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BMI of transfusion dependent beta-thalassemia children of North-Western Indian Origin

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ABSTRACT: Background & Aims: *BMI has been reported to be relatively low amongst Thalassemia patients and majority of the published work has emanated from the developed western world. Owing to scarcity of auxological information, this study aimed to study the pattern of BMI in transfusion dependent β-thalassemia children of north-western Indian origin.*

Methods: *407 boys and 158 girls diagnosed cases of β-Thalassemia major between 1-20 years were enrolled from 'Thalassemia Blood Transfusion Unit' of Department of Pediatrics, PGIMER, India. Each patient was measured for weight and length/height at six monthly age intervals in Growth Laboratory/Growth Clinic of the institute. Mean (SD) BMI was computed for thalassemia patients at each age level. Gender differences were assessed using unpaired Student's t-test.*

Results: *Mean BMI of male and female β-Thalassemia children was 15.8±1.26kg/m^2 and 16.0±1.11kg/m^2 at 1 year and it increased to 17.8±2.10kg/m^2 and 18.3±1.7kg/m^2 at 20 years, respectively. Gender differences remained statistically non-significant. Pattern-wise, these children showed close resemblance to normal American children (CDC 2000) upto 4-5 years. BMI curves ran around 25th percentile till 10 years. After that, BMI curves demonstrated downward divergence. BMI impairment in male children increased with advancement of age making them underweight (<5th percentile) after 15 years.*

Conclusions: *Impaired BMI attainments not only speak of poor growth and nutrition status of β-Thalassemia patients despite regular blood transfusions but also call for timely institution of medical, surgical and other appropriate interventions to improve their growth and overall health status.*

Keywords: *BMI, Physical growth, β–Thalassemia, Indian origin*

INTRODUCTION

β-thalassemia is a hereditary haemolytic disease presenting during infancy or pre-school years of life. Despite, being treated with periodic blood transfusions and chelation therapy, growth retardation remains a significant problem of β-thalassemia patients. Growth impairment in children with thalassemia major appears to be due to under-nutrition (Tienboon et al. 1996), hypogonadism (Wang et al. 1989, Noetzli et al. 2012), hypothyroidism (Eshragi et al. 2011, Filosa et al. 2006), chronic anemia (Muncie & Campbell 2009), folate and micronutrient deficiencies (Patil & Mujawar 2010), tissue hypoxia (Elsayh et al. 2014), adverse effects of iron overload (Piomelli 1995) as well as chelating therapy (Al-Khabori et al. 2013). Though with advancement of treatment and refinement of transfusion guidelines clinical picture of β-thalassemia patients has substantially improved yet, their auxological attainments remain compromised (Pemde et al. 2011, Hamidah et al. 2008, Theodoridis et al. 1998). Besides growth failure, attenuation of adolescent growth spurt has also been reported amongst thalassemia patients (Soliman et al. 2009).

Postnatal tracking of BMI from birth to adulthood has often been recommended to plan need based auxological/ nutritional interventions and predict outcome (Nair et al. 2006). BMI has been reported to be relatively low amongst Thalassemia patients studied in different parts of the world. As compared to their western counterparts, longitudinal information published on the pattern of BMI of Indian β-thalassemia children is scant. However longitudinal efforts, though time consuming in nature, being made at Advanced Pediatrics Centre, PGIMER, Chandigarh, provide unique opportunity to understand varied aspects of auxological dynamics in these patients (Bhalla et al. 2008). Therefore, in this presentation an attempt has been made to study the pattern of BMI amongst β-thalassemia children from North-western India who are receiving regular blood transfusions.

MATERIAL & METHODS

A total of 5992 anthropometric assessments carried out on 565 (Boys: 407, Girls: 158) diagnosed cases of β-Thalassemia major, aged 1-20 years, enrolled from the ‘Pediatric Hematology Clinic’ of the Department of Pediatrics, Postgraduate Institute of Medical Education & Research, Chandigarh, India envisaged sample for this mixed-longitudinal study. Besides,

institutional support, this research was partially sponsored by Department of Science & Technology (DST), U.T., Chandigarh.

Age of each child born to literate parents, was ascertained as per known date of birth. However, nearly exact age of those born to illiterate parents belonging to rural and slum areas was determined using regional events, festivals, weather and crop cultivation pattern etc. Each child was measured for body weight and crown-heel length (CHL)/standing height in the Growth Laboratory and Growth Clinic of the Institute, at 6 monthly ± 15 days age intervals using a mixed longitudinal growth research methodology. Body weight of every child was measured with 'Electronic Weighing Scale' with platform (Make: Avery, Capacity: 100kg, Least count: 50g). The use of 'Supine Length Measuring Table' (Make: Holtain Limited, Crymych, Dyfed, UK, Least count: 1mm) was made to measure CHL till 2 years of age. Beyond 2 years, 'Stadiometer' (Make: Holtain Limited, Crymych, Dyfed, UK, Least count: 1mm) was used to measure standing height. Each patient was measured by trained anthropometrists employing standardized anthropometric instruments and techniques (Weiner & Lourie 1969, Eveleth & Tanner 1990). The magnitude of intra/inter rator error was ±50g for body weight and ±1mm for CHL/height. BMI [Body weight (kg)/ CHL/ height^2 (meter)] was calculated for every subject at each age.

Mean pre-transfusion hemoglobin levels at each visit were also determined amongst thalassemia patients of the two sexes. Necessary health check-up of each patient was carried out by a doctor attached to the Clinic. Record of any disease/ complication experienced by patients and treatment offered to them was also kept. Mean (SD) BMI (kg/m^2) of thalassemia patients of the two sexes for each age level was computed. The magnitude of gender differences was ascertained by using unpaired Student's t-test. Statistically, p value of ≤ 0.05 depicting 95% CI was considered as significant.

RESULTS

Mean BMI of male and female β-Thalassemia children was 15.8±1.26kg/m^2 and 16.0±1.11kg/m^2 at 1 year and it increased to 17.8±2.10kg/m^2 and 18.3±1.7kg/m^2 at 20 years, respectively (Table 1 and Figs 1 & 2). In male thalassemia patients BMI measured 15.8±1.26kg/m^2 at 1 year, and 17.8±2.1 kg/m^2 at 20 years. In female patients BMI grew from 16.0±1.11kg/m^2 at 1 year to 18.3±1.71kg/m^2 by 20 years. The male thalassemia children possessed higher BMI than the

females till 11.0 years of age whereafter, females took lead over male patients. Barring some initial and later half yearly age levels, the magnitude of gender differences generally, never reached any significant level (Table 1). When contrasted with their normal CDC (Ogden et al. 2002) peers, thalassemia patients possessed lower BMI values beyond 4 years of age (Fig 1 & 2). The magnitude of this impairment increased with advancement of age.

Mean pre-transfusion hemoglobin levels determined during each visit were found to be 9.0 g% and 9.1 g% in male and female patients, respectively.

DISCUSSION

The use of BMI is frequently made world over to determine underweight and obesity amongst children, adolescents and adults. Therefore, early detection of its derangement becomes necessary to prevent consequent health related hazards. BMI amongst β-Thalassemia children experienced a regular but slow decrease in mean values upto 7 years in males and 6 years in females. Afterwards, it grew slowly and an uninterrupted increase was noticed until 19.5 years (Table 1). Male patients in general, possessed higher BMI than females till 11 years whereafter, females took lead over males. Existence of statistically non-significant gender differences in our patients at majority of the age levels are in consonance with observations of Al-Naama et al (2016) and Sohn et al (2013) who too did not report significant differences in BMI of male and female β-Thalassemia patients of Iraqi and American origin, respectively.

The substantially lower placement of curves plotted for β-thalassemia patients as compared to those of their normal American (Ogden et al. 2002) counterparts reveal persistence of relatively compromised nutritional state despite, regular blood transfusions through which they could on average maintain pre-transfusion hemoglobin level of 9.0 g% (male) and 9.1 g% (female). Initially BMI curves of both male and female β-Thalassemia patients ran between 50^{th} and 25^{th} percentile of CDC growth charts till 4 to 5 years (Fig 1 & 2). Thereafter, pattern-wise, these showed close resemblance with 25^{th} percentile until around 10 years. Afterwards, when contrasted with female patients, BMI curves for male patients diverged to run below 5^{th} percentile making them underweight ($<5^{th}$ percentile) beyond 15.0 years.

The sudden divergence of BMI curves shows that mere blood transfusions are not sufficient to meet increased nutritional/ auxological and other health related demands of β-thalassemia children beyond pre-adolescent years of life. Existence of underweight as a common

problem amongst beta-Thalassemia patients of Iranian origin (Asadi-Pooya & Karamifar 2004) older than 10 years of age, resemble the trend observed amongst our patients. Occurrence of multiple endocrinopathies, amongst these under-weight patients have been placed as a reason by these authors.

Growth failure is common in patients with thalassemia. The relatively compromised BMI related auxological attainments noticed amongst transfusion dependent β–Thalassemia children of Egyptian (Fahim et al. 2013), Pakistani (Zahra et al. 2015, Ali & Jahan 2016), Indian (Pemde et al. 2011, Meena et al. 2015) and Iraqi (Al-Naama et al. 2016) origin, are in consonance with our findings. Poor nutritional support, chronic illness, endocrinal changes due to iron overload (Fahim et al. 2013, Meena et al. 2015), high serum ferritin and low hemoglobin (Ali & Jahan 2016) as well as low serum leptin levels (Al-Naama et al. 2016) have been placed as possible reasons for the increased incidence of growth deficits in these patients.

Likewise, a low BMI recorded amongst older Thalassemia patients of Egyptian (>12-year) (Eissa & El-Gamal 2014) and Indian origin (>18 years) (Prakash & Aggarwal 2012) as compared to younger patients resemble our findings. This shows that with progression of disease and age advancement, BMI in transfusion dependent β-thalassemia patients decreases in magnitude. The support to this contention may be drawn from observations of Saxena (2003) who too reported lower BMI at older ages depicting negative inter-relationship between serum ferritin and body mass index. In contrast, a study from India did not reveal relation amid serum ferritin levels and growth (Gomber & Dewan 2006). Normal BMI noticed in transfusion dependent beta-thalassemia patients of Iranian (Hashemi et al. 2011) and North American (Vogiatzi et al. 2009) origin also remains at variance with our findings, for which at present no reasoning could be offered.

CONCLUSIONS

The present study establishes that as compared to normal children auxological/ nutritional attainments of transfusion dependent β-Thalassemia patients evaluated in terms of BMI remain impaired. The magnitude of this impairment increased substantially with advancement of age in thalassemia children older than 10 years as compared to younger ones despite, blood transfusions. This shows that mere blood transfusions are not sufficient to meet increased needs of thalassemia children growing beyond pre-adolescent years.

Compliance with Ethical Standards

Conflict of Interest: The authors declare "No conflict of Interest".

Informed Consent: Informed consent of either of the parents/ guardian of every patient was taken before his/her inclusion in the study. Every effort was made to maintain privacy as well as confidentiality of the data generated on study subjects.

Ethical Approval: The research has been duly approved by the Institute Ethics Committee as well as Departmental Review Board of the Dept. of Pediatrics, PGIMER, Chandigarh.

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Table 1: Mean (SD) of Body Mass Index (kg/m2) of Male and Female β-Thalassemia Children

Age	Male		Female		Gender Differences (p value)	95% CI	
	N	Mean (SD)	N	Mean (SD)		Lower	Upper
1.0	35	15.8 (1.26)	20	16.0 (1.11)	0.547	-0.888	0.476
1.5	48	16.2 (1.24)	24	15.4 (1.16)	0.008**	0.218	1.428
2.0	50	16.0 (1.38)	18	15.3 (1.03)	0.048*	0.006	1.435
2.5	48	15.9 (1.30)	21	15.4 (1.00)	0.095	-0.970	1.176
3.0	51	15.7 (1.14)	25	15.1 (1.05)	0.031*	0.055	1.137
3.5	65	15.3 (0.99)	24	15.3 (1.15)	0.962	-0.482	0.506
4.0	69	15.2 (1.30)	25	15.3 (1.10)	0.798	-0.659	0.508
4.5	91	14.9 (1.27)	30	14.5 (0.84)	0.200	-0.173	0.816
5.0	97	14.8 (1.27)	30	14.4 (0.95)	0.074	-0.045	0.955
5.5	108	14.7 (1.22)	32	14.2 (1.09)	0.039*	0.025	0.979
6.0	105	14.6 (1.28)	32	14.2 (1.12)	0.093	-0.071	0.926
6.5	129	14.6 (1.26)	36	14.3 (0.85)	0.131	-0.102	0.784
7.0	127	14.5 (1.23)	39	14.4 (0.98)	0.533	-0.292	0.562
7.5	145	14.7 (1.32)	43	14.5 (1.15)	0.274	-0.195	0.685
8.0	139	14.7 (1.21)	38	14.4 (0.98)	0.131	-0.973	0.746
8.5	144	14.9 (1.41)	45	14.7 (1.32)	0.392	-0.265	0.674
9.0	142	14.9 (1.51)	41	14.8 (1.34)	0.560	-0.365	0.672
9.5	132	15.0 (1.42)	48	14.8 (1.41)	0.344	-0.245	0.698
10.0	142	15.2 (1.40)	38	15.0 (1.60)	0.561	-0.367	0.674
10.5	167	15.3 (1.39)	55	15.1 (1.83)	0.351	-0.252	0.707
11.0	159	15.2 (1.43)	52	15.1 (1.16)	0.912	-0.409	-0.457
11.5	159	15.3 (1.52)	41	15.4 (1.58)	0.629	-0.673	0.408
12.0	137	15.6 (1.63)	46	15.5 (1.51)	0.873	-0.489	0.575
12.5	155	15.7 (1.72)	40	15.9 (1.73)	0.517	-0.811	0.409
13.0	139	15.8 (1.75)	44	16.1 (1.86)	0.345	-0.900	0.316
13.5	125	16.0 (1.96)	43	16.8 (2.12)	0.016*	-1.567	-0.165
14.0	130	16.1 (2.04)	45	16.6 (2.10)	0.097	-1.297	0.108
14.5	125	16.3 (1.81)	34	16.7 (2.12)	0.232	-1.153	0.281
15.0	133	16.4 (1.97)	44	16.7 (1.95)	0.296	-1.037	0.317
15.5	115	16.5 (1.94)	40	16.7 (2.20)	0.566	-0.945	0.519
16.0	106	16.7 (2.21)	36	16.9 (2.04)	0.535	-1.089	0.567
16.5	114	16.9 (1.94)	37	17.5 (2.32)	0.115	-1.371	0.151
17.0	100	17.2 (2.18)	38	17.3 (1.87)	0.632	-0.985	0.599
17.5	103	17.1 (2.21)	40	18.3 (2.30)	0.007*	-1.973	-0.325
18.0	90	17.7 (2.54)	32	18.2 (2.25)	0.298	-1.541	0.476
18.5	90	17.5 (2.14)	38	18.5 (2.58)	0.019*	-1.928	-0.177
19.0	74	18.1 (2.23)	28	18.8 (2.55)	0.160	-1.754	0.294
19.5	70	18.1 (2.26)	21	19.4 (2.78)	0.040*	-2.417	-0.057
20.0	73	17.8 (2.10)	19	18.3 (1.77)	0.446	-1.444	0.641

***p≤0.05, **p≤0.01, ***p≤0.001, df= n-2**

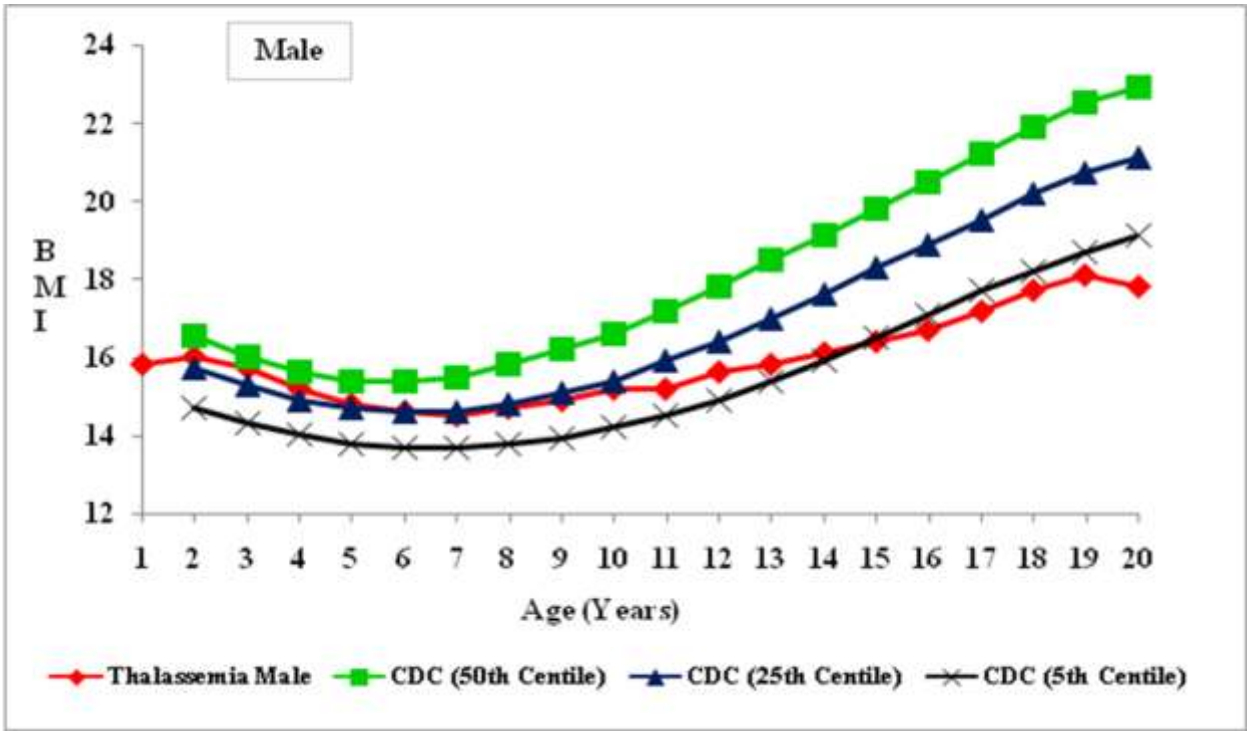

Fig 1: Comparison of Body Mass Index (kg/m^2) of Male Thalassemia and Normal Children

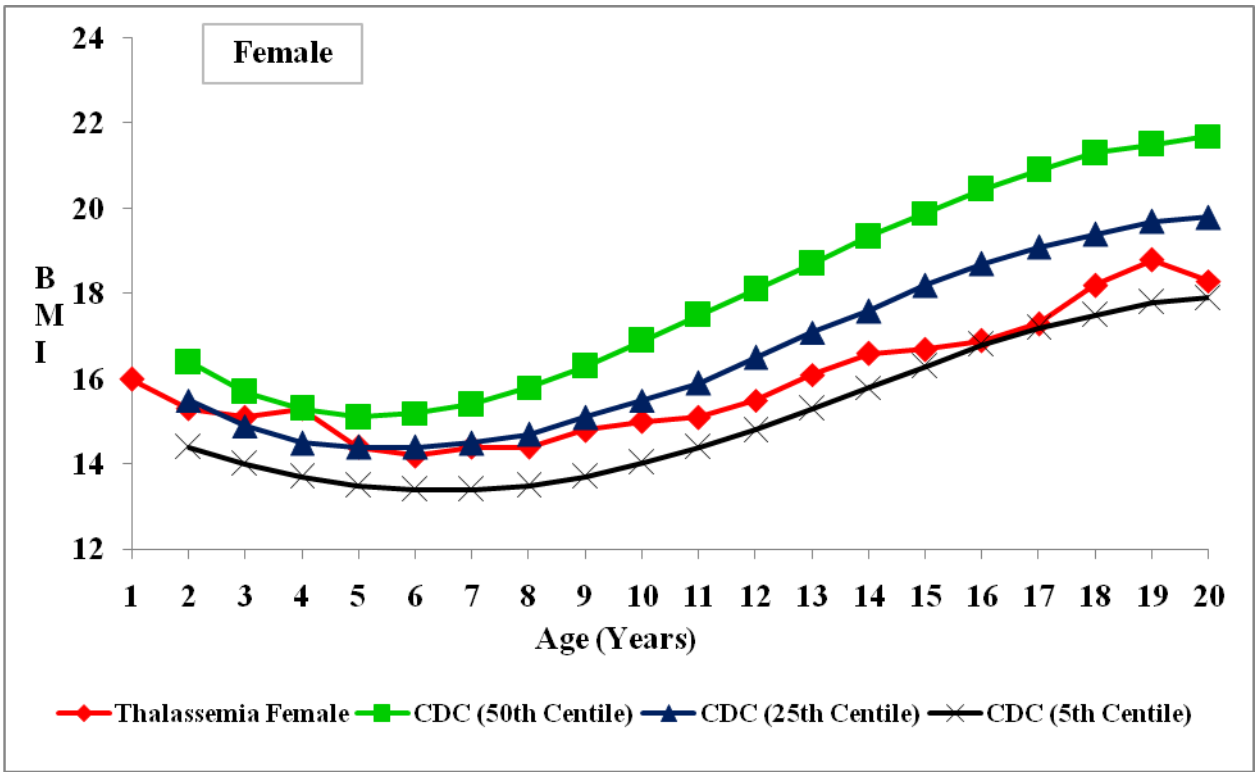

Fig 2: Comparison of Body Mass Index (kg/m^2) of Female Thalassemia & Normal Children