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Prevalence of Obesity among Children (10-12 Years) of Different Schools of Dehradun City (India)

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Abstract: Obesity is one of the most common metabolic and nutritional diseases. The effect of obesity of children has a wide spectrum of adverse effects that can rage from low self-esteem to increased risk of many degenerative diseases. So, present study was conducted in different schools of Dehradun city to find out prevalence of obesity among children (10-12 years) in different schools and its variability according to economical status, eating practices and physical activities. The study was conducted to assess the prevalence of obesity among children (10-12 years of age) from 8 different schools, having students coming from low as well as high economic status families. Selection of schools was done on the basis of their fee structure. The general information about age, sex, parent's occupation and number of family members with anthropometric measurements like height, weight, waist circumference, hip circumference, MUAC taken and compared with NCHS-3 standards. Calculation of BMI and WHR was also done. Nutrients intake was noted by 24 h dietary recall method. The physical activity pattern was also noted. It was found that there were more percentage of obese and overweight children in affluent class as their energy, protein, carbohydrate and calcium intake was higher. Also, they are less engaged in energy consuming activities. Increasing affluence, over-consumption of calories and reduced physical activity are noted which result in childhood obesity.

Key words: Body Mass Index (BMI), Waist Hip Ratio (WHR), Mid Upper Arm Circumference (MUAC), Type 2 Diabetes Mellitus (T2DM), physical activity, India

INTRODUCTION

Urbanization and modernization have inevitably altered dietary habits and lifestyle practices in India contributing to the emergence of escalating obesity trends in general and amongst children in particular. Even in situation in which a genetic disposition to obesity exists, interactions between genetic and environmental factors play a part in development of obesity (Gopalan, 1998).

Obesity is generally defined as an excess concentration of body fat or adipose tissue. Excess deposition of fat in the body which is usually referred to as overweight or obesity (Ketel *et al*., 2007).

Nearly 22 million children under the age of five are estimated to be overweight worldwide. The calculated global prevalence of overweight (including obesity) in children aged 5-17 years is 10% and the prevalence varies from over 30% in America to <2% in sub-Saharan Africa. The prevalence of overweight/obesity in urban children in Delhi has shown an increase from 16% in 2002 to about 24% in 2006. According to the recent data, the prevalence among adolescent children (14-17 years) was 29% in private schools and 11.3% in government funded schools in 2006-2007 (Bhardwaj *et al*., 2008).

The increase in weight among children and teenagers has caused an elevation in the prevalence of chronic disease like type-2 diabetes, coronary heart disease, insulin resistance, impaired glucose tolerance, respiratory problem, menstrual irregularity, arthritis and hypertension. Other complications include asthma and obstructive sleep apnea among children (Zafar *et al*., 2007). About one-third of overweight or obese urban Asian Indian children have insulin resistance (Misra *et al*., 2004). Interestingly, higher level of hyperinsulinemia and related metabolic derangements has been recorded in Asian Indian neonates and children as compared to white Caucasian neonates (Yajnik *et al*., 2002). Similar comparative data are available for young children indicating early occurrence of insulin resistance in Asian Indians (Misra *et al*., 2007a). Obesity, especially abdominal obesity, is among the strongest risk factors for T2DM. In children, T2DM has been increasingly reported globally. T2DM was reported exclusively in overweight or obese Asian children with ancestral origin in Pakistan, India or Middle-Eastern countries in UK (Ehtisham *et al*., 2000). Generalized obesity and abdominal obesity were significantly higher in children and adolescents with T2DM in North India (Vikram *et al*., 2006). Important independent risk factors for development of T2DM in

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Asian Indian adolescents and young adults were hypertriglyceridemia, high waist to hip ratio and family history of diabetes (Vikram *et al*., 2003). High levels of C-Reactive Protein (CRP) levels denote future risk for development of T2DM and CHD. In Asian Indian adolescents, high CRP levels were seen in 13% subjects overall, in ~22% of overweight and in ~25% in those with excess body fat (Vikram *et al*., 2006). CRP levels show an association with waist-hip ratio and Waist Circumference (WC) in Asian Indian children (Vikram *et al*., 2003). Interestingly, excess dietary intake of saturated fat was a strong correlate of high CRP levels in Asian Indian adolescents (Arya *et al*., 2006).

Overweight and obesity were more prevalent among through with higher level of education and people with high income (Al-Mahroos and Al-Roomi, 2001). The objectives of this study were:

- To assess the nutritional status of subjects and prevalence of obesity by anthropometric measurements (height, weight, BMI, WHR, MUAC)
- To study the dietary habits of children of 10-12 years of age in different schools
- To study the physical activity pattern of 10-12 years old children
- Investigation of the effect of lifestyles including dietary practices and physical activity pattern on prevalence and nature of obesity

MATERIALS AND METHODS

Firstly, list of all the schools were made under two heads, i.e., schools with low fee structure ($\leq$Rs. 100 month^{-1}) and school with high fee structure (Rs. 1000-2000 month^{-1}) in the city Dehradun.

Four schools were selected from low fee structure and four from high fee structure schools. A total of 1736 students, aged 10-12 years of 6th standard were selected randomly from both types of schools in which 896 (boys 504; girls 392) belongs to low fee structure and 840 (boys 460; girls 380) belongs to high fee structure school.

Personal information like age, sex, socio-economic status was gathered. Physical activity, dietary intake and anthropometric measurement were measured. Anthropometric measurements like height, weight, MUAC were taken by standard techniques and compared with NCHS-3. Body weight was measured to the nearest 0.1 kg using well calibrated weighing balance. Height was measured to the nearest 1 mm. For WHR, waist circumference (at a distance around the smallest area below the ribcage and above the umbilicus) and hip circumference (at the maximum circumference of the buttocks) were measured and then their ratio was calculated. The standard WHR of 0.8 in girls and 0.95 in boys have been used in this study (Misra *et al*., 2007b):

$$\text{WHR} = \frac{\text{Waist circumference}(\text{cm})}{\text{Hip circumference}(\text{cm})}$$

Mid-upper arm circumference of the subjects (at half way between the acromion process of the scapula and tip of elbow) was measured by using flexible fibre glass tape. BMI was calculated by dividing body mass (kg) by body weight (m^2). BMI was categorized according to the standard given by Cole *et al*. (2000):

$$\text{BMI} = \frac{\text{Weight}(\text{kg})}{\text{Height}(\text{m}^2)}$$

Dietary pattern was assessed by 24 h recall method in which subjects recalls food intake for the preceding 24 h by interview or by completing questionnaire. In the study dietary recall of 3 consecutive days was done. The food taken by the subjects was converted to energy, protein, carbohydrate, fat, calcium and iron content were calculated with the help of nutritive value of Indian foods prescribed by Gopalan *et al*. (1989) and then the values were compared with the recommended daily allowances given by Indian Council of Medical Research. Physical activity pattern was assessed by a well designed questionnaire on mainly two types of activities-energy consuming activities (cycling, basketball, cricket and all outdoor plays) and non energy consuming activities (watching TV, playing computer games and all indoor plays). Statistically, analysis of data was done with arithmetic mean percentage.

RESULTS

Anthropometric measurements: Analysis of the anthropometric (height, weight, BMI, WHR, MUAC) measurement of the subjects are shown in Table 1.

Height: It was clear that most of the students have standard height in both types of schools but in schools with high fee structure there was high percentage of students, i.e., 67.82% for boys and 50.52% for girls with standard height in comparison to low fee structure school which have 52.38% of boys and 50% of girls with appropriate height. Only few students with height above the standard in both types of schools and schools with high fee structure had high percentage of students with height above the standard but in both types of schools it was seen that percentage of girls were higher than boys,

Table 1: Anthropometric analysis of the subjects

	Low (%)		High (%)	
Analysis	Boys (504)	Girls (392)	Boys (460)	Girls (380)
Height				
<Standard	36.50	34.69	16.52	31.57
= Standard	52.38	50.00	67.82	50.52
>Standard	11.11	15.30	15.65	18.94
Weight				
<Standard	37.71	30.61	15.65	10.52
= Standard	57.14	58.16	56.52	63.15
>Standard	8.73	11.22	28.69	27.36
BMI				
Normal				
<Normal	90.4	87.70	69.20	67.10
Overweight	3.90	4.10	14.80	17.60
Obese	5.70	8.20	16.20	15.30
WHR				
<Standard	34.92	26.53	10.43	11.57
= Standard	56.34	60.20	67.82	68.42
>Standard	8.73	13.26	21.75	20.00
MUAC				
<Standard	29.50	28.90	8.90	9.90
= Standard	59.60	65.80	68.90	71.30
>Standard	10.90	5.30	22.20	18.80

i.e., in low fee structure school 11.11% boys and 15.30% girls with height above the standard and in high fee structure school 15.65% of boys and 18.94% of girls fall in this category. It may be because of growth spurt during adolescent which is earlier in girls.

Weight: Weight (Table 1) of most the students were normal as it was for height. In low fee structure school 57.14% boys and 58.16% girls and in high fee structure school 56.52 % boys and 63.15% girls had normal weight but it was found that in comparison to boys number of girls were more with normal weight in both types of school. In high fee structure school 28.69% boys and 27.36% girls were having weight above the standard while less percentage of students under low fee structure schools were having weight above the standard, i.e., 8.73% boys and 11.22% girls.

BMI: Higher percentage of students had normal BMI. About 90.4% of boys and 87.7% of girls had BMI normal or below normal, who belongs to school with low fee structure while 69.2% boys and 67.1% girls had normal BMI from schools with high fee structure. Percentages of obese were higher than overweight in both types of schools for both girls and boys.

It was clear from above mentined results that weight and height of students below the standard was more in both types of school but they are having normal BMI.

WHR: Most of the students had normal WHR, i.e., 56.34% boys, 60.20% girls had normal WHR who belongs to school with low fee structure and 67.82% boys and 68.42% girls belongs to schools with high fee structure. In both the schools number of girls were higher in comparison to boys for having normal WHR. In low fee structure school, it was seen that more students had WHR below normal in comparison to WHR above normal in both girls and boys, while in high fee structure schools it was found that less number of students had WHR below normal in comparison to WHR above normal in both girls and boys. It was found that 21.75% boys and 20% girls in high fee structure had WHR above normal and in low fee structure school 8.73% boys and 13.26% girls had WHR above normal.

MUAC: MUAC was same as in WHR, i.e., most students had normal MUAC in both types of schools and in both types of schools number of girls were higher in comparison to boys having standard MUAC and secondly as in WHR most students belongs to low fee structure school had more number of students having MUAC below standard (29.5% boys and 28.9% girls) in comparison to MUAC above standard (10.9% boys and 5.3% girls) and vice-versa in school with high fee structure.

Dietary intake: Nutrient intake (energy, protein, carbohydrate, fat, calcium, iron) was also compared.

Energy: It was found that in school with low fee structure most of the students had energy intake either equal to RDA or less than RDA, i.e., 49.2% boys, 51.0% girls had energy intake less than RDA and 43.6%, 40.8% girls had energy intake equal to RDA and only 7.1% boys and 8.1% girls were taking energy more than RDA while most of students with high fee structure had energy intake equal to RDA and other either taking less or more energy, i.e., 47.8% boys, 45.2% girls were taking energy equal to RDA and 21.7% boys, 21.2% girls were taking energy less than RDA.

Protein: It is clear from results that students belonging to schools with low fee structure were taking a protein deficient diet as 60.3% boys and 63.2% girls were consuming protein less than normal requirement and only 3.9% boys and 7.1% girls were taking more protein than RDA while 53.9% boys and 45.6% girls belonging to high economic status were taking protein as per recommendation.

Carbohydrate: About 50% of boys and 40.8% girls taking recommended amount of carbohydrate while 46.0% boys and 55.1% girls are taking carbohydrate less than RDA, among students studying in schools with low fee

Table 2: Nutrient analysis of the subjects

	Low (%)		High (%)	
Analysis	Boys (504)	Girls (392)	Boys (460)	Girls (380)
Energy				
<RDA	49.2	51.0	21.7	21.20
= RDA	43.6	40.8	47.8	45.20
>RDA	7.1	8.1	29.5	33.60
Protein				
<	60.3	63.2	35.6	32.20
=	35.7	29.5	53.9	45.60
>	3.9	7.1	10.4	22.80
Carbohydrate				
<	46.0	55.1	26.0	26.30
=	50.0	40.8	52.1	51.50
>	3.9	4.0	21.7	21.00
Fat				
<	28.5	26.5	7.8	13.60
=	53.9	64.2	55.6	54.70
>	10.3	9.1	35.6	40.00
Calcium				
<	25.3	28.5	13.9	16.80
=	52.3	58.1	41.7	40.00
>	22.2	13.2	44.3	32.60
Iron				
<	87.3	82.6	80.8	72.63
=	12.6	17.3	19.1	23.15
>	-	-	-	4.21

structure and only 3.9% boys and 4.0% girls taking carbohydrate more than RDA. On the other hand, 52.1% boys and 51.5% girls were taking recommended carbohydrate and 26.0% boys and 26.3% girls taking carbohydrate less than RDA while 21.7% boys and 21.0% girls having more carbohydrates than RDA and carbohydrate intake was more in high fee structure school.

Fat: In low income group 53.9% boys and 64.2% girls were taking recommended fat and 28.5% boys and 26.5% girls taking fat less than RDA while in high economic status 35.6% boys and 40% girls were taking fat more than RDA thus prevalence of obesity and fat related disease was more in this class and 55.6% boys and 54.7% girls taking fat equal to RDA.

Calcium: About 52.3% boys and 58.1% girls taking recommended calcium and 25.3% boys and 28.5% girls taking less calcium than RDA. Only 22.2% boys and 13.2% girls taking calcium more than RDA in school with low fee structure. On the other hand, 41.7% boys and 40% girls taking calcium more than RDA and only 13.9% boys and 16.8% girls taking calcium less than RDA.

Iron: In school with low fee structure most of students, i.e., 87.3% boys and 82.6% girls taking less than iron than RDA and only 12.6% boys and 17.3% girls taking iron equal to RDA. Same trend is also in school with high fee structure. Around 80.8% boys and 23.15% girls taking iron less than RDA and 19.1% boys and 23.15% girls taking iron equal to RDA. Only 4.21% girls taking iron more than RDA while no boys falls in this category (Table 2).

Table 3: Physical activity pattern of subjects

	Low-economic status		High-economic status	
Type of activity	Boys (%)	Girls (%)	Boys (%)	Girls(%)
Energy consuming	90.6	85.2	75.8	66.5
Non-energy consuming	9.4	14.8	24.2	33.5

Physical activity: Students belong to low economic status were found (Table 3) to be involved in energy consuming activities more as compared to high economic status. It was found that in low economic status schools, 9.4% boys and 14.8% girls were not involved in any energy consuming activities but in high economic status school, their percentage was found as high as 24.2% in boys and 33.5% in girls resulting in prone to obesity among them.

DISCUSSION

An important finding of this study is an over burgeoning prevalence of overweight among the high fee structure school children when compared to previous surveys in India (Sharma *et al*., 2007; Subramanyam *et al*., 2003; Tharkar and Viswanathan, 2009). Subramanyam *et al*. (2003) showed the prevalence of overweight and obesity among affluent girls aged 10-15 years in Chennai was 9.6 and 6.2%, respectively in 1998. This study has shown higher figures which is suggestive of the obesity epidemic in 21st century. Female gender had higher preponderance to overweight and was more prominent in schools with high fee structure. However, puberty and growth spurt which occur at an earlier age for girls may account to confounding effect. It has been reported that the number of adipose tissue cells increase during these periods followed by slow down after puberty (Hirsch, 1975). But, the reports from other studies show that the prevalence are marginally lesser during post pubertal period (Laxmaiah *et al*., 2007). Results from studies done in India and other parts of the globe also showed that female genders are at risk of being overweight and obese (Hanley *et al*., 2000; Mohammadpour-Ahranjani *et al*., 2004; Sidhu *et al*., 2006). Another finding of this study indicates obesity was more in high fee structure school according to weight as compared to low economic status but this difference was low when their BMI was compared. It means a level of stunting was also prevalent in low economic fee structure schools which indicate chronic energy deficiency. Prevalence of overweight and

obesity was significantly higher among the schools with high fee structure. Hence, researchers infer that overweight and obesity is more in schools with high fee structure. These results show consistency with results from other Indian studies (Marwaha *et al*., 2006; Tharkar and Viswanathan, 2009).

Nutrient intake (energy, protein, fat, carbohydrate and calcium) was found to be high in children of affluent families. Despite taking rich diet, students of both types of school were found to be taking low protein, calcium and iron. So, need to be emphasis on the diet which can sufficiently provide these nutrients and improve their health status and this finding is supported by another study conducted by Tharkar and Viswanathan (2009) found that the children from private schools consumed more of fast food items and carbonated drinks as all these food items were easily available in their school canteen and thus take in adequate diet. Swinburn *et al.* (2004) stated that risk factors for obesity were considered to be a high intake of energy-dense, micronutrient-poor foods (convincing); heavy marketing of energy-dense foods and fast food outlets (probable); sugar-sweetened soft drinks and fruit juices (probable).

In high fee structure school, 28.8% students were not involved in physical activities that burn energy but among children of lower economic status, only 12.1% were not involved in energy consuming activities. While in another study done by Tharkar and Viswanathan showed widespread prevalence of unhealthy lifestyle habits in school children from lower and upper socioeconomic status. Percentage of children scoring minimum of 0 and maximum of 8 among the lower socioeconomic status were 5.2 and 2.4%, respectively while it was 0.5 and 7.6% for upper socioeconomic status children. Swinburn *et al.* (2004) stated that risk factors for obesity were considered to be sedentary lifestyles (convincing). In one study, it was also found in their research that physical activity and parental obesity on the other hand had more significant roles in the obesity of the subjects. Most obese children had reduced physical activity, including sports participation as compared to those who are not obese (Savva *et al*., 2002).

Though the children were well informed about the good effects of physical activity and nutritious diet, researchers found that they were not following the same. It was found that there was more percentage of obese and overweight students in affluent class as their nutrient intake was higher. Also, they are less engaged in energy consuming activities. Thus, it can be said that with increasing affluence, over-consumption of calories and reduced physical activity are noted which result in childhood obesity. The recent trend is that the school children concentrate more on academics and are involved in less of sports and activities. Leisure hours are spent in watching TV or playing computer/video games, thus explaining the sedentary lifestyle of today's school children. These findings were consistent with other studies (Hanley *et al*., 2000; Merchant *et al*., 2007; Francisco *et al*., 2007; Patrick *et al*., 2004). The three factors-socioeconomic status, fast food/unbalanced diet and less physical activity showed significant association with overweight and obesity in this study.

CONCLUSION

To summarize, the results suggest that childhood obesity is on the rise especially among children studying in high fee structure. Moreover, the persistence of unhealthy practices among the children must be given attention. The health impact of increasing prevalence of overweight and obesity among children and adolescents is a matter of serious concern. This study has thus highlighted the need to not only improve the awareness on prevention of childhood obesity among children but a need to motivate and reinforce them to practice healthy lifestyle is utmost essential and a need for planning school based intervention programs for preventing childhood obesity and increasing the level of awareness on the ill effects of obesity, among parents, teachers and children in order to control the escalating prevalence. Certain guidelines and policies like school canteen policy, healthy food practices, inclusion of health related topics in curriculum and compulsory physical training classes must be introduced in the schools. There must be a multi sector approach from the government, school authorities and parents to introduce policies and guidelines to curb on the obesity menace and to help today's children to live a long healthy life tomorrow.

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