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Growth Pattern of School Going Children of Medinipur Districts of West Bengal, India

Binoy Kumar Kuiti, Ishita Dash, Monamika Jana, Swarup Pratihar and Kaushik Bose

Department of Anthropology Vidyasagar University, Midnapore 721 102, West Bengal, India

KEYWORDS Height. Weight. Body Mass Index

ABSTRACT Childhood and adolescence are two significant parts of the maturation clock where an acceleration of growth is observed. The reference values are central to growth monitoring. The present study was carried out to develop the mean, standard deviation and 50th percentile for height, weight, and BMI of studied population and to compare them with the regional, national and international studies. A cross-sectional, schools and household-based study were conducted. A total 970 children and adolescents (378 girls and 592 boys) from four blocks of Purba and Paschim, Medinipur districts were included in this investigation. In the present study, when compared with two regional references of NNMB tribes (2007-08 WB) and NNMB rural (2011-12), boys and girls mean values of height and weight were comparable. The present physical growth standard can be suggested for monitoring of growth of primary and high school going children from these two districts.

INTRODUCTION

In the recent era, anthropology is well known for the study of human variation and their adaptive nature in the environment, while few decades ago a physical anthropologist gave special attention to human nutrition and health. In the nutritional state, growth is a process by which human beings develop biologically from conception to bereavement and it is an enormous technique for attributes of a species adaptation. By continuous and composite interaction method, growth is a creation of heredity and environment (Tanner 1990). Therefore, the growth model is also controlled by a maturation clock (Tanner 1962). In that particular time schedule of this maturation clock, puberty plays in and an acceleration of growth is observed. Anthropometric parameters such as height, weight, breadths, skinfolds and circumferences measurement are valuable non-invasive indicators to detect nutritional status and assess the growth and development of children (Kuczmarski et al. 2000; Sigulem et al. 2000; Saxena et al. 2004; Sinha et al. 2012; Gualdi-Russo 2015). Accurate anthropometric measurements of height, weight, and BMI serve as reliable means for evaluating the growth of a child and help detect gross abnormalities without manifesting of other clinical signs of illness (Khadgavat et al. 1998; Kuperminc and Stevenson 2008; Benfer et al. 2012). Therefore, the health workers and physicians have used the growth charts in schools and public health clinic for supplemental feeding programmes and intervening community health programs (Hamill et al. 1979). The pattern of growth of population changes over time, and hence growth references should be updated regularly, particularly for the nation in their nutrition transition (Kim et al. 2000; Khadilkar et al. 2015).

India is undergoing a major transition and a secular trend is a presenter from publication spanning the past four decades. Earlier studies on rural population have indicated advancement of age have been given subordinate clue for their increment of physical traits (Bose et al. 2007; Qamra et al. 2012; Verma 2012; Jaiswal 2013; Longkumer 2013; Patil et al. 2013; Basu et al. 2014; Wilde et al. 2014; Karri et al. 2015; Patil et al. 2015; Bharthi et al. 2017). In India, wide variation in the growth determinants is present, and it is essential that the normal values are developed

*Address for correspondence:
Kaushik Bose
Professor in Biological Anthropology
Vidyasagar University,
Midnapore 721 102, West Bengal, India
E-mail: kaushikbose@cantab.net

region wise and are redefined from time to time (Khopkar et al. 2014; Sireesha et al. 2015).

The present studies promoted partially fulfill the emptiness of an anthropometric profile among rural children and adolescents of undivided Medinipur district in West Bengal. This study was carried out to develop the mean, standard deviation and median (50th percentile) curves for height, weight and BMI of studied population and lastly tried to compare them with the regional (NNMB tribe 2007-08 and NNMB rural 2011-12), national (Agarwal et al. 1992; Merwaha et al. 2011; Khadilkar et al. 2015) and international (CDC 2002; WHO 2006) studies.

The objectives of this study were to, firstly, construct height-for-age, weight-for-age and BMI-for-age charts for children of two Medinipur districts in the West Bengal state, India, aged 6-14 years, secondly, evaluate the secular trend in height in this group, and thirdly, determine if the height, weight, and BMI of contemporary children in the two Medinipur districts differs from regional Bengali children (NNMB tribe 2007-08 and NNMB rural 2011-12), national (Agarwal et al. 1992; Merwaha et al. 2011; Khadilkar et al. 2015) and international (CDC 2002; WHO 2006) studies.

MATERIAL AND METHODS

The study was carried out in the Purba Medinipur and Paschim Medinipur districts, which are situated in the southern part of the state of West Bengal, India. Purposive data sampling has been used for data collection in two blocks of each district. Medinipursadar block and Binpur block were selected for Paschim Medinipur and Contai I and Ramnagar-I for Purba Medinipur District. A total 970 children and adolescents (592 boys and 378 girls) from four blocks of two districts were included in the study.

An updated list of all government allied schools (primary to higher secondary schools) obtained from two districts administrative offices was used as a sampling frame. From each of four blocks in two districts, one primary and one higher secondary school was selected by random sampling technique and all the children and adolescents in the age group of 6-17 years of selected schools were included in the study. Children suffering from any major systemic diseases or with any major surgical operation likely to affect their growth and with limb deformities were excluded from the study.

The purpose and the process of the study were explained to the school head teacher and head authority of governing body of schools. Data was collected in pre-tested questionnaire schedule from 2015-2016. For all study subjects, the same measuring equipment was used, which were calibrated daily for standardization to reduce bias or error. Weight and height measurements were collected by four trained observers (BK, ID, MJ and SP) using standard techniques (Lohman et al. 1988) and data was recorded by standardized reference manual (WHO 1995). Ethical approvals were taken from Department of Anthropology of Vidyasagar University, before commencing the study.

Data was analyzed using SPSS-16 software for windows. In order to test the significance of the difference, statistical tests such as unpaired t-test, ANOVA was used wherever necessary. Increment curve for height, weight, and BMI, and growth curve difference between present study and reference population were made using Microsoft Excel.

RESULTS

A total of 970 subjects were included in the study out of whom 378 (39.0%) were girls and 592 (61.0%) were boys. Significantly higher number of boys than girls was included in the study ($\chi^2 = 37.489$; df = 11; $p < 0.001$).

Table 1 shows the mean, 50th percentile and standard deviation of height among the study participants, by age and gender. A clear significant increase in height with increasing age has been found irrespective of gender ($F = 184.00$, $p < 0.001$ for girls; $F = 283.76$, $p < 0.001$ for boys). The total increment of height between 6 to 17 year girls was lower (39.7 cm) than boys (50.4 cm). Significant ($p < 0.05$) sexual dimorphism was found in age 10, 11, 13, 14, 15, 16 and 17 years respectively. Median (50th percentile) coincided with the mean in various age groups in both the sexes. The distance curve for height in the present sample showed (Fig. 1) a gradual increase from 6-17 years, while the peak height velocity (PHV) curve (Fig. 2) indicated the highest rate increment at the age of 13 years (9.4 cm/year) among the rural boys and girls at 11 years (7.41cm/year) of two Medinipur districts.

Table 2 depicts the mean, 50th percentile and standard deviation of weight among the study rural children and adolescent, by age and gen-

Table 1: Descriptive statistics for growth pattern of height among the studied children (6-17 years)

Age	*Boys*					*Girls*					
in year	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*t' test*
6	48	111.3	6.4		112.0	63	111.7	6.5		110.4	-0.359
7	43	116.8	6.2	5.5	116.3	24	116.3	7.2	4.6	115.5	0.281
8	53	119.6	5.3	2.8	119.2	25	120.5	5.5	4.2	122.0	-0.695
9	32	123.5	5.0	3.9	123.6	37	122.1	5.2	1.6	125.4	1.145
10	86	129.3	7.0	5.8	129.5	45	127.0	5.8	4.9	127.1	2.002*
11	55	136.7	5.9	7.4	136.5	22	132.4	7.4	5.4	131.3	2.676**
12	56	138.7	7.7	2.0	140.1	29	137.0	7.3	4.6	136.5	0.995
13	56	148.1	8.2	9.4	147.5	17	142.2	5.7	5.1	142.9	2.790**
14	52	153.0	7.3	4.9	151.3	41	148.0	6.2	5.9	147.4	3.498**
15	39	156.9	7.7	3.8	157.5	23	148.2	5.1	0.2	149.8	4.785***
16	42	159.0	6.6	2.1	160.2	30	150.4	4.8	2.1	151.4	6.106***
17	30	161.7	9.3	2.8	161.8	22	151.0	6.8	0.7	151.3	4.573***

For Boys F=283.76 p<0.001 and Girls F=184.00 p<0.001
ANOVA= Analysis of Variance, t' test= Independent Sample t' test, *= p<0.05, **= p<0.01, ***= p<0.001

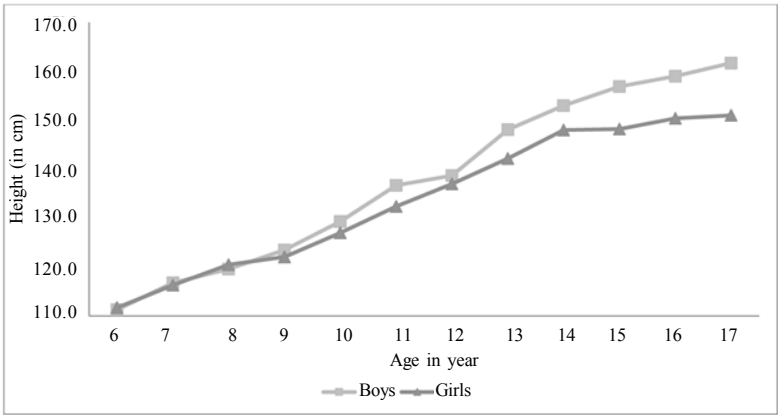

Fig. 1. Age and sex-specific linear growth of study children

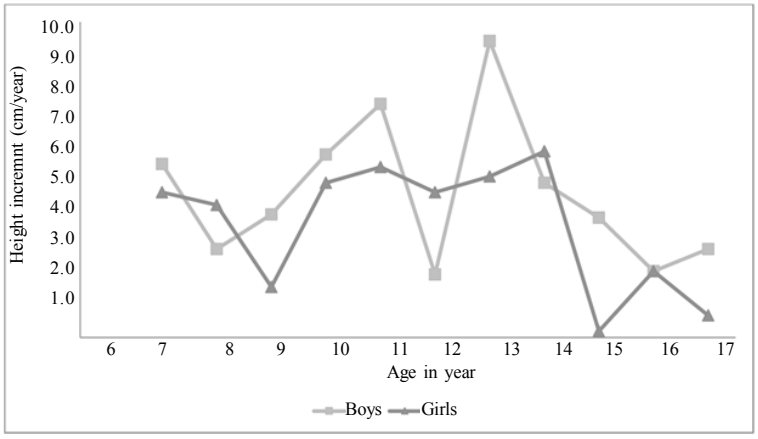

Fig. 2. Sex and age specific increment pattern of height

Table 2: Descriptive statistics for growth pattern of the weight among the studied children (6-17 years)

Age	*Boys*					*Girls*					
in year	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*t' test*
6	48	17.7	3.6		17.0	63	17.6	2.9		17.0	0.281
7	43	19.3	3.6	1.6	19.0	24	19.7	4.1	2.1	18.5	-0.3
8	53	21.8	4.8	2.5	21.0	25	20.2	3.9	0.6	20.0	1.573
9	32	23.8	3.7	2.0	23.0	37	21.6	3.8	1.4	21.0	2.363*
10	86	26.3	6.4	2.5	25.0	45	23.3	3.9	1.7	23.0	2.815**
11	55	29.6	4.5	3.3	30.0	22	29.6	5.6	6.3	30.0	-0.008
12	56	30.6	5.5	1.0	30.8	29	31.4	6.3	1.8	33.0	-0.58
13	56	35.5	6.9	4.9	34.8	17	32.3	5.9	1.0	34.6	1.852
14	52	40.5	9.6	5.0	38.5	41	39.6	3.0	7.2	40.0	0.656
15	39	42.2	7.4	1.7	41.0	23	39.6	3.8	0.1	41.1	1.801
16	42	45.2	7.2	3.0	44.5	30	42.6	5.0	3.0	42.3	1.763
17	30	50.3	8.8	5.1	48.8	22	44.1	8.4	1.5	45.0	2.546*

For Boys F=121.954, p<0.001 and Girls F=147.819, p<0.001.
ANOVA= Analysis of Variance, t'test= Independent Sample t' test, *= p<0.05, **= p<0.01, ***= p<0.001

der. Like height, weight also significantly increased with increasing age irrespective of gender (F = 147.819, p < 0.001 for girls; F = 121.954, p < 0.001 for boys). In pooled data, total increment of weight between 6-17 year, boys were higher (32.6 kg) than girls (26.5kg). Significant (p<0.05) sexual dimorphism was found in age groups 9, 10 and 17 years, respectively. The median weight (50th percentile) coincided with the mean in weight various age groups in both the sexes. The distance curve for weight in the present sample showed (Fig. 3) a gradual increase from 6-17 years, while the peak weight velocity (PWV) curve (Fig. 4) indicated the highest rate increment at the age of 17 years (5.1 kg/year) among the rural boys and girls at 14 years (7.2 kg/year) of two Medinipur districts.

The descriptive statistics of BMI among the study subject (age and gender specific) are presented in Table 3. One-way ANOVA showed the

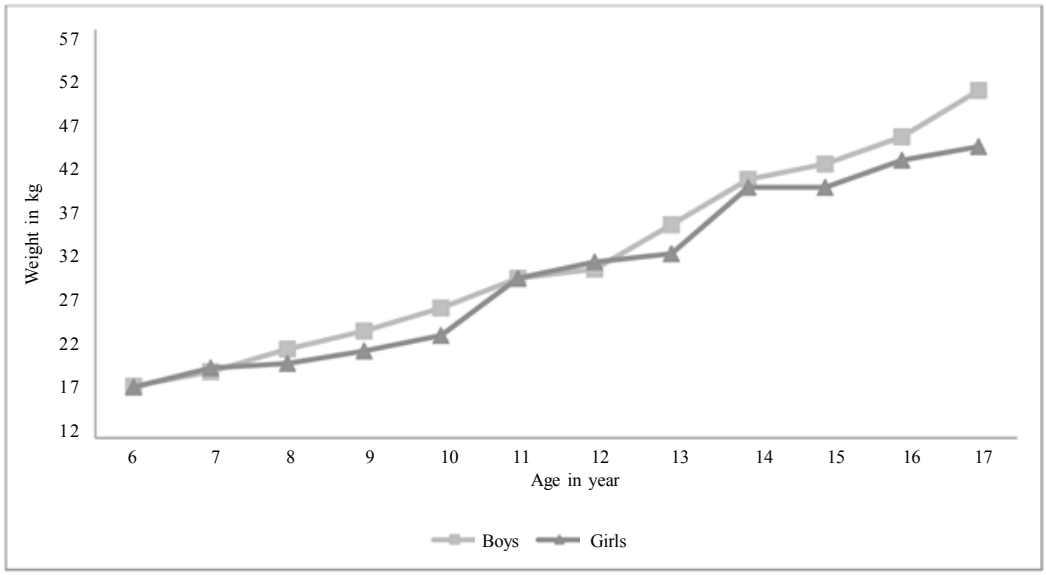

Fig. 3. Age and sex-specific linear growth of weight among the study children

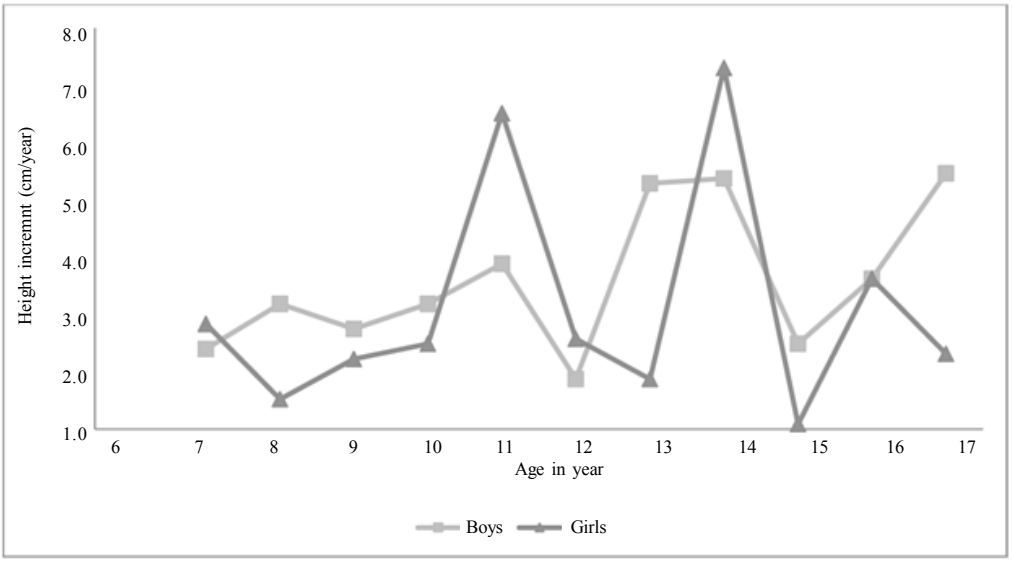

Fig. 4. Sex and age specific increment pattern of weight

Table 3: Descriptive statistics for growth pattern of BMI among the studied children (6-17 years)

Age	*Boys*					*Girls*					
in year	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*Number of individuals*	*Mean*	*Standard deviation*	*Increment*	*50th percentile*	*t' test*
6	48	14.3	2.3		13.9	63	14.1	2.1		13.9	0.475
7	43	14.1	1.9	-0.2	14.0	24	14.4	1.8	0.3	13.7	-0.599
8	53	15.2	2.7	1.1	14.5	25	13.8	1.9	-0.6	13.2	2.202*
9	32	15.6	2.0	0.4	14.9	37	14.4	1.7	0.6	14.3	2.511*
10	86	15.7	3.4	0.1	14.9	45	14.4	1.9	0.0	13.9	2.321*
11	55	15.8	2.3	0.1	15.2	22	16.9	3.3	2.5	16.2	-1.475
12	56	15.8	2.0	0.0	15.6	29	16.7	3.3	-0.2	16.0	-1.361
13	56	16.1	2.2	0.3	15.5	17	15.9	2.5	-0.8	15.8	0.203
14	52	17.2	3.5	1.1	16.9	41	18.1	1.4	2.1	17.6	-1.7
15	39	17.1	2.7	-0.1	16.3	23	18.0	1.3	-0.1	17.8	-1.76
16	42	17.8	2.1	0.7	17.6	30	18.8	1.9	0.8	18.6	-2.149*
17	30	19.1	2.4	1.3	18.6	22	19.3	3.2	0.4	19.1	-0.192

For Boys F=12.176, p<0.001and Girls F=26.952, p<0.001
ANOVA= Analysis of Variance, t'test= Independent Sample t' test, *= p<0.05, **= p<0.01, ***= p<0.001

significant increment of BMI with age, irrespective of gender ($F = 26.952$, $p < 0.001$ for girls; $F = 12.176$, $p < 0.001$ for boys). The total increase in BMI between 6 to 17 year in, girls were higher (5.2 kg/m^2/year) than boys (4.8 kg/m^2/year). Significant ($p < 0.05$) sexual dimorphism was found in ages 8, 9, 10 and 16 years, respectively. The distance curve for BMI in the present sample showed (Fig. 5) a gradual increase from 6-17 years, while the BMI velocity curve (Fig. 6) indicated the highest rate increment at the age of 17 years (1.3kg/m^2/year) among the rural boys and girls at 11 years (2.5kg/m^2/year).

DISCUSSION

The present study covered children and adolescents in the age group of 6-17 years. When

Fig. 5. Age and sex-specific linear growth of BMI among the study children

Fig. 6. Sex and age specific increment pattern of BMI

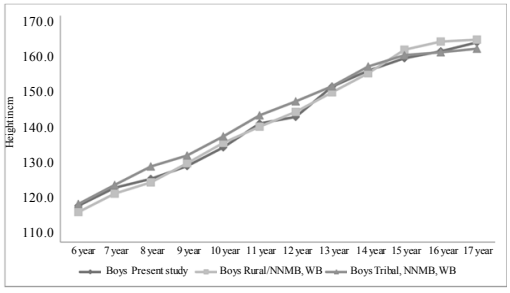

Fig. 7. Comparison of mean height of boys from the present study with regional studies

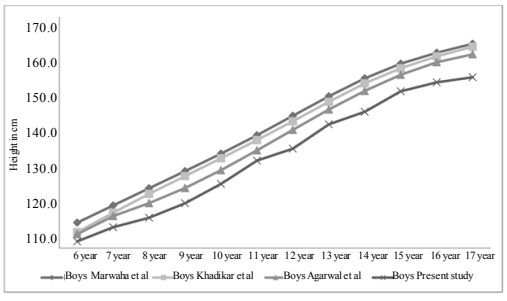

Fig. 8. Comparison of 50th percentile height of boys from the present study with national studies

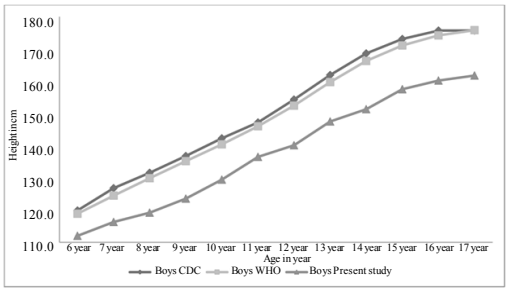

Fig. 9. Comparison of 50th percentile height of boys from the present study with international studies

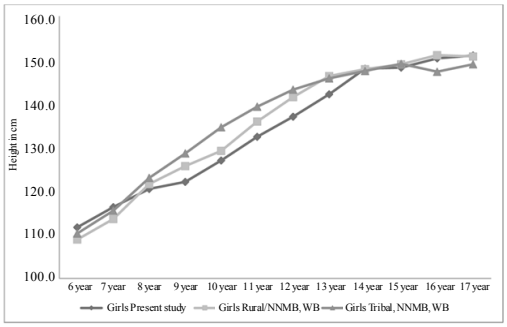

Fig. 10. Comparison of mean height of girls from the present study with national studies

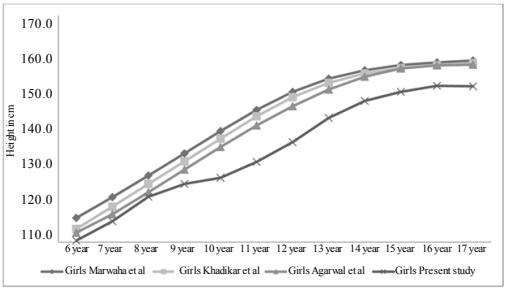

Fig. 11. Comparison of 50th percentile height of girls from the present study with national studies

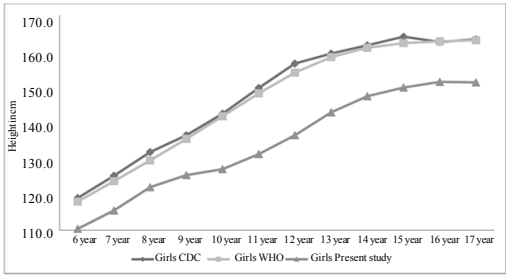

Fig. 12. Comparison of 50th percentile height of girls from the present study with international studies

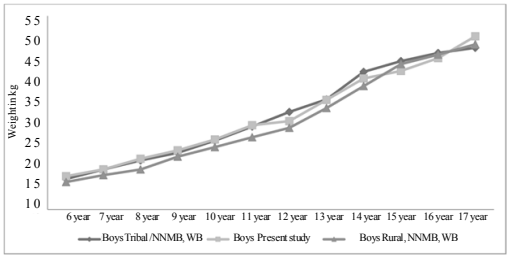

Fig. 13. Comparison of mean weight of boys from the present study with regional studies

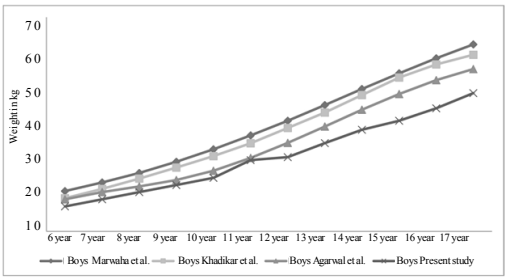

Fig. 14. Comparison of mean weight of boys from the present study with national studies

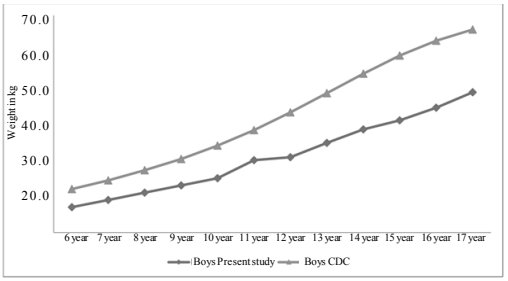

Fig. 15. Comparison of 50th percentile weight of boys from the present study with international studies

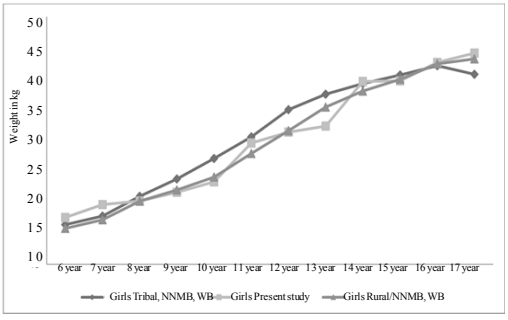

Fig. 16. Comparison of mean weight of girls from the present study with regional studies

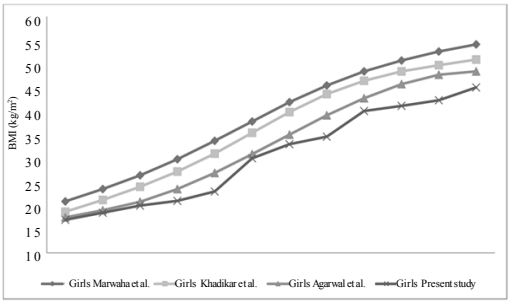

Fig. 17. Comparison of 50th percentile weight of girls from the present study with national studies

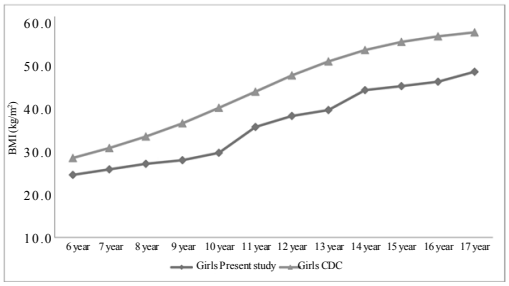

Fig. 18. Comparison of 50th percentile weight of girls from the present study with international studies

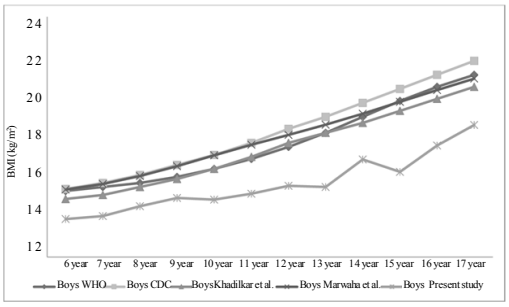

Fig. 19. Comparison of 50th percentile BMI of boys from the present study with national and international studies

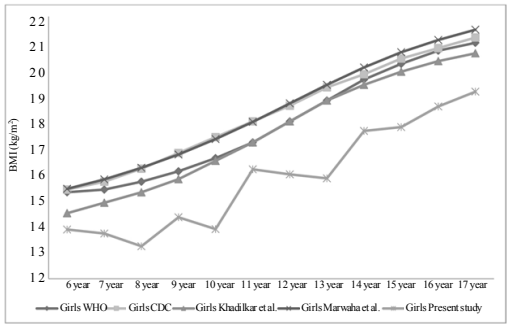

Fig. 20. Comparison of 50th percentile BMI of girls from the present study with national and international studies

compared with NNMB rural (NNMB 2011-12) and NNMB tribal (NNMB 2007-08) for regional references, among boys at 8, 9, 10, 11, 12 and 15 years the mean values for height of present study were smaller, the maximum difference being at the age 12 (-4.8cm, NNMB tribal) and 16 (-3.0 cm, NNMB rural) respectively (Fig. 7). In the case of girls (Fig. 8) the mean value for height was also lower at 8, 9, 10, 11, 12, 13 and 15 years. The maximum shortness among girls has been found at the age 10 (-7.6 cm, NNMB tribal) and 12 (-4.5 cm, NNMB rural) respectively. Compared with 50th percentile value of data of national studies (Agarwal et al. 1992; Merwaha et al. 2011; Khadilkar et al. 2015) the growth trend of 50th percentile among present children was less in both sexes (Figs. 9 and 10) than other national references. Hence, Agarwal's 50th percentile reference value showed minimum average differences from all ages in both sexes (-4.7 cm for boys and -5.6 for girls) than other references (Merwaha et al. 2011; Khadilkar et al. 2015). The growth trend of children studies by Agarwal was closer to present studied children than others national references (Merwaha et al. 2011; Khadilkar et al. 2015). For the present study, the 50th percentile value of height for boys and girls (Figs. 11 and 12) were lower than two international studies (CDC 2002; WHO 2006).

The mean and 50th percentile values have been similar for all ages in boys as well as girls (Agarwal et al. 1992). The mean values of weight among studied subjects were comparable with regional references of NNMB (Fig. 13), except at the age of 12, 14, 15 and 16 years where values less by -0.1 kg to -2.3 kg. In girls (Fig.14), the mean values for all ages have been comparable, except at the ages of 8, 9, 10, 12, 13 and 15 years were present study values have been lesser by -0.3 kg to -5.2 kg than these reference studies (NNMB tribe 2007-08; NNMB rural 2011-12). Compared with 50th percentile value of data of national study (Agarwal et al. 1992; Merwaha et al. 2011; Khadilkar et al. 2015), the growth trend of 50th percentile among present children showed less weight in both sexes (Figs. 15 and 16) than other national references. Hence, Agarwal's 50th percentile reference value showed minimum average differences from all ages in both sexes (-3.8 kg for boys and -2.6 kg for girls) than other references (Merwaha et al. 2011; Khadilkar et al. 2015). As for growth trend in weight, Agarwal's studied children were closer to present studied children than other national references (Merwaha et al. 2011; Khadilkar et al. 2015). For the present study, the 50th percentile value of weight for boys and girls (Figs. 17 and 18) was much lighter than international studies of CDC 2000 (CDC 2002).

Median values for BMI, like height and weight, have coincided with corresponding mean values of BMI in various age groups and both sexes in Purba and Paschim Medinipur districts. In present study (Figs. 19 and 20) at all age's 50th percentile value of BMI was lower than that of national and international reference values (CDC 2002; WHO 2006; Merwaha et al. 2011; Khadilkar et al. 2015). Other findings indicated that the mean values of BMI were higher for girls than boys up to the age of 14 years, and a similar finding was reported by Thakor et al. (2000).

CONCLUSION

The present study provides the physical growth standard for school-based population (6-17 years) of Purba and Paschim Medinipur districts from the southern part of West Bengal, India. It may be helpful for monitoring of growth at a glance. In both sexes, the 50th percentile values of height were comparable to NNMB regional references up to 15 years age. Thus, there is a secular trend in height and weight of Indian children, which may be a good indicator of improvements in socioeconomic and socio-environmental conditions. It is necessary that regional standards be developed and re-evaluated regularly for children and adolescents. However, this study has a major limitation. It was cross-sectional in nature and so provides no information on longitudinal growth.

RECOMMENDATIONS

Overall, the children of both districts, based on the values of three indices remain vulnerable to suffer from improper growth increment and malnutrition. There may be several socio-cultural and environmental factors associated with this phenomenon. The factors responsible for the same are to be identified and proper intervention strategies including feeding programmes, general medical, and awareness and health care facilities, improvement of food security are to be implemented.

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