

# Obesity in Kolkata children: Magnitude in relationship to hypertension

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## Abstract

**Background:** Limited data is available from India regarding the distribution and profile of childhood obesity and hypertension. **Materials and Methods:** A population based cross-sectional study was conducted in the urban schools of Kolkata. Using stratified random sampling method, 979 participants were selected. Body mass index (BMI) status and blood pressure (BP) were estimated using standard protocol and their various correlates regarding sociodemographic characteristics were looked into. **Results:** Majority (38.92%) of the study population were in the preadolescent group followed by adolescent group (33.40%). Male constituted 52.09%, overweight was more prevalent among preadolescent age group (22.57%). Overall 27 cases of prehypertension were found of which 19 (70.37%, n=27) were in the adolescent age group. There was no significant association between ages with increased BMI status. We detected total 15 cases (1.53%) of hypertension in our study population and three-fourths of them were from adolescent age group. However, significant association was seen between high BP with increasing age. Average fast food intakes and screen time was higher in obese as compared to their normal peers. Upper and upper-middle social status contributed to higher number of obese/overweight and hypertensive children and was the significant risk factor. **Conclusion:** Childhood obesity and hypertension were found to be common in the city of Kolkata which suggest the need for greater public awareness programs on these morbidities.

**Key words:** Hypertension, obesity, overweight

## INTRODUCTION

Childhood overweight and obesity are increasingly prevalent global problems and have received much attention in recent years. Obesity is evolving as a major nutritional problem in the developing countries, affecting a substantial number of adults and resulting in an increased burden of chronic disease. These are serious public health challenges of the 21<sup>st</sup> century as it appears to increase the risk of subsequent morbidity, whether or not obesity

persists into adulthood.<sup>[1,2]</sup> Outcomes related to childhood obesity include hypertension, type 2 diabetes mellitus, dyslipidemia, left ventricular hypertrophy, nonalcoholic steatohepatitis, obstructive sleep apnea, and orthopedic and psychosocial problems.<sup>[3-5]</sup> The knowledge that blood pressure during childhood is an established predictor of adult blood pressure, which in turn increases mortality from CVD, clearly underscores the importance of studying childhood blood pressure and the need for establishing preventive measures in early life.<sup>[6]</sup>

Studies on urban Indian schoolchildren from selected regions report a high prevalence of obese and overweight children.<sup>[7-11]</sup> In addition, studies on Indian schoolchildren have also demonstrated that the prevalence of hypertension in overweight children is significantly higher than that among normal children.<sup>[12-15]</sup>

Pediatric weight problems are increasing in frequency and

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they are sometimes undiagnosed. However, till date no nationally representative data have emerged from India to quantify these tendencies on a large scale and to look at the diagnosis rate over time. This makes it difficult to project the prevalence of obesity and overweight among children in India. The objective of this study was to determine the prevalence of childhood obesity and elevated BP in a representative sample of schoolchildren (5-18 years) from the city of Kolkata, West Bengal, India. The other objective was to determine socioeconomic correlates of obesity and high BP among schoolchildren along with the relationship of obesity with BP.

## MATERIALS AND METHODS

We conducted a population-based cross-sectional study during 1<sup>st</sup> July 2008 to 30<sup>th</sup> June 2009 in the four urban schools of Kolkata, West Bengal. We calculated sample on the basis of the prevalence of obesity in urban Indian school children as 29%.<sup>[16]</sup>

We calculated the sample size by using the formula of  $4pq/L^2$  where L is the allowable error. The sample size was calculated as 979, considering a relative error of 10%. The sample was selected by stratified random sampling from the four urban schools that were selected randomly from among the list of urban high schools in Kolkata. Apollo Gleneagles Hospital and Research Institute Kolkata ethics committee approved the project. The students present on the day of visit were included in the study. In the resource poor setting of our study, we had to choose four schools randomly from the list of schools of Kolkata collected from State Department of school education.

The main outcome measures were obesity and hypertension prevalent among the schoolchildren and their socioeconomic correlates. The data collection tool used for the study was an interview schedule that was developed at the Institute with the assistance from the faculty members and statistician. This predesigned and pretested questionnaire contained questions relating to the sociodemographic information, dietary habits, outdoor activities, leisure time along with record of height, weight and BP. By initial translation, back-translation, retranslation followed by pilot study the module was custom-made for the study. The pilot study was carried out at the out patients department of Apollo Gleneagles Hospital and Research Institute among comparable subjects following which some of the questions from the interview schedule were modified.

All concerned principals, teachers, and students were briefed about the study. The meetings were organized with the principals, teachers, and members of parents

associations. They were explained about the objectives of the study and were assured that the information collected from their schools would be kept confidential and would be used only for academic purpose. All the participants were explained about the purpose of the study along with the scope of future intervention, if necessary. They were ensured strict confidentiality, and then informed consent was taken from each of the participants before the total procedure. The participants were given the options not to participate in the study, if they wanted.

Data regarding family and personal information were recorded by personal interview by the principal investigator. It was followed by weight measurement and BP check-up as mentioned below in details. Children from the representative sample were called for screening according to their classes and were given rest for 5 min. The procedures were explained briefly and demonstrated to them. Three readings of the BP of each child were taken, maintaining an interval of 2 min between each reading. The mean of three readings was reported. The weight and height of each child were recorded. Height was measured by a WHO approved wall-mounted height measuring scale. A calibrated and standardized mechanical weighing scale was used to measure weight. Overweight and obesity were defined by body mass index (BMI) for gender and age. Gender, age and height were considered for determining hypertension. Children with a BMI >85<sup>th</sup> percentile of reference data were considered overweight and those with a BMI >95<sup>th</sup> percentile were considered obese.<sup>[3]</sup> The reference data used to identify the cut-off points were taken from the CDC 2000 dataset for BMI.<sup>[17]</sup> BP was measured using standard methodology as recommended by The Fourth Report on the diagnosis, evaluation, and treatment of high BP in children and adolescents. Average systolic or diastolic BP >95<sup>th</sup> percentile for gender, age, and height was considered as hypertension. Prehypertension was defined as average systolic BP or diastolic BP that was >90<sup>th</sup> percentile but <95<sup>th</sup> percentile. Children with BP levels >120 mmHg systolic and/or 80 mmHg diastolic were also considered prehypertensive.<sup>[18]</sup> Children were defined as overweight and obese if their BMI falls above 85<sup>th</sup> and 95<sup>th</sup> percentiles, respectively, of the reference curve for their age and gender.

*Hypertension in children and adolescents:* Hypertension is defined as average systolic and/or diastolic BP that is 95<sup>th</sup> percentile for gender, age, and height on three or more separate occasion. BP levels that are 90<sup>th</sup> percentile but <95<sup>th</sup> percentile is now termed “prehypertension.” Kuppaswamy’s socioeconomic status is an important tool in hospital and community-based research in India. It was proposed in 1976.<sup>[19]</sup> This scale takes account of education, occupation, and income of the family to classify study groups in to high, middle, and low socioeconomic status.

As pointed out rightly by Mishra and Singh<sup>[20]</sup> and later from Rewa *et al.*<sup>[21]</sup> we have used the latest revision based on price revision.

*Average calorie intake of the children population:* The usual calorie requirement were calculated on the basis of 1000 kcal plus 100 kcal per year of life.<sup>[22]</sup> Calorie intake in relation to within 10% of age specific requirements were taken as “High,” “Normal,” and “Low” intake of the children population under study. We used questionnaire method to assess individual average calorie intake by 24h recall method and translated using the guide for carrying out using Indian Council of Medical Research publication: “Nutritive value of Indian Foods.”<sup>[23]</sup>

*Average outdoor activity:* The average outdoor activity was calculated on the basis of energy spent excluding those related to the activities of daily living and routine outdoor activities related to the academics. We utilized the list provided in the “Energy expenditure on various physical activities” for our under perception regarding the issue.<sup>[24]</sup>

The principal investigator disseminated information on importance on BMI, hypertension in health education sessions among the students to complement the findings of the study.

*Statistical analysis:* The collected data were thoroughly screened and entered into Excel spreadsheets and analysis was carried out. The procedures involved were transcription, preliminary data inspection, content analysis, and interpretation. SPSS 11.0 was used to calculate proportions, and significance test was used in this study.

## RESULTS

Out of 979 subjects, majority were the preadolescent group 38.92%. Children (5-8 years) constituted 27.68%, while

**Table 1: Demographic profile of the study population**

Age (years)	Male (%)	Female (%)	Total (%)
Childhood (5-8)	159 (31.18)	112 (23.88)	271 (27.68)
Preadolescent (9-12)	192 (37.64)	189 (40.30)	381 (38.92)
Adolescent (13-18)	159 (31.18)	168 (35.82)	327 (33.40)
Total	510 (100)	469 (100)	979 (100)

**Table 2: Distribution of age with obesity and hypertension**

Age (years)	BMI status		BP		Total participants
	Overweight, n (%)	Obese, n (%)	Prehypertensive, n (%)	Hypertensive, n (%)	
Childhood (5-8)	39 (14.39)	14 (5.17)	5 (1.84)	00 (00)	271
Preadolescent (9-12)	86 (22.57)	00 (00)	3 (0.79)	3 (0.79)	381
Adolescent (13-18)	56 (17.12)	8 (2.45)	19 (5.81)	12 (3.67)	327
Total	181 (18.49)	22 (2.25)	27 (2.76)	15 (1.53)	979

Chi square 32.239, d.f. 2,  $P < 0.001$ .

and adolescents group were 33.40%. Male constituted 52.09%, while female counterpart was 47.91%. In both sexes, preadolescent were the majority [Table 1].

Overweight was observed most in the preadolescent age group (22.57%) followed by the adolescent (17.12%) and childhood (14.39%) age groups. Among preadolescents the 10-year age group had highest number of overweight (11.54 %). Two-third of the overweight was observed in the adolescent age in our series. Among all obese, majority were in childhood age group (5.17%). There was no significant association between age with increased BMI status (Chi square 1.28, d.f. 2,  $P = 0.5272$ ). Overall, 27 cases of prehypertension were found in our study subjects of which 19 (70.37%,  $n=27$ ) were in the adolescent age group. We detected total 15 cases (1.53%) of hypertension in our study population, nearly three-fourth of them (12) were from adolescent age group. High BP among schoolchildren was observed along with increasing age that was statistically significant [Table 2].

Risk factors and outcomes in relation to their BMI attributes were also calculated. The average fast food intake in terms of number of times per week among the obese children was  $5.43 \pm 0.34$  and in overweight was  $4.11 \pm 0.56$ . The average screen time of hours per week among obese and overweight children was also higher as compared to normal children. Moreover, the average outdoor activity was also less among obese and overweight subjects. The average systolic and diastolic BPs were more in obese and overweight children than normal ( $P < 0.0001$ ) [Table 3].

We compared the BMI status and hypertension in relation to Kuppaswamy's socioeconomic status scale. Children from the upper and upper-middle Kuppaswamy's socioeconomic status contributed significantly highest number of obese and overweight children in our series. In cases of obesity these two strata of social scales contributed 72.72% ( $n = 16$ ). In case of overweight upper and upper-middle strata of Kuppaswamy's scale contributed 91.16% ( $n = 165$ ). In both the cases, these figures were also significantly higher than other stratum as a risk factor of overweight and obesity (Chi square 100.43, d.f. 3,  $P < 0.0001$ ). Prehypertension and hypertension was

detected more in children of higher class accounting to 51.85% and 53.53%, respectively. Incidence goes down as the social status decreases. However, this difference was not statistically significant (Chi square 12.01, d.f. 3,  $P = 0.0073$ ) [Table 4].

## DISCUSSIONS

We conducted a cross sectional study to determine the magnitude of childhood obesity and overweight as well as hypertension in a representative population of schoolchildren from Kolkata. The relationship of obesity with childhood hypertension was also explored.

Childhood obesity showed a prevalence of 2.25 per 100 children. On the whole, prevalence of overweight and obesity was 20.74%. Childhood hypertension showed a prevalence of 1.53 per 100 children.

The study done in Ernakulum district, Kerala observed that the proportion of overweight children increased from 4.94% of the total students in 2003 to 6.57% in 2005. The increase was significant in both boys and girls. The proportion of overweight children was significantly higher in urban regions and in private schools, and the rising trend was limited to private schools.<sup>[25]</sup> The prevalence values of childhood obesity in this study were lower than those of other studies from similar settings.<sup>[7-11]</sup>

Childhood hypertension and prehypertension collectively was 4.29% that was observed higher in children with overweight and obesity. In addition, studies on Indian schoolchildren have also demonstrated that the prevalence of hypertension in overweight children is significantly higher than that among normal children.<sup>[12-15]</sup>

*Benson et al.*, undertook a study to assess trends in diagnosis

rates of overweight and obesity in children aged 2 through 18 years between June 1999 and October 2007 in a large academic medical system in northeast Ohio. On retrospective review of BMI measurements recorded for patients during the study period, 19% of the children were overweight, 23% were obese, and 8% (33% of the obese patients) were severely obese; among these, 10% of overweight patients, 54% of obese patients, and 76% of severely obese patients had their conditions diagnosed. *Benson et al.*, also found that 90% of overweight children, 46% of obese children and 24% of severely obese children remained undiagnosed. These data highlight the need to improve the diagnosis of weight problems in children and adolescents, especially overweight children, who could benefit most from potential interventions.<sup>[26]</sup>

*Reilly et al.*, examined risk factors for obesity at 7 years of age in a subsample of 909 UK children from the Avon longitudinal study of parents and children. A junk-food dietary pattern at 3 years of age was associated with obesity at 7 years of age in an unadjusted model. A junk food dietary pattern was characterized by increased levels of fizzy drinks, sweets, chocolates, chips, fried foods and other junk foods. There was no significant relationship with obesity for a healthy, traditional, or fussy dietary pattern. Height and weight were measured by the research team.<sup>[27]</sup>

*Thompson et al.*, found that the frequency of eating food purchased from quick-service outlets was positively associated with a change in BMI z-score, after adjusting for baseline BMI z-score. For those who ate quick-service food more than twice a week, the mean change in BMI z-score was 0.82 compared with 0.28 for those who never ate quick-service food. However, there was no relationship found for eating in coffee shops or restaurants.<sup>[28]</sup>

In a systematic review of the epidemiological evidence

**Table 3: Distribution of BMI attributes in relation to various correlates**

BMI attributes	Average fast food intake (no. of times per week)	Average screen time (hours per week)	Average outdoor activity (hours per week)	Average BP	
				Systolic	Diastolic
Obese (n = 22)	5.43 ± 0.34	14.86 ± 4.42	4.12 ± 0.92	121.86 ± 0.89	82.62 ± 0.24
Overweight (n=181)	4.11 ± 0.56	13.99 ± 3.33	5.88 ± 0.59	111.41 ± 0.64	67.67 ± 0.34
Normal (n = 776)	2.29 ± 0.69	11.09 ± 4.49	8.17 ± 1.11	106.06 ± 0.98	63.19 ± 0.56

BMI - Body mass index

**Table 4: Distribution of Socioeconomic status in relation to obesity and hypertension**

SES (Kuppuswamy scale)	BMI status		BP		Total participants
	Obesity n (%)	Overweight n (%)	Prehypertensive n (%)	Hypertensive n (%)	
Upper	10 (45.45)	92 (50.83)	14 (51.85)	8 (53.33)	299
Upper middle	6 (27.27)	73 (40.33)	7 (25.93)	4 (26.67)	277
Lower middle	4 (18.18)	11 (6.08)	5 (18.52)	2 (13.33)	226
Lower	2 (9.10)	5 (2.76)	1 (3.70)	1 (6.67)	177
Total	22	181	27	15	979

to find the association between diet and physical activity and subsequent excess weight gain and obesity assessed at 5 years of age or older was published in 2009. A number of behavioral risk factors have been postulated, including TV viewing, diets with high energy density and fast foods. Prospective studies with an accurate measure of diet and physical activity exposures, as well as outcomes in terms of body fatness, are deemed to provide the more robust evidence on which to base interventions to achieve long-term behavioral change and prevent excess weight gain. Relevant exposures include patterns of diet, breastfeeding, food and drink, food preparation, dietary constituents, physical activity and inactivity, energy intake, energy density of diet, and energy expenditure. There was no consistency in terms of “healthy diets” compared with “unhealthy diets,” being associated with lower levels of subsequent weight gain.

Epidemiological evidence showed that physical activity, in general, is not associated with subsequent excess weight gain and obesity. Most of the studies reporting total physical activity had either no effect or a small negative association with subsequent excess weight gain.<sup>[29]</sup>

Marshall *et al.*'s systematic review of a total of 39 studies indicated that 49% of the variance in body fatness may be explained by factors other than TV viewing. Therefore, the authors conclude that this very small effect is unlikely to be of substantial clinical importance.<sup>[30]</sup>

Dietz and Gortmaker examined data from 2153 children included in two different cycles of the US National Health Examination survey, from cycle II (1963-1965) and from cycle III (1967-1970). The children were aged 6-11 years in cycle II and 12-17 years in cycle III. The study reports both prospective and cross-sectional associations. A significant positive association was observed between time spent watching TV (reported by their parents) and subsequent obesity (Reg. coeff. 0.029,  $P_0 = 0.001$ ) and super obesity (Reg. coeff. 0.14,  $P_0 = 0.001$ ). Obesity was defined as triceps skinfold X85th percentile and superobesity X95th percentile.<sup>[31]</sup>

Berkey *et al.*, examined the associations between recreational inactivity (defined as watching TV/videos or time spent playing computer games or video games) and 1-year change in BMI in a US cohort of 6149 girls and 4620 boys, who were 9-14 years old at baseline. More time with TV/video games was associated with larger 1-year increases in BMI in girls and in boys.<sup>[32]</sup>

Horn *et al.* examined the 2-year predictors of subscapular skinfold thickness in a cohort of 198 Mohawk children in Canada. In girls, but not in boys, TV viewing was

a significant 2-year predictor of subscapular skinfold thickness. Video gameplaying habits were not a significant predictor of skinfold thickness in boys or in girls. Models were adjusted for physical activity, physical fitness, age, gender, community, and baseline subscapular skinfold thickness. TV viewing was self-reported using a questionnaire.<sup>[33]</sup>

Robinson and Hammer examined relationships between hours of after-school television viewing and adiposity among 971 female adolescents. Self-reported hours of after-school television viewing at baseline were not significantly associated with change in BMI over 2 years.<sup>[34]</sup>

The strength of the study was that no study on this topic has been undertaken so far in this region though South Asian countries which is home to approximately one quarter of the world's population, are major contributors to the global burden of CVD at present, and this contribution is projected to grow, given their consistent population growth rates.<sup>[35]</sup> Moreover, our study generated awareness about dangers of obesity and hypertension among children, guardians and teachers. We strictly followed the current recommendation for children in detecting elevated BP that can only be confirmed after a minimum of three separate BP measurements. Thus “white coat hypertension” was ruled out in our study.<sup>[17]</sup>

Our study had several limitations. Application of international reference standards of BMI and hypertension in an Indian setting may have limitations. In the present study, we measured incident hypertension.

In conclusion, the crisis of both childhood obesity and elevated BP is global and is steadily affecting many low and middle-income countries, particularly in urban settings. The prevalence has increased at an alarming rate globally. In our study, elevated BP was seen in high percentages in children with overweight and obesity when compared with children who were neither overweight nor obese. Unless effective interventions and preventive strategies are instituted at the local and national level, these observations suggest that the trend of increasing cardiovascular disease in adults observed in recent decades will accelerate even further. These trends are disturbing and call for concerted efforts targeted at improving lifestyles of children and adolescents.

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