Growth Performance of Affluent Indian Preschool Children: A Comparison with the New WHO Growth Standard

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This study was conducted to evaluate the nutritional status of 2-5 year old affluent, urban children using the new WHO 2006 standards. A cross-sectional, multicentric preschool-based study was conducted on 1493 children (727 boys). Mean Z scores for height, weight, body mass index and weight for height (-0.75(1.1), -0.59(1.1), –0.19(1.22) and -0.26(1.18), respectively) were below the WHO standard median.

Key words: *Growth, India, Preschool children, WHO.*

Malnutrition poses a grave risk to the health of preschool children in developing countries. The relative magnitude of different measures of nutritional status is affected by the choice of reference charts used. In April 2006, the World Health Organization (WHO) released child growth standards for children up to the age of 5 years, to provide a multiethnic benchmark for breastfed children[1].

We conducted a multicentric, cross-sectional study to assess how Indian affluent preschool children (2-5 year) match or diverge from the WHO 2006 standards. We also compared the percentage of children who were underweight and stunted according to the WHO 2006 and WHO 1977 (WHO/NCHS) standards[2].

METHODS

1493 children (mean age 3.8±0.8 years, 727 boys) 317 (152 boys-North), 325 (150 boys-South), 371 (222 boys-East), 480 (203 boys-West) were studied between June 2007 and January 2008. Eight study sites were selected. Nutritionally well-off areas (i.e. areas without slum clusters, low income housing schemes and those with high land prices as published by Government agencies) were identified and list of schools catering to children of socio-economically well-off families was prepared (Yearly fees around Rs 10000 (Indian per capita income 2007-2008, Rs 2021/month)[4]. Three schools were selected by generating random numbers. Based upon reported variance on heights and weights of affluent Indian children, sample size of 1346 children in 2-5 y age group was determined with type I error probability of 0.05 and power of the test to be 0.90 to detect a difference of 0.5 cm in height or 0.5 kg in weight in age-and sex-groups[5]. Therefore a cohort of around 1500 children was selected and informed consent was obtained from nine schools.

Height was measured using Leicester Height Meter (Child Growth Foundation, UK, range 60-207cm), weight was measured using portable electronic weighing scales (Salter, India) (100g). The study was approved by our Institutional ethics committee. Measurers were tested for height inter- and intra-observer variability (20 subjects, each

TABLE I HEIGHT, WEIGHT AND BMI PERCENTILE VALUES FOR BOYS AND GIRLS

Age (in years)	Gender	Height Percentile (in cm)						
		3	**10**	**25**	**50**	**75**	**90**	**97**
2	Boys	-	79.3	81.9	84.8	87.8	90.9	-
	Girls	77.6	80	82.5	85.3	88.2	91.3	94.7
2.5	Boys	80.3	83	85.8	88.7	91.8	95.1	98.5
	Girls	80.7	83.2	85.9	88.7	91.8	95	98.5
3	Boys	83.9	86.7	89.6	92.6	95.8	99.2	102.8
	Girls	83.8	86.5	89.3	92.2	95.4	98.7	102.2
3.5	Boys	87.5	90.4	93.4	96.6	99.9	103.3	106.9
	Girls	90	92.9	96	99.2	102.5	106	109.6
4	Boys	91	94	97.2	100.4	103.8	107.4	111.1
	Girls	90	92.9	96	99.2	102.5	106	109.6
4.5	Boys	94.4	97.6	100.8	104.2	107.7	111.3	115.1
	Girls	-	96.1	99.3	102.6	106	109.6	-
5	Boys	97.8	101	104.4	107.9	111.4	115.1	119
	Girls	96.1	99.3	102.6	106	109.6	113.2	117
		Weight Percentile (in Kg)						
		3	**10**	**25**	**50**	**75**	**90**	**97**
2	Boys	-	9	9.7	10.6	11.8	13.3	-
	Girls	8.6	9.2	9.8	10.6	11.4	12.4	13.6
2.5	Boys	9.1	9.8	10.7	11.7	13	14.7	17.1
	Girls	9.3	9.9	10.7	11.5	12.5	13.7	15.2
3	Boys	9.9	10.7	11.7	12.8	14.3	16.3	18.9
	Girls	9.9	10.7	11.5	12.5	13.7	15.1	16.7
3.5	Boys	10.7	11.6	12.7	14	15.6	17.8	20.8
	Girls	10.6	11.4	12.4	13.5	14.8	16.4	18.4
4	Boys	11.5	12.5	13.6	15.1	17	19.4	22.8
	Girls	11.2	12.1	13.2	14.5	16	17.8	20.1
4.5	Boys	12.2	13.3	14.6	16.2	18.3	21	24.8
	Girls	-	12.9	14.1	15.5	17.2	19.3	-
5	Boys	13	14.2	15.6	17.4	19.7	22.7	26.9
	Girls	12.5	13.6	14.9	16.5	18.4	20.8	23.8
		BMI Percentile (in Kg/m^2)						
		3	**10**	**25**	**50**	**75**	**85**	**95**
2	Boys	-	13	13.8	14.7	15.9	16.6	-
	Girls	11.8	12.5	13.3	14.4	15.6	16.4	17.8
2.5	Boys	12.4	13	13.8	14.8	16	16.7	18.1
	Girls	11.8	12.5	13.4	14.4	15.7	16.5	18
3	Boys	12.3	13	13.8	14.8	16.1	16.8	18.4
	Girls	11.8	12.6	13.4	14.5	15.8	16.6	18.2
3.5	Boys	12.3	13	13.8	14.9	16.2	17	18.6
	Girls	11.9	12.6	13.5	14.6	15.9	16.7	18.3
4	Boys	12.3	13	13.8	14.9	16.3	17.1	18.8
	Girls	11.9	12.6	13.5	14.6	16	16.9	18.5
4.5	Boys	12.3	13	13.9	15	16.4	17.2	19
	Girls	-	12.6	13.5	14.7	16.1	17	-
5	Boys	12.3	13	13.9	15	16.5	17.4	19.3
	Girls	11.9	12.6	13.6	14.7	16.2	17.1	18.9

observer measured 4 children 4 times), coefficients of variation were < 0.01(1%). Seven subjects with Z scores exceeding ±5SD and children with major illnesses were excluded (verified by pediatrician)(6). LMS Growth programme, WHO Anthro 2005 (WHO homepage (http:// www.who.int/child-growth/ software/en/), EPI_INFO v6.04 and SPSS 11.0 (Chicago, USA, 2001) were used for analysis. Percentage of children stunted (height for age <-2 SD), underweight (weight-for-age < -2 SD), wasted (weight for height <-2 SD) and with low BMI (BMI for age <-2 SD) according to the WHO 2006 and WHO/NCHS standards, were calculated.

RESULTS

Table **I** shows smoothened percentile values for the study population. The 3rd and 50th percentiles for height, weight and BMI for the study population were lower, and the 97th percentiles for boys, height, weight and BMI were higher than the WHO standards (data not presented). The mean Z scores for height, weight, BMI and weight for height (–0.75(1.1), –0.59(1.1), –0.19(1.22) and –0.26(1.18), respectively) were below the WHO 2006 standard median. *Table* **II** shows age and sex wise distribution of Z scores for height, weight, BMI and weight for height based on WHO 2006 standards. Percent of children (boys and girls) stunted, underweight, wasted or having weight for height Z score <-2 when using the WHO 2006 and the WHO/NCHS cut-offs is illustrated in *Table* **III**.

TABLE II HEIGHT, WEIGHT AND BMI Z SCORES BASED ON WHO 2006 STANDARDS

Parameter	Age Interval (yr)	Boys Z score	Girls Z score
Height	2-3	–1.0	–0.8
	3-4	–0.4	–0.7
	4-5	–0.6	–0.9
Weight	2-3	–0.8	–0.3
	3-4	–0.4	–0.4
	4-5	–0.4	–0.7
BMI	2-3	–0.2	–0.3
	3-4	–0.2	–0.3
	4-5	0.0	–0.3
Weight for Height	2-3	–0.3	–0.3
	3-4	–0.3	–0.3
	4-5	–0.1	–0.3

* BMI: Body mass index.

DISCUSSION

Our study shows that as a group, the mean Z scores for height, weight, BMI and weight for height for the study population were below the WHO 2006 standard median. From the age of 2 years until 5 years, the mean Z score for height, weight and BMI showed consistent improvement when compared with the WHO 2006 standards. Interestingly, the BMI did not differ much from the WHO 2006 standards, suggesting relatively small body size. Using the WHO 2006 cut-offs, a higher percentage of boys and

TABLE III PERCENTAGE OF CHILDREN WITH Z SCORE BELOW -2 AND ABOVE +2 FOR HEIGHT, WEIGHT, BMI AND WEIGHT FOR HEIGHT USING THE WHO 2006 AND WHO/NCHS (1977) STANDARDS

Parameter	Boys (%)		Girls (%)	
	WHO 2006	WHO/NCHS	WHO 2006	WHO/NCHS
Stunting (Z score < -2)	13.6	11.2	11.2	6.7
Underweight (Z score < -2)	8.5	10.7	10.4	10.6
Wasting (Z score < -2)	4.3	12.9	9.4	17.5
Wt For Ht* (Z score < -2)	6.4	3.9	8.1	6.7
Tall (Z score >2)	1.4	5.2	1	10.5
Overweight (Z score >2)	3.6	4.9	0.6	2.7
BMI >95th percentile	7.3	5.5	3.8	2.2
Wt For Ht* (Z score >2)	5.5	4.5	3	1.6

* Weight for height; BMI: Body mass index.

WHAT THIS STUDY ADDS?

- The growth performance of affluent Indian preschool children was suboptimal compared with the new WHO growth standard.

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girls were classified as being stunted and wasted, lower percentage of boys were classified as being underweight, a similar number of girls were classified as being underweight using both cut-offs and a lower percentage were classified as having BMI<-2SD.

The WHO 2006 standards have placed the breastfed child as the norm for growth and have set a lower standard for weight gain as compared to the WHO/NCHS charts(7). This would reduce the threshold for diagnosis of overweight and obesity, thus helping to curb the global epidemic of obesity. At present, charts published by Agarwal, *et al.* for Indian children under 5 years of age are in use(8). However, implementing the use of the WHO standards by all caregivers of children under 5 years would reduce the confusion resulting from the use of multiple charts; this is particularly relevant in today's era of migration and global traffic.

Our data suggest that change to WHO 2006 standards may have some impact on nutritional indicators in clinical practice and on National statistics used to measure the success of government initiatives. Using the new standards could give the impression of deterioration in nutritional status if previous data are not re-analyzed. Healthcare professionals looking after children thus need to be trained before the new charts are adopted.

Our study has several shortcomings. The study is cross-sectional and due to logistic reasons we have not measured children <2 years or recorded birth, parental or feeding history. It is possible that the relationship to the standards may vary according to age and our results may have been affected to some extent as the 0-2 age group could not be represented.

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Annexure-I

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