pronounced retardation in both height and weight in children with cyanosis [16]. Height is usually affected in more severe heart disease. In this study, 44.44% of total TOF has appropriate height. Maybe it was due to pink TOF that does not affect height. In the cases of TGA, PA, and TAPVR, the full picture is not reflected due to a shortage of cases. In this study, most cases were acyanotic heart disease. In total, 62% of cases had congenital acyanotic heart disease. ASD and VSD were the most prevalent among all. Among congenital acyanotic heart disease, only 09 cases (29.84%) were short in relation to their mid-parental height. Short stature was observed in 33.33% of VSD cases. In this study, only haemodynamically important VSD (Large VSD) was taken. In the case of AV canal defect, 50% of cases were shorter. Maybe it was due to haemodynamics of this cardiac lesion having severe effects on height. On the hand, 70.96% of cases had appropriate height. Patients with cyanotic CHD are affected in growth, depending on the severity of tissue hypoxemia and the degree of physiological adaptation. A comparison between height between cyanotic and acyanotic disease revealed the incidence of short stature was observed

more in cyanotic heart disease in comparison to acyanotic heart disease. It may be due to the presence of left to right shunt that causes a decrease in cardiac output that goes to the systemic circulation. Da Silva VM discussed in his article that at birth the weight and length of children with CHD are typically normal or close to normal and APGAR scores are generally adequate [17]. From the above discussion, it is very clear that congenital heart disease has a strong association with short stature. All the findings of this current study may be helpful in further similar studies.

Limitation of the study

This was a single-centered study with small-sized samples. Moreover, the study was conducted over a very short period and no follow-up was done at all. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION & RECOMMENDATION

As per the findings of this current study, we can conclude that the height status of children having CHD is comparatively lower than the expected range. Haemodynamically important CHD is the mainstay of the cause. Cyanotic heart disease affects height more than acyanotic disease. Incidence of short stature is observed more in TOF, large VSD and large ASD. For getting more specific results, we would like to recommend conducting similar mores studies in several places with larger-sized samples.

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