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## RESEARCH ARTICLE

## ASSOCIATION OF BMI WITH WAIST CIRCUMFERENCE AND WAIST FOR HEIGHT AMONG URBAN PRIMARY SCHOOL CHILDREN IN WEST BENGAL, INDIA

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### Abstract

**Background:** Childhood obesity has become a major public health concern over the past decade. In India, there is an increasing trend of overweight and obesity among children & adolescents particularly in urban community.

**Objective:** To investigate the association of body mass index with waist circumference and waist for height of urban primary school children.

**Design:** A community based cross-sectional analytical study.

**Setting:** Government urban primary schools of Charankabi Mukundapur, Lake Girls, Tirthapati and Belegata in Kolkata, West Bengal, India.

**Subjects & Methods:** 560 children aged 6 to 8 years (class II to IV) from four urban primary schools. All subjects underwent physical examination and anthropometric measurements.

**Results:** 19.34% & 17.61% of urban primary school children under study were wasted & severely wasted, respectively while 10.65% & 11.68% were overweight & obese according to BMI. 38.04% & 6.30% of them had 5<sup>th</sup> & 95<sup>th</sup> percentile of waist circumference. 54.34% urban children had 5<sup>th</sup> percentile of waist for height percentile. Body mass index of children has significant positive correlation ( $P \leq 0.01$ ) with waist circumference and waist for height ( $P \leq 0.05$ ).

**Conclusions:** The prevalence of overweight and obesity is high among urban primary students but under nutrition in terms of wasting is also common.

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## INTRODUCTION

Malnutrition continues to be a primary cause of ill health and mortality among children in developing countries. It is a major public health problem and accounts for about half of all child deaths worldwide (UNICEF 2004). The most important nutritional problem in the world today is the Protein Energy Malnutrition and this problem is more severe in third world countries affecting children of all ages especially the under fives (WHO, 1983). At the same time the prevalence of obesity in both developed and developing countries has risen dramatically posing a threat to public health (Bray GA, 1996).

Obesity is defined as accumulation excess body fat (WHO, 2000). Nevertheless, in epidemiological studies it has been mainly classified based on anthropometric data with surrogates for body composition rather than direct estimates of composition because body composition criterion methods are cumbersome and expensive, limiting their

use in large-scale epidemiological studies. Therefore, body mass index (BMI) continues to be the most commonly used variable for diagnosing obesity at the community level irrespective of age due to its simplicity and association with diseases (WHO,2000). Most studies used body mass index in evaluation of health effect and mortality associated with obesity (Manson et al.,1987), ( Seidell et al.,1996),(Visscher et al.,2000),(Singh et al.,1999) (Calle et al.,1999), however, the measurement of waist circumference alone may reflect the abdominal fat mass (Han et al.,1997), (Pouliot et al.,1994) (Kissebah et al.,1995) and may indicate a need for preventive weight management (Lean et al.,1995).Thus, waist circumference has been suggested as a simple clinical alternative to BMI for detecting possible health risks due to obesity (Seidell et al.,2001).

Indian data regarding current trends in childhood obesity are emerging. Some studies done in India indicate an increasing trend in the prevalence of overweight and obesity among children and adolescents (Marwaha et al.,2006),( Khadilkar et al.,2011) (Kotian et al.,2010).This have major impacts towards increasing prevalence of non-communicable disease like diabetes, hypertension and cardiovascular disease in early adulthood (Chakraborty et al.,2012).While under-nutrition in children has been the major public health concern in India over the past several decades (Subramanyam et al.,2010) relatively less attention has given to childhood overweight and obesity as there is strong indication of coexistence of under-nutrition and over-nutrition or obesity in the country.

However, though there are reports (NFHS-3,2006),(Mittal et al.,2006),(Chowdhury et al.,2008), (Bisai et al.,2008) available regarding the prevalence of under-nutrition and over-nutrition or obesity among children in West Bengal, no attempts was made to find out association between body mass index with waist circumference and waist for height of them.

## Objectives

- a) To assess overweight, obesity and underweight of urban primary school children in terms of body mass index.
- b) To determine the waist circumference and waist for height of them.
- c) To find out the association of body mass index with waist circumference and waist for height.

## Materials and Methods

### Study design and Settings

Students were randomly selected considering some inclusion criteria i.e., (i) children were apparently healthy and not suffering from any chronic diseases or physical disabilities (ii) participated in this study voluntarily.

This study was carried out among four urban primary school children of Charankabi Mukundapur, Lake Girls, Tirthapati and Belehata in Kolkata, West Bengal, India. A total of 560 students aged 6–8 years (280 boys & 280 girls) participated in this study.

### Ethical consideration

This study was approved by the Institutional Ethical Committee of All India Institute of Hygiene & Public Health, Kolkata, Ministry of Health & Family Welfare, Govt. of India.

During the visits to the schools community meetings were held in presence of the headmaster of the schools and the parents accompanied by their school-age children before commencement of the study in order to give a clear explanation of the objectives of the study. Informed written consent was also obtained from mothers of the participants.

### Anthropometric measurements

Body weight (including light indoor clothing) was measured using an electronic balance (accuracy 0.1 kg) and standing height (without shoes) with a portable stadiometer (nearest 0.1 cm). Waist circumference was taken midway between the inferior margin of the last rib and the crest of the ilium in a horizontal plane (to the nearest 0.1 cm) with a non-stretchable tape. All anthropometric measurements were measured three times, and the mean was used for analysis. The body mass index was then calculated. Waist/Height (W/Ht) ratio was measured as the ratio of the waist circumference (cm) and the height (cm).

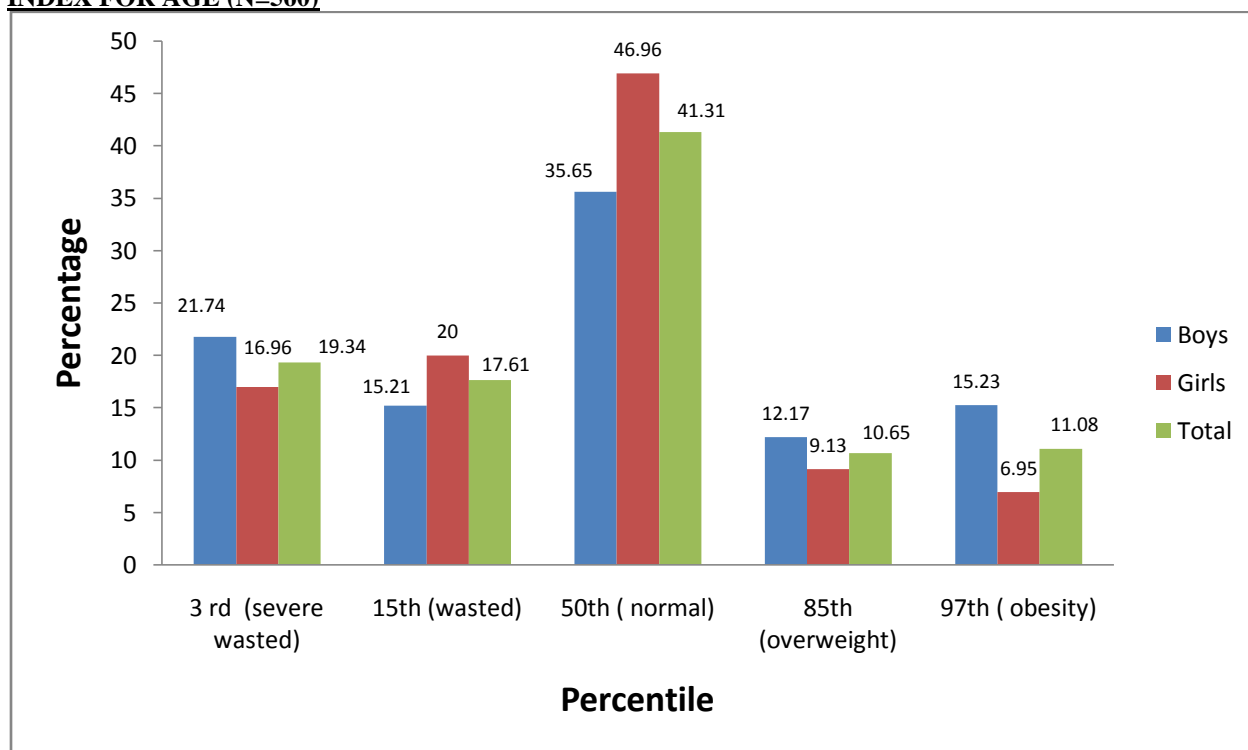
Data analysis was performed in percentiles separately for boys and girls by using the recommended age specific criteria (WHO, 2006), (Kuriyan et al., 2006).

### Statistical methods

Descriptive statistics were computed for all the continuous variables. SPSS, Windows version 21.0 (Chicago, USA) were used for the statistical analysis.

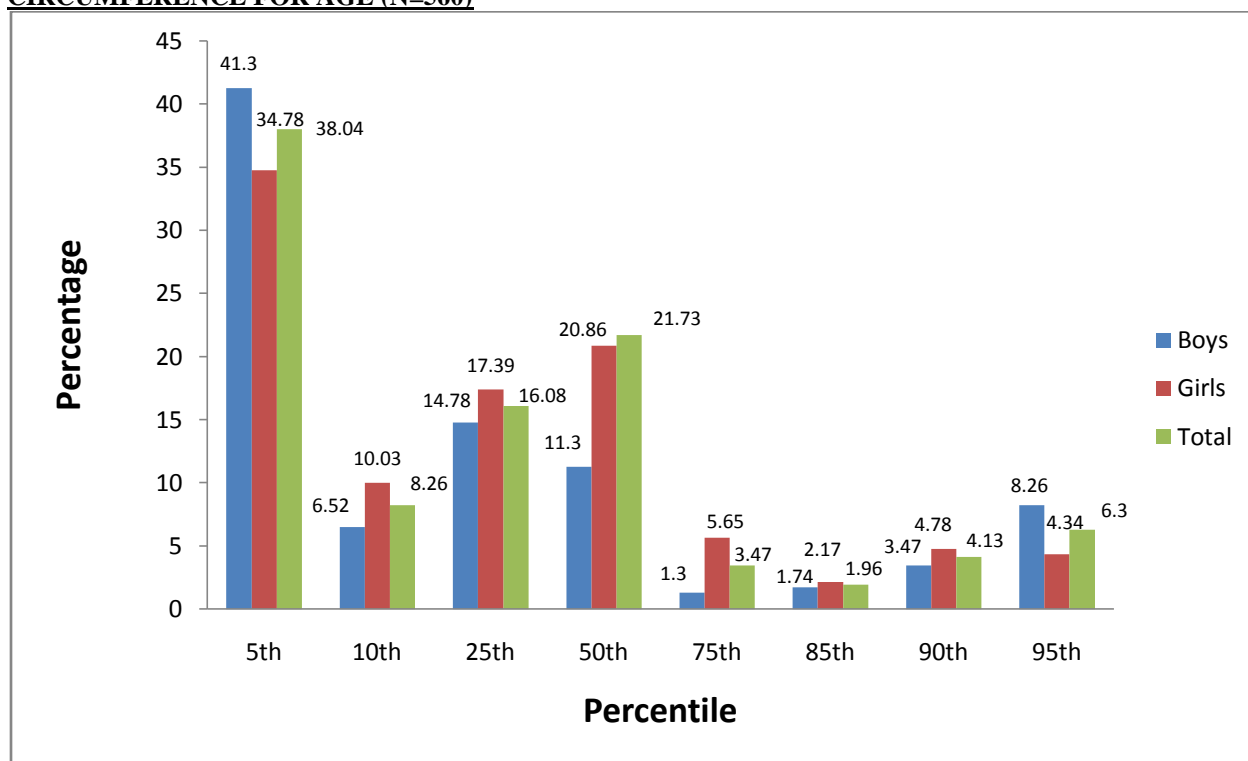
## RESULTS

**Fig. 1: DISTRIBUTION OF URBAN PRIMARY SCHOOL CHILDREN ACCORDING TO BODY MASS INDEX FOR AGE (N=560)**

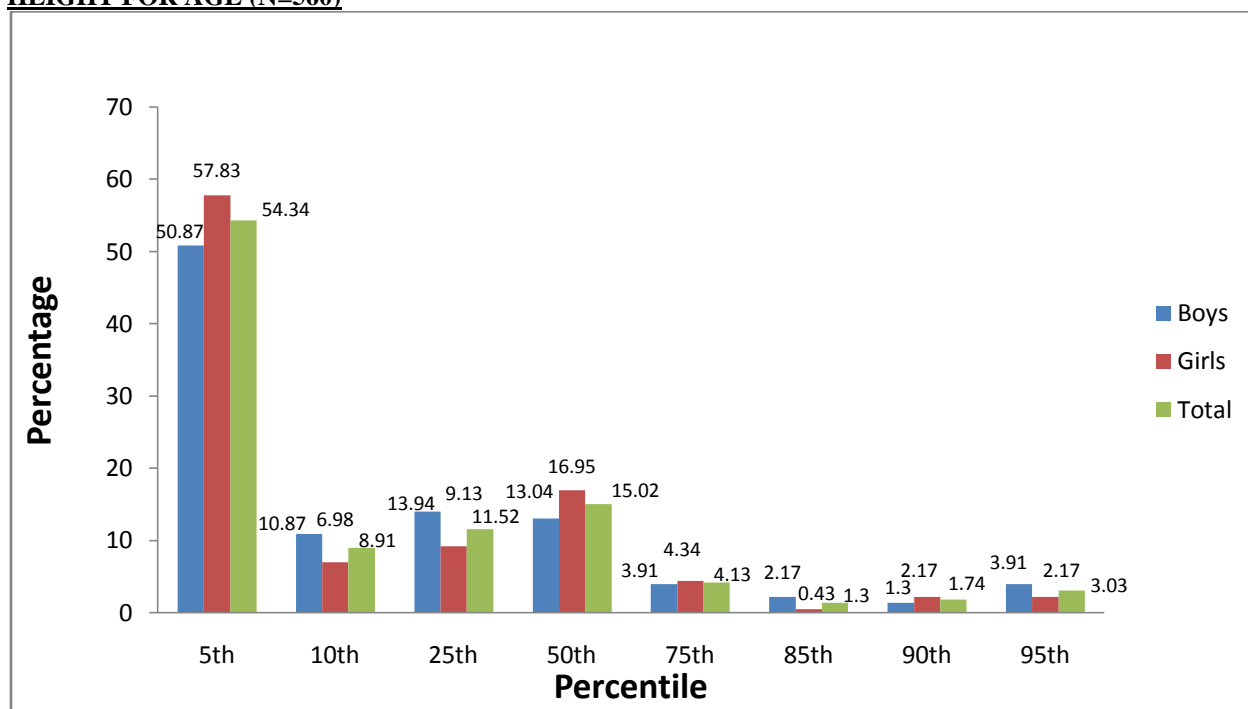


According to BMI for age, out of 280 boys 21.74% were severely wasted , 15.21% wasted , 35.65% normal, 12.17% overweight and 15.27% obese ; out of 280 girls 16.96% were severely wasted, 20% wasted, 46.96% normal, 9.13% overweight and 6.95% obese; out of 560 children 19.34% were severely wasted , 17.61% wasted , 41.31% were normal, and 10.65% overweight and 11.08 obese (Fig. 1).

**Fig. 2: DISTRIBUTION OF URBAN PRIMARY SCHOOL CHILDREN ACCORDING TO WAIST CIRCUMFERENCE FOR AGE (N=560)**



According to the Waist circumference for age, out of 280 boys 41.3%, 6.52%, 14.78%, 11.3%, 1.3% , 1.74%, 3.47%, 8.26% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively; out of 280 girls 34.78%, 10.03%, 17.39%, 20.86%, 5.65%, 2.17% , 4.78%, 4.34% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively ; out of total 560 school children 38.04%, 8.26%, 16.08%, 21.73, 3.47%, 1.96% , 4.13%, 6.3% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively (Fig. 2).

**Fig. 3: DISTRIBUTION OF URBAN PRIMARY SCHOOL CHILDREN ACCORDING TO WAIST FOR HEIGHT FOR AGE (N=560)**

According to the Waist for height for age, out of 280 boys 50.87%, 10.87%, 13.94%, 13.04%, 3.91%, 2.17%, 1.3%, 3.91% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively; out of 280 girls 57.83%, 6.98%, 9.13%, 16.95%, 4.34%, 0.43%, 2.17%, 2.17% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively; out of total 560 school children 54.34%, 8.91%, 11.52%, 15.02%, 4.13%, 1.3%, 1.74%, 3.03% of them had 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, 85<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile respectively (Fig. 3).

## DISCUSSION

BMI is used extensively as an indirect measure of body fatness in spite of its original intentions to determine the best body weight for height. According to BMI 17.61% of the total children were wasted and 19.34% of them were severely wasted (figure.1). Severe wasting was found to be more in case of boys (21.74%) in comparison to girls (16.96%). Moreover, wasting was found to be high in girls (20%) than boys (15.21%). The figures for wasting existed are better than those reported by Mendhi et.al. (Mendhi et al.,2006). Significant positive correlation ( $p \leq 0.01$ ) ( $r = 0.86$ ) was found between BMI for age and waist circumference of the children exists. Correlation between BMI for age and the waist for height also was found to be significant ( $p \leq 0.05$ ) ( $r = 0.79$ ) and positive.

Current guidelines recommend measurements of both BMI and waist circumference for assessing the risks associated with excess adiposity (Health Canada Publications Centre, 2003) (National Institutes of Health, 1998). Furthermore, waist circumference is a straightforward measurement requiring inexpensive simple equipment and the recording of a single value. The study revealed that 38.04% of urban primary students belong to (figure. 2) 5<sup>th</sup> percentile while 8.26% and 16.08% of them belong to 10<sup>th</sup> and 25<sup>th</sup> percentile which clearly indicates high prevalence of malnourishment among them. Data also showed in both lowest (5<sup>th</sup> percentile) & highest (95<sup>th</sup> percentile) grades of waist circumference grades, boys are more malnourished than girls and more studies are required to find underlying reasons.

Results of waist for height (figure.3) showed that more girls (57.83%) were at the lowest grade of waist for height than boys (50.87%) and same for the 50<sup>th</sup> percentile ie, 16.95% for girls and 13.04% for boys. These percentages were reversed in 85<sup>th</sup> and 95<sup>th</sup> percentile where boys (2.17% & 3.91%) were more overweight & obese than girls (0.43% & 2.17%).

From all the three methods for assessing the nutritional status it has appeared that under nutrition was highly prevalent among the primary school children under study while boys were more affected than girls. It is interesting

that while the prevalence of under nutrition was quite high among the study population, at the same time high percentage of them were found to have overweight according to waist circumference for age (10.65%), waist for height (12.39%) and BMI (21.73%). A study profile of the rates of overweight and obesity among urban children of various states of India (Subramanyam et al.,2003),(Sidhu et al.,2006) and an earlier study in Kolkata (Bose et al.,2007) showed that the prevalence of overweight among students was higher than those reported in those studies. This is a reason for concern as with advancement in age, many overweight of these children may become obese.

Prevalence of overweight among the children under study was quite high and the finding indicated the co-existence of under nutrition and over nutrition in the urban society. This may be due to one or more of the several causes such as socioeconomic status, lack of physical activity and ill balanced calorie dense diet.

## CONCLUSION

- This study among the school children reveals that the boys are more vulnerable to both under nutrition and over nutrition than girls.
- A significant linear correlation between body mass index with waist circumference and waist for height exists among them.
- The health risks associated with an excessive abdominal fat distribution in children in comparison to adults remain unclear at this stage; although there is mounting evidence to suggest that concern should be raised.

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**Conflict of Interest:** None declared.

## REFERENCES

- Bose K, Bisai S, Mukhopadhyay A et.al.** Overweight and obesity among affluent Bengalee schoolgirls of Lake Town, Kolkata, India, *Maternal and Child Nutrition*, (2007),3,pp. 141–145.
- Bisai S, Bose K, Ghosh A.** Prevalence of undernutrition of Lodha children aged 1-14 years of Paschim Medinipur district, West Bengal, India. *Iran J Pediatr* 2008; 18:323-329.
- Bray GA.** Health hazards of obesity. *Endocrinol Metab Clin North Am* 1996; 25: 907-19.
- Calle EE, Thun MJ, Petrelli JM, Rodriguez C.** Heath CW Jr. Body-mass index and mortality in a prospective cohort of U.S. adults. *N Engl J Med* 1999;341: 1097-105.
- Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S.** Obesity in Kolkata children: Magnitude in relationship to hypertension. *J Natural Sci Bio Med.* 2012;2:101-6.
- Chowdhury SD, Chakraborty T, Ghosh T.** Prevalence of undernutrition in Santal children of Puruliya district, West Bengal. *Indian Pediatr* 2008; 45:43-46.
- Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight And Obesity in Adults,** 1998. NIH Publication no. 98-4083. Bethesda, MD: National Institutes of Health.
- Health Canada Publications Centre.** Canadian Guidelines for Body Weight Classification in Adults, pp. 1–40. Ottawa, Canada, 2003.
- Han TS, McNeill G, Seidell JC, Lean ME.** Predicting intra-abdominal fatness from anthropometric measures: the influence of stature. *Int J Obes Relat Metab Disord* 1997; 21: 587-93.
- International Institute for Population Sciences (IIPS) and Macro International.** *National Family Health Survey (NFHS-3), India,* 2005-06: West Bengal. Mumbai: IIPS, 2008.
- Kissebah AH, Videlingum N, Murray R, et al.** Relation of body fat distribution to metabolic complications of obesity. *J Clin Endocrinol Metab* 1982;54: 254–60.
- Khadilkar VV, Khadilkar AV, Cole TJ, Chiplonkar SA, Pandit D.** Overweight and obesity prevalence and body mass index trends in Indian children. *Int J Pediatr Obes.* 2011;6:216-24.

- Kotian MS, S GK, Kotian SS.** Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. *Indian J Community Med.* 2010; 35:176-8.
- Kuriyan R, Thomas T, Lokesh D P, et al.** Waist Circumference and Waist for Height in Urban South Indian Children Aged 3-16 Years, *Indian pediatrics*;2011;48(10)756-771.
- Lean ME, Han TS, Morrison CE.** Waist circumference as a measure for indicating need for weight management. *BMJ* 1995; 311: 158-61.
- Manson JE, Stampfer MJ, Hennekens CH, Willett WC.** Body weight and longevity. A reassessment. *JAMA* 1987; 257: 353-8.
- Marwaha RK, Tandon N, Singh Y, Aggarwal R, Grewal K, Mani K.** A study of growth parameters and prevalence of overweight and obesity in school children from Delhi. *Indian Pediatr.* 2006; 43:943-52.
- Mittal PC, Srivastava S.** Diet, nutritional status and food related traditions of Oraon tribes of New Mal (West Bengal), India. *Rural Remote Health* 2006;6:385.
- Mendhi GK, Barua A, Mahanta J.** Growth and Nutritional Status of School age Children in Tea garden workers of Assam. *J human Ecol.* 2006; 19(2):83-85.
- Pouliot MC, Despres JP, Lemieux S, et al.** Waist circumference and abdominal sagittal diameter: best simple anthropometric indices of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. *Am J Cardiol* 1994; 73:460-8.
- Seidell JC, Verschuren WM, van Leer EM, Kromhout D.** Overweight, underweight, and mortality. A prospective study of 48,287 men and women. *Arch Intern Med* 1996; 156: 958-63.
- Singh PN, Lindsted KD, Fraser GE.** Body weight and mortality among adults who never smoked. *Am J Epidemiol* 1999; 150: 1152-64.
- Seidell JC, Kahn HS, Williamson DF, Lissner L, Valdez R.** Report from a centers for disease control and prevention workshop on use of adult anthropometry for public health and primary health care. *Am J Clin Nutr* 2001; 73: 123-6.
- Subramanyam MA, Kawachi I, Berkman LF, Subramanian SV et al.** (2010). Socioeconomic Inequalities in Childhood Under nutrition in India: Analyzing Trends between 1992 and 2005.
- Subramanyam V., Jayashree R. & Raft M.** Prevalence of overweight in affluent adolescent girls in Chennai in affluent adolescent girls in Chennai in 1981 and 1998. *Indian Pediatrics* (2003) 40 , 332-338.
- Sidhu S., Kaur N. & Kaur R.** Overweight and obesity in affluent school children of Punjab. *Annals of Human Biology* (2006) 33,255-259.
- UNICEF**, State of World's Children, 2004.
- Visscher TL, Seidell JC, Menotti A, Blackburn H, Nissinen A, Feskens EJ, et al.** Underweight and overweight in relation to mortality among men aged 40-59 and 50-69 years: the Seven Countries Study. *Am J Epidemiol* 2000; 151: 660-6.
- WHO.** Measuring change in Nutritional status: guidelines for assessing the nutritional Impact of supplementary feeding programs for vulnerable groups. WHO; Geneva. 1983,p -9.
- World Health Organization.** Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 2000. (WHO Technical Report Series, 894).
- WHO Multicentre Growth Reference Study Group.** Assessment of differences in linear Growth among populations in the WHO Multicentre Growth Reference Study, *Acta Paediatr Suppl.* 2006; 450:56-65.