Correlation of Body Mass Index and Waist Circumference with Blood Pressure in School Age Children

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Research Article

Abstract: **Introduction:** In increasing number of countries over-weight and obesity represent a hovering menace and a rapidly growing threat to health of population. Childhood obesity plays a central role in insulin resistance and metabolic syndrome which includes hyperinsulinemia, hyperlipidemia type 2 diabetes mellitus and increased risk of atherosclerotic cardiovascular diseases. **Materials and methods:** Analytical cross sectional study done to compare Body Mass Index ,Waist circumference and Blood pressure in school age children (10 -14yrs) of two schools belonging to Karad city. 470 children from English medium school(affluent group) and 481 children from Nagar Parishad school (non affluent group). **Conclusion**: The increase in the prevalence of high body mass index and waist circumference in students showed a significant association with their habits and with high earning parents, preference and frequent eating of non vegetarian food, frequent intake of fast food, eating outside food (hoteling), television viewing, and preference to indoor games than outdoor games.

Keywords: Body mass index, Waist circumference, Blood pressure, Obesity.

Introduction

In increasing number of countries over-weight and obesity represent a hovering menace and a rapidly growing threat to health of population. They are now replacing traditional problems (such as under nutrition and infectious diseases) as the most significant causes of ill health. In a developing country like India, notable contrast is, poverty leading to malnutrition, coexisting with increasing incidence of obesity which has almost tripled over a decade[1]. ICMR and WHO have predicted that cardiovascular diseases would be the most important cause of mortality and morbidity in India by the year 2015 AD[2]. Blood pressure is influenced by various non-modifiable factors such as age, gender, height, weight, genetic factors, and non-modifiable factors such as family environment, eating behaviour, sedentary lifestyle (watching TV, playing video games, computers).[2] In obese children with high BMI the blood pressure tends to be high and would probably continue in the same track even as adults[3]. For this reason, the objectives of our study were to assess blood pressure, body mass index and waist circumference; to correlate BMI, Waist circumference with blood pressure (systolic and diastolic) and to study associated factors (obesity, diet, sedentary life style) in children.

Material and Method

This is a analytical cross sectional study done to compare Body Mass Index ,Waist circumference and Blood pressure in school age children (10 -14yrs) of two schools belonging to Karad city. In this Cross sectional study, results are calculated in frequencies, percentages, mean and standard deviation. The Sampling population includes, students from two schools of Karad city.1) English medium school (affluent group) where annual fees exceeds ₹ 10000/- 2) Nagar Parishad government schools (non affluent group) in Karad Town where Primary and secondary education is free. There were total 951 students in our study, 470 children in affluent group and 481 children in non affluent group. Children between 10- 14yrs of age of two schools of both sexes were included and those children who are receiving diuretics, antihypertensive drugs, acute illness, drugs like steroids, prolonged bed rest due to any reason, endocrinal abnormality were excluded from study. **Weight (WT)** was measured in the upright position to the nearest 0.1 kg using electronic balance machine with minimum clothes and bare feet measured thrice and average taken. **Height (HT)** was measured to the nearest 0.1 cm using calibrated fixed stadiometer. The child stood in a straight upright position keeping the heels, buttocks and back in contact to a vertical flat surface. The head was so positioned that the child looked directly forward in the Frankfurt plane and the bi-auricular plane being horizontal, taken thrice and average taken. **Waist circumference (WC)** was measured in triplicate, midway between lowest rib and superior border of iliac crest, with a flexible, non-stretchable tape at the end of normal expiration to the

nearest 0.1 cm. The average of the 3 waist circumference measurements were used in all analysis. **Body Mass Index (BMI)**Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, Each Child was classified on basis of age and gender specific BMI percentile as underweight (<5th percentile), healthy weight BMI≥ 5th percentile < 85th percentile). Over weight (BMI≥85th and < 95th percentile) and obese (BMI≥ 95th percentile) for that age and gender. **Bloodpressure (BP)** was measured in sitting position, by using a mercury sphygmomanometer. The students were made to rest and relax before measuring their BP for 10 minutes. Blood Pressure was taken in sitting position by using mercury sphygmomanometer kept at the level of chest. The cuff was applied evenly and snugly on the right upper arm with the lower edge at 2.5cm above the antecubital fossa and the cuff covering two third of arm. (as per WHO guidelines). The cuff was inflated rapidly and deflated slowly. The point of onset of the first tapping sound was taken to indicate systolic blood pressure (SBP) and the diastolic blood pressure (DBP) reading was taken when the sound disappeared. For each subject, two recordings were taken at an interval of 30 minutes and the average of two readings was taken and it was considered to be the final reading. High blood pressure in children was defined as systolic or diastolic blood pressure of≥ 95th percentile of age and gender. All those with raised blood pressure were re-evaluated again, after 15 days and detailed history and physical examination were carried out again. All measurements were taken three times and average was taken as final measurement.

Observations and Results

Total 951 students were included in our study, 470 children in affluent group and 481 children in non affluent group.

Table 1: Shows weight, height, body mass index and stystolic blood pressure of each age group in affluent school and in non affluent school.

Age group	Weight (kg)	Height (cm)	BMI	SBP (mm of Hg)	Weight (kg)	Height (cm)	BMI	SBP (mm of Hg)
	Affluent group				Non affluent group			
10th Year	25±4.64	131.94±5.81	14.27±2.16	112±5	37.2±10.6	142±10	18±3.8	117±7
11th Year	27.3±6.6	134.9±7.5	14.8±2.6	112±6	37.9±9.5	143.1±8.3	18±3	115±7
12th Year	34.6±8.8	142.5±9.1	16.8±2.8	114±9	41.4±11.5	147.2±10.5	18±3	117±8
13th Year	36±8.8	145.9±10.7	16.7±3.0	114±7	47.7±11.7	155.1±9.4	19±4	121±8
14th Year	35.9±9.9	148.1±11.5	16.0±2.7	115±6	50.3±12.4	159±7.3	19±4	122±8

In the present study, there was a significant positive correlation between systolic blood pressure and body mass index (r=0.450, p= 0.0001), systolic blood pressure and waist circumference (r = 0.449,p=0.001) in the affluent school. There was also a positive correlation between systolic blood pressure and body mass index(r=0.377,p=0.001) and systolic pressure and waist circumference (r=0.254, p=0.001) in the non-affluent school.

Table 2: Shows Family income of students in study.

Family income (Rs)/Month	Normal BMI (%)	Overweight (%)	Obesity (%)	Total	Normal BMI (%)	Overweight (%)	Obesity (%)	Total
Group	**Affluent group**				**Non affluent group**			
≤25000	97(97)	3(3)	0	**100**	-	-	-	**-**
25001-50000	175(92.59)	11(5.82)	3(1.58)	**189**	-	-	-	**-**
>50000	124(68.5)	33(18.23)	24(13.25)	**181**	**-**	**-**	**-**	**-**
≤5000	-	-	-		254(97.69)	6(2.3)	0	**260**
≤5000	-	-	-		216(97.73)	3(1.35)	2	**221**
Total	**396**	**47**	**27**	**470**	**470**	**9**	**2**	**481**

There was a significantly (p<0.0001) increased prevalence of overweight and obesity among students having family income >25000Rs/month in the affluent School. There was no significant (p=0.2311) increase in prevalence of overweight and obesity among students having a family income >5000Rs/month in the non affluent School.

Table 3: Dietary pattern of the students studied.

Dietary pattern	Normal BMI (%)	Overweight (%)	Obesity (%)	Total	Normal BMI (%)	Overweight (%)	Obesity (%)	Total (%)
Group	**Affluent group**				**Non affluent group**			
Only Veg	98(90.74)	8(7.4)	2(1.85)	**108**	68(98.55)	1(1.44)	0	**69**
Mixed≤1/week	232(94.3)	11(4.47)	3(1.21)	**246**	309(98.27)	4(1.27)	0	**313**
Mixed>1/week	66(56.84)	28(24.13)	22(18.96)	**116**	93(93.93)	4(4.04)	2(2.02)	**99**
Total	**396**	**47**	**27**	**470**	**470**	**9**	**2**	**481**

There was a significant (p<0.0001) increase in the prevalence of overweight and obesity in students who had a mixed dietary pattern from the affluent School. There was a significant (p =0.0261) increase in the prevalence of overweight and obesity in students who had a mixed dietary pattern from the non affluent School.

Table 4: Shows frequency of the hotel visits per week by students in the study.

Frequency/ week	Normal BMI (%)	Overweight (%)	Obesity (%)	Total	Normal BMI (%)	Overweight (%)	Obesity (%)	Total
Group	**Affluent group**				**Non affluent group**			
0	37(92.5)	2(5)	1(2.5)	**40**	468(97.90)	9(1.88)	1(0.20)	**478**
1	285(92.53)	16(5.19)	7(2.27)	**308**	1(100)	0	0	**1**
>1	74(60.65)	29(23.77)	19(15.57)	**122**	1(50)	0	1(50)	**2**
Total	**396**	**47**	**27**	**470**	**470**	**9**	**2**	**481**

There was a significant (p<0.0001) increase in the prevalence of overweight and obesity in those children who were eating outside food > once in week from affluent School. There was a significant (p<0.0001) increase in the prevalence of overweight and obesity in those children who were eating outside food more than once a week from the non affluent School. However there was a significant (p<0.001) increase in the tendency of frequent hotel visits among the children from the affluent School than the non affluent School.

Table 5: Shows Indoor games played in hours per day by students in study

Hours/Day	Normal BMI (%)	Overweight (%)	Obesity (%)	Total	Normal BMI (%)	Overweight (%)	Obesity (%)	Total
Group	**Affluent group**				**Non affluent group**			
0	317(87.32)	31(8.53)	15(4.13)	363	465(97.68)	9(1.89)	2(0.42)	476
0-2	78(73.58)	15(14.15)	12(11.32)	105	5(100)	0(0)	0(0)	5
>2	1(50)	1(50)	0	2	0(0)	0(0)	0(0)	0
Total	**396**	**47**	**27**	**470**	**470**	**9**	**2**	**481**

There was a significant (p=0.0038) increase in the prevalence of overweight and obesity in those children who were playing indoor games every day from the affluent School. There was no significant (p=0.9426) effect of playing indoor games on overweight and obesity on students from the non affluent School. However there was a significant (p<0.001) increase in the tendency of playing indoor games among children from the affluent School than the non affluent School.

Table 6: Outdoor games playing in hours per day by students in study.

Hours/Day	Normal BMI(%)	Overweight (%)	Obesity (%)	Total	Normal BMI (%)	Overweight (%)	Obesity (%)	Total
Group	**Affluent group**				**Non affluent group**			
0	30(56.6)	11(20.75)	12(22.64)	**53**	50(94.43)	2(3.77)	1(1.88)	**53**
0-2	299(85.67)	35(10.02)	15(4.29)	**349**	158(97.5)	3(1.85)	1(0.61)	**162**
>2	67(98.52)	1(1.47)	0	**68**	262(98.49)	4(1.5)	0	**266**
Total	**396**	**47**	**27**	**470**	**470**	**9**	**2**	**481**

There was a significant (P<0.0001) increase in the prevalence of overweight and obesity in those children who were not playing outdoor games per day from the affluent School. There was no significant (P<0.2561) effect of playing outdoor games on the prevalence of overweight and obesity in children from the non affluent School.

Discussion

There is an increase in the prevalence of hypertension worldwide during last 10-20 years. It is considered a global epidemic. People because of necessity migrate increasingly. This has resulted intermingling of dietary habits and introduction of new food items at an increase rate and volume.[4] Asians are more vulnerable to adverse effects of overweight and obesity because they have 3-5% higher body fat, which is more centrally distributed for the same BMI. Coronary heart disease and type 2 diabetes are the major complications of overweight and obesity[4.] Many household appliances are available for the convenience of life. Physical exertion has diminished at work place, as well as in schools, while food consumption as well as unhealthy food habits have increased resulting in increased energy balance leading to overweight and obesity and elevated blood pressure. All celebrations and festivals seem centered around the fat rich fast food. Children are forced to use their playtime in tuition classes right from the nursery to the college level due to intense competition. TV, Cable TV viewing, videogames, computer and mobile usages do not require much calorie expenditure. Unavailability of playground in school is another contributory factor for increase in overweight, obesity and elevated blood pressure[5]. Total 951 students from two schools were studied. One from private English Medium School and another from Nagar Parishad school. In

observations, 96 out of 951 (10.01%) were having high Body Mass Index, and 106 out of 951 (11.14%) were having increased Waist Circumference, and 18 out of 951 (1.89%) had increased blood pressure. These observations were comparable to the result by N.K. Anand *et al*[6]. The findings of present study revealed that the rise in BP was directly proportional to the increase in age in both the sexes with a spurt of about 5mm Hg in SBP at the age of 12 yr in the both sexes. Each age year group BP was significantly differently from the other ($p<0.001$).Similar observations have been made by other workers[7,8,9], who found a spurt in SBP between 13 to 15 yr age group. In this study the correlation of body mass index and waist circumference with blood pressure was significantly high in children of parents with a presumed high income from the affluent School while the family income of students from non affluent School was low .This results indicate that elevated blood pressure is a problem mainly of the higher socioeconomic strata. Majority of children (774 from both schools) in the study had mixed diet. The prevalence of hypertension in overweight and obese children was statistically higher in the children eating mixed i.e. non veg food once or more in a week from both the schools. These results were comparable to results reported by Bisavmohan *et al*[10], Aggarwal T.*et al*[11] and Kuriyan R. *et al*[12], who also showed non vegetarian food consumption was associated with increased hypertesion, overweight and obesity in children. The students who ate outside food (i.e. Hoteling) more than once in a week showed a statistically significant higher prevalence of overweight and obesity as compared to the students who didn't eat outside food (i.e. Hoteling) from the affluent school where as there were very less number of students from the non affluent School who used to eat outside food (i.e. Hoteling). These findings were similar to findings reported by Goyal R.*et al*[13], who also showed increased prevalence of overweight and obesity in children who ate outside food on weekend. This study has also observed the prevalence of overweight obesity and high blood pressure in affluent School children playing indoor games significantly higher as compared to students who didn't play indoor games. This study has also demonstrated a statistically significant decreased prevalence of overweight and obesity in children playing outdoor games as compared to students who didn't play outdoor games. Bharti etal[14] reported higher prevalence of overweight and obesity in children who play less than 30 minutes outdoor games. From both the affluent School and the non affluent School, there were significant numbers of students who had self impression of average built but they were actually overweight and obese. These observations probably suggest that a significant number of children with increased BMI and increased waist circumference were not aware that they were at risk and that they had better take precaution to decrease BMI and Waist circumference by changing their lifestyles and food habits.

Summary and Conclusion

The increase in the prevalence of high body mass index and waist circumference in these students showed a significant association with their habits and with high earning parents, preference and frequent eating of non vegetarian food, frequent intake of fast food, eating outside food (hoteling), television viewing, preference to indoor games than outdoor games.

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