

PREVALENCE OF OBESITY IN SCHOOL GOING CHILDREN BETWEEN
11 TO 16 YRS OF AGE AND COMPARISON OF BLOOD PRESSURE
IN OBESE AND NON OBESE CHILDREN

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ABSTRACT:

AIMS: Prevalence of obesity in school going children between 11-16 years of age and comparison of BP in obese and non obese children. **METHODS:** Prospective cross sectional school based study was undertaken in four schools of Bangalore city involving 1000 children in the age group of 11-16 years belonging to all socio economic classes. Using BMI as the criteria and based on NCHS guidelines, children were classified as non obese, overweight and obese and prevalence of overweight and obesity was calculated. Blood Pressure in obese and non obese children was compared. All anthropometric and BP measurements were made by a single observer. **RESULTS:** The prevalence of obesity and hypertension was 7.3% and 5.2% respectively. 28.8% of obese children were hypertensive, which is strikingly high when compared to 1.9% in non obese children. **CONCLUSION:** High BMI is a strong predictor of hypertension.

KEYWORDS:

BMI, Hypertension, Obesity, Prehypertension.

INTRODUCTION

Think “malnutrition” and the image that comes to mind is a child who is undernourished. However, malnutrition includes under nutrition as well as overweight and obesity. Historically, a heavy child meant a healthy child, and the concept “bigger is better” was widely accepted. Today as the standards of living continue to rise, overweight and obesity are posing a threat to the world health. The World Health Organization (WHO) describes overweight and obesity as one of today’s most important public health problems, which is escalating as a global epidemic. It is also increasingly recognized as a significant problem in developing countries and countries undergoing economic transition.¹ The 1999-2002 National Health and Nutritional Examination Survey from USA (NHANES), indicates that an estimated 16% of children and adolescents aged 6- 19 years are overweight. This is a 45% increase from the overweight estimates of 11% obtained from NHANES 3 (1988-1994).² Results from the 2007-2008 NHANES, indicate that an estimated 16.9% of children and adolescents aged 12-19 years are obese. In the age group of 12- 19 years the prevalence is approximately 18%.³ The International Obesity Task Force (IOTF) published

a report in May 2004 which showed that 155 million children (1 in 10) are overweight and around 30 -45 million are obese.⁴

The epidemic of obesity has not spared the developing nations either. As compiled by WHO, prevalence of childhood obesity is over 2% in many developing countries. Studies from metropolitan cities in India have reported a high prevalence of obesity among affluent school children.⁵ Several factors like overeating, psychological factors, sedentary lifestyle and genetic predisposition trigger this energy imbalance. Social, educational, economic, cultural, psychological and personal factors alongwith availability of food play a key role in “food behavior”. Childhood obesity is a single marker of the child at risk for development of various **non- communicable diseases** later in life. These problems will be worse if obesity begins in childhood.⁶

Studies on Indian school children have also demonstrated that the prevalence of hypertension in overweight children is significantly higher than that among normal children.^{7, 8} WHO has also emphasized the urgent need of understanding the prevalence trend and influencing factors of childhood obesity. Studies

showing the prevalence of obesity and hypertension in obese children are very scanty from this part of South India. Results of such studies are helpful in the development of interventional strategies to halt the emerging epidemic of childhood obesity and its comorbid conditions including hypertension. This background has initiated us to undertake the present study entitled “**Study of prevalence of obesity in school children between 11- 16 years age and comparison of blood pressure in obese and non obese children.**”

MATERIALS AND METHODS

This study was a prospective cross-sectional school-based study carried out in Bangalore city for the duration of one year. Apparently, healthy school going children between 11 -16 years of age were included in our study. Children diagnosed to be obese due to endogenous causes on clinical examination and children who did not get the consent from their parents were excluded.

Data regarding the list of schools in Bangalore city was collected from Deputy Director of Public Instructions

Office. Out of these, 4 schools were selected based on **simple random sampling method** (Lottery method). Permission of the school Principals was taken before conducting the study. Children between the ages 11-16 years (6th – 10th standard) were enrolled in the study. Classes were selected randomly from each of the four schools and all the children present in the selected classes were asked to take part in the study. Informed and written consent to the study was taken from the parents. Their exact ages were as ascertained from the school register. Both upper and lower socio economic populations are included. In each selected class, the height and weight of all the children enrolled in the study was measured. **Weight** was measured using a Bathroom Scale without any footwear with minimal clothing calibrated to 0.5kg accuracy. Scales was zeroed before each session. The **height** was measured in centimeters without any footwear using a WHO approved wall mounted height measuring scale with an accuracy of 0.1cm by making the child to stand upright, barefoot on the ground with heels, buttocks and shoulders touching the wall and head in **Frankfurt plane**. BMI was calculated by using the formula:

Weight in kilograms

Height in meter ²

Children were categorized based on BMI as per NCHS guidelines with respect to their age and sex.⁹ CDC charts for BMI were used to plot the data.

Category	BMI
Normal	5 th – 84 th percentile
Overweight	85 th – 94 th percentile
Obese	>= 95 th percentile

Blood pressure measurement:

Blood pressure was measured using diamond **mercury sphygmomanometer** and standard methodology as per Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and adolescents and the BP charts provided by this report were used to determine the cut off values.¹⁰ Height for age standards was determined using the CDC 2000 growth charts.¹¹

Before blood pressure measurement, students were familiarized to the instrument and the nature of the procedure was explained. Blood pressure was determined by auscultation in right arm after a minimum

rest of 30 minutes. For each student, the blood pressure was measured thrice in the same visit with a minimum of two minutes rest between each determination. Average of the three readings was taken as the mean blood pressure of the child.

Position: Sitting posture with hands resting on examination table with cubital fossa at the level of the heart. Stethoscope was placed over the brachial artery pulse proximal and medial to cubital fossa and below bottom edge of cuff.

Cuff size: Cuffs having bladder width approximately 40% of arm circumference and the bladder length covering 80–100% of circumference of the arm were used. Cuff was placed midway between olecranon and acromion process.¹⁰

Systolic blood pressure was determined by the onset of the tapping of **Korotkoff-1** sound and the **diastolic** at its disappearance **Korotkoff-5** sound. The children were considered **hypertensive** if the systolic or diastolic blood pressure or both were equal to or more than the 95th percentile for height for age and sex. **Prehypertension** was defined as systolic or diastolic blood pressure or

both between 90th and 95th percentile for height for age and sex, or if the systolic blood pressure was more than or equal to 120 mm of Hg or the diastolic blood pressure was more than or equal to 80 mm of Hg.¹⁰ Students found to have hyper-tension or prehypertension on first visit were contacted to undergo a second set of blood pressure measurements at least **four weeks later**. Three further sets of reading were taken on second contact. The pre stated norms were then used to conclude the presence or absence of hypertension or prehypertension. All anthropometric and blood pressure measurements were made by a **single observer**. **Blood pressure** was also compared **between the non-obese group and the obese group**.

STATISTICAL ANALYSIS

- Descriptive and inferential statistical analysis has been carried out in the present study.
- Results on continuous measurements are presented on Mean \pm SD (Min-Max) and results on categorical measurements are presented in Number (%).

- **Significance is assessed at 5 % level of significance.**
- Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients.
- Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups..

Odds Ratio=OR=ad/bc

OR<1: Negatively related

OR=1 Not related

OR>1 positively related

Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 ,Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

Table 1: Age and gender distribution of children studied

Age in years	Male	Female	Total
11 years	57(10.4%)	57(12.7%)	114(11.4%)
12 years	96(17.5%)	76(16.9%)	172(17.2%)
13 years	122(22.2%)	102(22.7%)	224(22.4%)
14 years	118(21.5%)	98(21.8%)	216(21.6%)
15 years	83(15.1%)	63(14%)	146(14.6%)
16 years	74(13.5%)	54(12%)	128(12.8%)
Total	550(100%)	450(100%)	1000(100%)

$$\chi^2=1.846; P=0.870$$

Table 2: Distribution of over-weight and obesity in the study population with mean BMI

BMI	Number of children	%	Mean BMI
Non obese	790	79.0	16.73±2.22
Over-weight	137	13.7	23.43±1.18
Obese	73	7.3	27.31±1.33
Total	1000	100.0	18.42±3.96

P<0.001**

Table 3: Association of age with obesity

Age in years	Total number of children	Distribution		
		Non obese	Overweight	Obese
11 years	114	103(90.4%)	9(7.9%)	2(1.8%)
12 years	172	150(87.2%)	16(9.3%)	6(3.5%)
13 years	224	178(79.5%)	29(12.9%)	17(7.6%)
14 years	216	169(78.2%)	29(13.4%)	18(8.3%)
15 years	146	107(73.3%)	24(16.4%)	15(10.3%)
16 years	128	83(64.8%)	30(23.4%)	15(11.7%)
Total	1000	790(79%)	137(13.7%)	73(7.3%)

Age is significantly associated with incidence of obesity with $\chi^2=35.954$; P<0.001**

Table 4: Association of gender with obesity

Gender	Total number of children	Distribution		
		Non obese	Overweight	Obese
Male	550	435(79.1%)	75(13.6%)	40(7.3%)
Female	450	355(78.9%)	62(13.8%)	33(7.3%)
Total	1000	790(79%)	137(13.7%)	73(7.3%)

$$\chi^2=0.006; P=0.997$$

Table 5: Blood pressure trend in the study population

Hypertension	Non obese	Over weight	Obese	Total
Normal	713(90.3%)	97(70.8%)	34(46.6%)	844(84.4%)
Pre-hypertension	62(7.8%)	24(17.5%)	18(24.7%)	104(10.4%)
Hypertension	15(1.9%)	16(11.7%)	21(28.8%)	52(5.2%)
Total	790(100%)	137(100%)	73(100%)	1000(100%)

$$\chi^2=150.00; P<0.001^{**}$$

Table 6 Age wise distribution of blood pressure pattern in obese & overweight Children

Age in years	Total number of children	Blood pressure		
		Normal	Pre-hypertension	Hypertension
11 years	11	8(72.7%)	1(9.1%)	2(18.2%)
12 years	22	17(77.3%)	2(9.1%)	3(13.6%)
13 years	46	31(67.4%)	8(17.4%)	7(15.2%)
14 years	47	33(70.2%)	6(12.8%)	8(17%)
15 years	39	19(48.7%)	13(33.3%)	7(17.9%)
16 years	45	23(51.1%)	12(26.7%)	10(22.2%)
Total	210	131(62.4%)	42(20%)	37(17.6%)

$$\chi^2=12.422; P<0.001^{**}$$

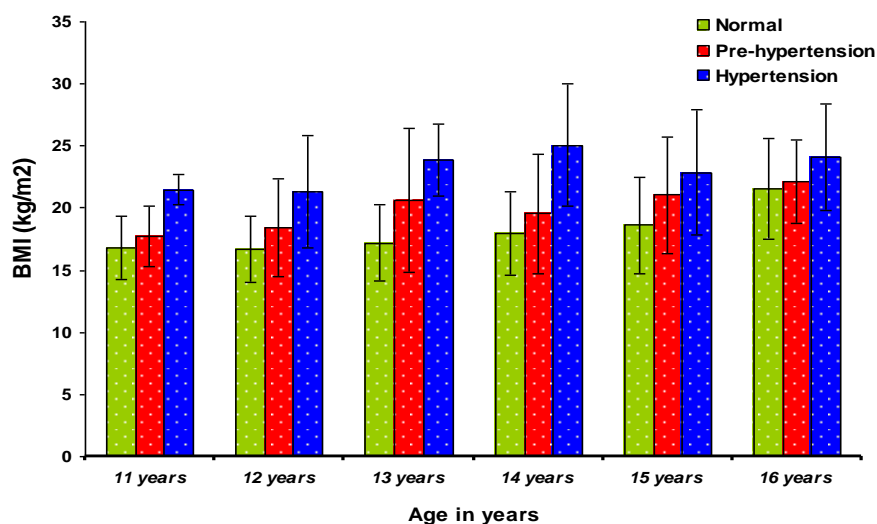
Table 7: Gender wise distribution of blood pressure in overweight & obese children

Hypertension	Male	Female	Total
Normal	72(62.6%)	59(62.1%)	131(62.4%)
Pre-hypertension	23(20%)	19(20%)	42(20%)
Hypertension	20(17.4%)	17(17.9%)	37(17.6%)
Total	115(100%)	95(100%)	210(100%)

$$\chi^2=0.010; P=0.995$$

Table 8: Mean BMI according to Age wise distribution of blood pressure.

Age in years	Total number of children	Mean \pm SD BMI (kg/m ²)		
		Normal	Pre-hypertension	Hypertension
11 years	114	16.83 \pm 2.54	17.77 \pm 2.42	21.48 \pm 1.19
12 years	172	16.68 \pm 2.67	18.41 \pm 3.91	21.33 \pm 4.5
13 years	224	17.18 \pm 3.07	20.65 \pm 5.82	23.86 \pm 2.87
14 years	216	17.92 \pm 3.36	19.54 \pm 4.79	25.09 \pm 4.97
15 years	146	18.61 \pm 3.85	21.04 \pm 4.68	22.86 \pm 5.04
16 years	128	21.58 \pm 4.03	22.17 \pm 3.37	24.12 \pm 4.28
Total	1000	17.82 \pm 3.50	20.70 \pm 4.53	23.58 \pm 4.36
	P value	<0.001**	0.138	0.628



DISCUSSION

This study was undertaken in four schools of Bangalore city in the age group of 11- 16 years belonging to all socio economic classes. Using BMI as the criteria and

based on NCHS guidelines, children were classified as non obese, overweight and obese and prevalence of overweight and obesity was calculated. Blood pressure in obese and non obese children was compared. Among

the 1000 children studied, 55% were boys and 45% were girls.

Prevalence of overweight and obesity:

The prevalence of overweight in our study was 13.7% and that of obesity is 7.3%. A study was done by **Ramachandran et al.** on urban Indian adolescent school children (13-18 years) in 2002. The prevalence of overweight was 17.8% for boys and 15.8% for girls. The prevalence of obesity was 3.6% for boys and 2.9% for girls.¹²

A study of 10-16 years old affluent school children in **Delhi** in 2002 showed that prevalence of obesity was 7.4% and overweight was 24.7%.⁵

Khadilkaret al in **2009** reported in their multicentric study that, the 97th percentile for weight had increased in adolescents of both the sexes when compared to 1989. This proved that obesity in India was increasing at an alarming rate.¹³

A study was conducted by **Garvita Jain et al** among school going children of 13 to 17 years in Chhattisgarh. They found that the magnitude of overweight (23.8%) and obesity (8.4%) is very high and alarming for both the sexes.¹⁴

The widely differing prevalence of overweight and obesity was due to the definitions used, age group and sex taken for the study, uniformity of selection of the sample, area selected, and the methodology used for the survey. Hence an exact comparison drawing a conclusion seems inappropriate. However they give a reasonable idea regarding the prevalence of childhood obesity in different parts of the country.

Prevalence of overweight and obesity in relation to age:

The prevalence of overweight and **obesity** was **highest** in the age group of **15-16 years** in our study (**p<0.05**). This was probably because of increase in adiposity during puberty and also the change in eating habits and decrease in physical activity. This observation is **similar** in a study done in south Karnataka by **Kotian et al** on children between 12-15 years of age.¹⁵

Prevalence of obesity in relation to gender:

In this study the prevalence of overweight and obesity in boys was 13.6% and 7.3% respectively. Similarly in the girls it was 13.8% and 7.3 % respectively.

There is **no difference** in the prevalence of obesity in boys and girls (**p > 0.05**).

COMPARISON OF BP IN OBESE vs NON OBESE CHILDREN:

Study done by	Age group	Hypertension in Overweight/obese children	Hypertension in non obese children
Mohan B et al 2004, Ludhiana ⁷	11-17 years	15.33% - in OW children 43.1% - in OB children	4.52%
Boyd G.S et al 2004, Philadelphia ¹⁶	2- 18 years	Prehypertension – 6.8% Hypertension – 27.9% Total- 34.7%	-
Rao et al 2007, Pune ¹⁷	9-16 years	Systolic BP was higher by 12mmHg and diastolic BP was higher by 8 mmHg	
Sharma et al 2010, Shimla ¹⁸	11-17 years	46% including both Prehypertension and hypertension	17%
Present Study	11-16 years	Prehypertension -17.5% in OW & 24.7% in OB Hypertension – 11.7% in OW & 28.8% in OB	Prehypertension- 7.8% Hypertension- 1.9%

The prevalence of **hypertension increases as the BMI increases** which has been observed in all the above studies mentioned in the table.

In our study, the prevalence of **hypertension** was **28.8%** in **obese** children compared to **1.9%** in **non obese** children which was statistically very significant (**p<0.001**). Table No 5

In our study, among the overweight and obese children, **high BP** was significantly more in the age group of 15-16 years depicted in Table No 6. This has also been observed in a study done in Kolkata by **Partha Chakroborty et al** in 2009⁸

There was no significant difference in the prevalence of hypertension in obese children of both the sexes in the present study.

LIMITATIONS OF THE STUDY

- Application of international reference standard of BMI and hypertension in an Indian setting may have limitations.
- We looked only at hypertension as a comorbid condition with obesity though there are many more. These areas are open for further research

STRENGTHS OF OUR STUDY

- There are very few studies from this region though South Asian countries contribute largely to the global burden of cardiovascular diseases.
- Our study generated awareness about dangers of obesity and hypertension among children, parents and teachers.
- We strictly followed the current recommendations for children in detecting elevated BP that can only be confirmed after a minimum of three separate BP measurements thus reducing the chances of white coat hypertension.

CONCLUSIONS

- The **prevalence** of obesity was **7.3%** in school going children of 11-16 years age in the year 2010 in Bangalore.
- The prevalence of obesity showed an increasing trend with age, with highest prevalence in 15-16 years age group with no significant gender differences.
- The prevalence of prehypertension was 10.4% and that of hypertension was 5.2%. Children of 15 -16 years of age were the most affected.
- **28.8% of obese** children were **hypertensive**, which was strikingly high when compared to **1.9 % in non-obese** children, thus reinforcing the fact that high BMI is a strong predictor of hypertension.
- Obese children are at a higher risk of developing “**childhood onset of adult diseases**”. Thus timely intervention will reduce morbidity and mortality in adulthood.

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