International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Lifestyle Health Risks Among Affluent School Children of Delhi

Dr. Suman Dua[1], Satwanti Kapoor[2]

[1]Department of Anthropolgy, University of Delhi, Delhi-110007, India

[2]Professor, Department of Anthropolgy, University of Delhi, Delhi-110007, India

Abstract: ***Changes in lifestyle and dietary pattern of people in developing nations make them susceptible to obesity associated with greater morbidity. The prevalence of obesity has increased in both developed and developing countries. A cross sectional study was conducted in private school in Delhi India. A total of 414 school children in the age group 7-9 years were studied Weight and height of each student was measured using standard measures and Body mass index (BMI) and waist to Hip ratio (WHR) were calculated. Factors like family history of obesity, physical activity, duration of sleep etc were taken into consideration. Overweight and overall obesity was seen in 38.49% boys and 34.8% girls. Children who were overweight ad obese showed higher mean values for all the measurements, adiposity indices as well as systolic and diastolic blood pressure (SBP, DBP).***

Keywords: Obesity, SBP, DBP, BMI, WHR

1. Introduction

Fast-paced life and obesity are known to cause lifestyle diseases among adults, but a recent study revealed the prevalence of high blood pressure among school going children in India. The study also revealed that 17% of girls and 22% of boys identified with hypertension were obese. (51).

The epidemic of childhood obesity is a substantial health burden worldwide (1, 2) and its impact is being observed in developing countries as well (41, 3, 16).

The problem is of larger magnitude in developing countries like India where a significant proportion of the population belongs to younger age group (Adlakha 1996). Rising prevalence of obesity in India may be attributed to various factors, like sedentary life style, unhealthy food habits, cultural practices and increasing affluence in middle class population (4). Obesity, along with under nutrition and infectious disease has become a significant contributor to ill health of people in developing countries. Obesity is a key determinant and an important risk factor for other non-communicable diseases such as non insulin dependent diabetes mellitus, cardiovascular disease including hypertension and certain cancers. Much of the increase in BMI in school aged children between 1970 and 1990 occurred in children between the 50^{th} to 100^{th} percentiles (49). The increase in severity of obesity results into an increase in outcomes such as type 2 diabetes mellitus and hypertension. Among middle school children (10-14 years), Leupker et al found a concordant increase in BMI and systolic blood pressure (48). Obesity, its attendant health consequences and the consequent health burden is expected to reach epidemic proportions in developing countries like India. The developing world now confirms the dual challenge of competing chronic under nutrition characterized by short stature and over nutrition reflected by a high weight for height, in the same persons. Childhood obesity may result from a number of underlying causes associated with life style pattern (47). The emerging evidence suggests an increase in over nutrition status among children as well as adults (41, 42). The National Family Health Survey, (NF HS-3), 2005-2006 data showed that combined prevalence of obesity (Body Mass Index ≥ 25 kg/m^2) was 9.3% and 12.6% among men and women aged 15-49 years respectively. (43).

The prevalence of overweight in the range of 22.25% and obesity prevalence of 2-6% in children and young adolescents of Delhi have been reported (6,10). Studies on Indian school children have also demonstrated that the prevalence of hypentension in overweight children is significantly higher than that among normal children. Changes in the dietary pattern and life style of people in developing nations make them more susceptible to obesity with predispostion of abdominal obesity, associated with greater morbidity. (7) Considering the threats of obesity and overweight in this era, the present study was undertaken to assess the nutritional status of children (7 to 9 years) based on BMI, as well as to see whether any differences were present in different categories of children, in the anthrpometric measurements and physiological measurements as well as life style patterns (sleep and physical activity).

2. Materials and Methods

Study was carried out in West Delhi Area; Criteria for selection of locale were homogeneity of sample- The study envisaged to assess the prevalence of overweight among affluent school age children (7 to 9 years). As public school mostly caters to upper strata of society, the children were expected to be from similar socio-economic background b) easy accessibility c) full cooperation from school authorities. The age groups were made as (1) 7 yrs, 11 months (2) 8 years 11 months (3) 9 years 11 months. Ages were cross checked from date of birth. Ethical approval for the study was taken from the ethical committee of the Department of Anthropology, University of Delhi, Delhi.

Only children without history of any active disease or without any significant past medical history as were

included in the study. The variables considered for present study were age, sex, height, weight, income, familial tendency for obesity, life style factors like duration of sleeping hours, physical activity etc. Height and weight were recorded using standard techniques (15). Blood pressure was measured using ausculcatory method (44). A proforma comprising questions relating to socioeconomic information and physical activity pattern of the subjects was used to collect data. The lifestyle pattern of the subjects was assessed through details obtained from filled in performa.

Sedentary activities included activities like watching T.V., Playing video, sitting or reading or doing home work and energy expensive activities were, cricket, skipping, football, walking cycling, racing. Nutritional status of subjects was assessed by anthropometric assessment. BMI was calculated using weight (kg) / height (m^2). Subjects were classified as obese if BMI was $\geq 95^{th}$ percentile and at risk of obesity (overweight) as $\geq 85^{th}$ but $< 95^{th}$ percentile for age and sex (21). The data were analyzed using SPSS Version 17.0.

3. Results

Data on 414 children aged 7 to 9 years were collected (Boys = 239, Girls=175). Age wise distribution of the subjects is shown in Table 1. All the measurements were found to increase from 7 to 9 years. (Table 2). Both systolic and diastolic blood pressure increased from 7 to 9 years. Systolic blood pressure was higher among Boys of 7 and 8 years whereas in the nine year age group girls showed higher mean values for systolic blood pressure than boys. WHR, showed higher mean values among overweight and obese children (boys & girls) as compared to normal children

Table 1: Distribution of subjects according to age and sex

Age (yrs)	*Boys*	*Girls*	*Total*
7	26	25	51
8	34	37	71
9	179	113	292
Total	239	175	414

Table 2: represents the difference in the mean values of different variables among children 7 to 9 years.

Measurement	*Groups*	*7 years Mean ± SD*	*Value of 't'*	*8 years Mean ± SD*	*Value of 't'*	*9 years Mean ± SD*	*Value of 't'*
Weight	1 2	19.4 ±0.80 20.98±2.15	0.37	21.06±2.85 22.19±3.18	0.32	27.53±6.24 30.14±9.24	29.03 ***
Height	1 2	115.56±1.69 116.18±1.57	0.20	120.29±2.10 120.63±1.13	0.03	130.84±5.40 130.40±5.97	0.28
BMI	1 2	14.52±0.54 15.32±1.62	0.47	14.55±1.87 15.29±1.98	0.04	16.14±2.79 17.59±4.19	42.88 ***
WHR	1 2	0.87±1.03 0.88±0.03	0.32	0.84±0.04 0.88±0.03	0.16	0.83±0.10 0.87±0.06	0.04
SBP	1 2	101.19±0.01 97.88±8.43	0.90	98.44±7.8 58.24±7.7	0.01	102.2±10.20 106.50±11.11	1.42
DBP	1 2	63.31±0.12 61.96±8.33	0.73	58.68±5.9 60.76±15.1	6.44 **	64.75±9.1 68.27±10.06	1.53

** , P < 0.01, *** , P < 0.001, 1 = Boys, 2 = Girls

Percentage of obese Children among boys was 14.6% whereas among girls was 18.8%. When overweight and obese children were considered together as 38.49%. Boys were found to be overweight / obese whereas 34.8% girls were found to be overweight / obese. More girls were found to be overweight and obese. Age and gender wise distribution of boys and girls ranging in age from 7 tp 9 years is shown for different categories of BMI (Table 3).

Table 3: Represents the difference in various measurements among the different categories of BMI based on IOTF criteria (7 years age group).

Measurement	*Groups*	*Boys Mean ± SD*	*F Value*	*Girls Mean ± SD*	*F Value*
Weight	1 2 3 4	15.00±0.00 18.96±0.96 22.17±0.58 25.00	*** 31.66 (0.00)	19.00±0.79 23.00±1.25 25.50±0.70 20.98±2.14	*** 55.78 (0.00)
Height	1 2 3 4	112.30±0.60 115.77±2.27 116.07±0.87 113.00±0.00	1.31 (0.29)	116.12±1.61 116.70±1.25 115.40±2.26 116.18±1.55	0.52 (0.60)
WHR	1 2 3 4	0.86±0.00 0.83±0.17 0.84±0.03 0.84±0.00	0.007 (0.99)	--- 0.87±0.02 0.89±0.04 0.86±0.03	*** 68.44 (0.00)
SBP	1 2 3 4	88.00±0.00 100.19±9.9 108.00±8.18 115.00±0.00	1.83 (0.170)	96.18±7.4 107.20±5.02 89.00±1.41	1.03 (0.38)
DBP	1 2 3 4	55.00±0.00 62.57±8.21 69.67±5.03 68.00±0.00	1.17 (0.34)	61.00±7.9 69.20±5.35 52.00±2.80	** 4.45 (0.02)

**, P < 0.01, *** , P < 0.001, 1 = Underweight, 2 = Normal 3 = Overweight, 4 = Obese

The difference among various measurements, weight, height, body mass index waist to hip ratio, systolic blood pressure and diastolic blood pressure for the age groups seven to nine years is shown in (Table 4). Among the seven year old children the girls were found to have higher mean values for weight, height body mass index, waist- Hip ratio, than boys but the 't' values were found to be non-significant.

Table 4: Represents the difference in the various measurements among the different categories of BMI based on IOTF criteria. (8 years age group)

Measurement	*Groups*	*Boys Mean ± SD*	*F Value*	*Girls Mean ± SD*	*F Value*
Weight	1 2 3 4	17.25 ± 0.35 19.86 ± 0.84 24.66 ± 0.41 28.50 ± 0.70	140.98 (0.00) ***	- 20.25 ± 1.8 24.22 ± 0.23 28.75 ± 1.77	32.77 0.00 ***
Height	1 2 3 4	119.30 ±0.98 120.11±1.03 121.23±0.85 120.65±1.63	2.619 (0.06)	- 120±1.12 121.43±0.67 121.10±1.27	3.27 * (0.00)
WHR	1 2 3 4	0.79±0.04 0.85±0.04 0.85±0.04 0.85±0.06	2.42 (0.086)	- 0.88±0.33 0.87±0.09 0.93±0.06	26.79 (0.00) ***
SBP	1 2 3 4	90.00±0.00 98.21±7.9 99.33±5.72 107.00±11.31	1.683 (0.192)	- 97.15±4.96 98.33±12.54 105.00±424	0.87
DBP	1 2 3 4	59.50±.71 57.83±5.4 59.67±8.45 65.00±7.07	0.966 (0.421)	- 58.92±18.04 62.50±10.40 67.50±3.54	.30

**, P < 0.01, ***, P < 0.001

The mean values for systolic and diastolic blood pressure were however higher among boys as compared to girls, but 't' values were found to be non-significant. For the age group 8 years, weight, BMI, WHR, SBP and DBP were found to be higher among girls as compared to boys. The 't' values were found to be significant only for height, BMI, SBP. Similarly, for the age group nine years, measurements such as weight, BMI, WHR, SBP and DBP were found to have higher mean values for girls as compared to boys, but the't' values were found to be statistically significant only for weight, BMI, WHR. Analysis of Variance was used to assess the differences in the various measurements for the different categories of Body mass index based on percentiles. Weight was found to have highest mean value in the obese categories. The 'F' value was statistically significant for all the three age group children among both boys and girls. Mean values of height were also found to be higher for overweight / obese children as compared to normal children. The 'F' value found to be significant for 8 years and 9, similarly WHR was also found to be higher among overweight and obese children in the age group 8 and 9 years.

Table 5: represents the difference in various measurements among the different categories of BMI based on IOTF Criteria. (9 years age group)

Measurement	*Group*	*Males Mean ± SD*	*F Value*	*Girls Mean ± SD*	*F Value*
Weight	1 2 3 4	19.10±2.22 24.11±2.33 29.10±3.48 36.50±7.41	86.43 (0.00) ***	19.00±1.4 23.52±4.34 28.44±4.02 40.76±5.56	105.03 (0.00) ***
Height	1 2 3 4	128.82±6.85 129.92±5.04 131.28±5.58 133.19±5.62	3.34 (0.02) **	127.15±3.88 128.46±5.61 130.07±6.63 133.44±5.09	6.28 (0.00) ***
WHR	1 2 3 4	0.83±0.03 0.82±0.13 0.84±0.07 0.85±0.03	0.52 (0.66)	0.83±0.01 0.85±0.42 0.85±0.35 0.91±0.07	10.88 (0.00) ***
SBP	1 2 3 4	102.60±9.20 97.95±7.10 103.02±9.37 113.47±10.74	26.53 (0.00) ***	94.50±6.36 103.02±9.05 100.47±7.33 114.64±10.70	15.60 (0.00) ***
DBP	1 2 3 4	58.80±5.21 61.66±7.08 65.00±8.77 74.38±8.91	21.72 (0.00) ***	59.00±1.41 64.00±7.68 65.65±9.26 75.90±9.20	16.61 (0.00) ***

** , P < 0.01, *** , P < 0.001

F values were found to show significant differences but not for age group 7 years. Systolic blood pressure showed higher mean values for obese category children as compared to normal children. The 'F' values were found to be significant for the age group 7 and nine years. The mean values for diastolic blood pressure were also found to higher among overweight / obese category as compared to normal. The 'F' values were found to be statistically significant for 7 and 9 years age group. (Table 3, 4 & 5)

BMI showed statistically significant correlation with blood pressure both SBP and DBP among both boys and girls. WHR however showed significant correlation with SBP, only among girls. (Table 6).

Table 6: Correlation between Adiposity indices and blood pressure among Boys and Girls (7-9 years)

Adiposity index		SBP	DBP
WHR	Boys Girls	0.03 0.19*	0.04 0.09
BMI	Boys Girls	0.48** 0.9**	0.54** 0.39**

** , P < 0.01, *** , P < 0.001

As far as the Life style patterns are concerned, when the time spent, was considered in hours for various activities significant difference was observed between normal versus overweight children (both ganders) for the number of hours for sleep, sedentary activities as well as energy expensive activities (Table 7).

Table 7: Represents the mean time spent in various activities by the children- (7 to 9 years).

Category of children		*Time spent in hrs/ day (mean ± SD)*		
		Sleep	*Sedentary Activity*	*Energy Expensive Activity*
Total children 404		8.95 ± 0.90	3.78 ± 0.89	1.61 ± 0.61
Normal wt children	251	8.95 ± 0.90 8.89 ± 0.81	3.78 ± 0.89 3.59 ± 0.85	1.61 ± 0.61 1.70 ± 0.61
Overweight/children obese	153	9.34 ± 0.89	4.58 ± 0.89	1.60 ± 0.45
Normal weight Boys	139	8.90 ± 0.79	3.65 ±0.98	1.64 ±0.62
Overweight and obese Boys	92	9.21 ±1.06	4.58 ±0.98	1.32 ± 0.45
Normal weight Girls	102	8.89 ±0.85	3.56 ± 0.89	1.51 ± 0.61
Overweight and obese Girls	61	9.49 ±0.79	4.39 ±0.85	1.10 ± 0.51

Underweight children are not included. (n = 10).

The values of 't' were found to be statistically significant showing difference between normal and overweight boys for scdentery as well as energy expensive activities. For girls, however the difference was found to be statistically significant for all the three categories i.e. number of hours of sleep, scdentary and energy expensive activities (Table 8).

Table 8: represents the 't' test for children for the time spent in various activities, by the children (7 to 9 years)

Category of children	*Sleep*	*Sedentary Activity*	*Energy Expensive Activity*
Normal vs overweight / obese children	3.29 *	7.19 *	4.95 *
Normal vs overweight / obese boys	1.89	5.72 *	4.15 *
Normal vs overweight / obese girls	3.21 *	4.45 *	3.34 *
Overweight / obese boys vs overweight / obese girls	1.90	0.51	1.14

*P<0.05
Overweight children belonged more to the familes where both parents were overweight (Table 9).

Tables 9: Shows the weight status of parents of children (7 to 9 years)

	Overweight / obese		Normal (Both Parents)	Chi-square
	Both Parent	Single		
Normal weight = 241	61 (25.3%)	92 (38.2%)	88 (36.5%)	5.97 (NS)
Overweight / obese = 163	63 (38.7%)	59 (3.61%)	41 (25.2%)	

NS = Non Significant
For overweight boys number of sleeping hours was more, they were more sedentary and did less of energy expensive activities as compared to normal boys. Same was true for girls also. Overweight children had more joint family system and business Background.

4. Discussion

Overweight / obesity among children is progressing towards epidemic levels. The health risks of excessive body fat are noted even with a relatively small increase in body weight, and not only with marked obesity (45). The World Health Organization has described obesity as one of today's most neglected public health problems. Following the increase in adult obesity trends, the proportion of children and abolescents who are overweight and obese has also been increasing (46).

Both systolic and distolic blood pressures were found to have higher mean values among overweight and obese children in all the age groups (7-9) yrs for boys as well as girls. Irrespective of race, gender, or age, the risk of elevated boood pressure was significantly higher for children in upper compared with lower decile of BMI [50].

The overall prevalence of overweight and obesity in the private school children of 7-9 years was found to be 36.9% (overweight-20.5% and obesity-16.4%), in the present study. Studies among school children in different parts of the country have demonstrated increasing prevalence of overweight and obesity, with great disparity between rural and urban parts of country. The prevalence of overweight and obesity in a private school of Orissa, among children of age, 5-15 years was found to be 28.63% (overweight – 14.1% and obesity - 14.53%); (11).

The prevalence of overweight (including obese) in adolescents was to be 22% in better off schools in Chennai. In a Delhi school (9) with tuition fees more than Rs.2,500 per month, the prevalence of overweight was 31% of which 7.5% were frankly obese (10). Maximum prevalence i.e. 36.54% was found in 5-10 year age group and 22.3% in adolescence period (10-15 years). The highest prevalence of overweight and obesity was found within the 7 to 10 years old group (11, 12). Prevalence of overweight and obesity as 38.4% in boys and 34.8% in girls was reported in a private school in Orissa (11). Similar results, that is males showed a higher prevalence of obesity than females (P<0.0001) was reported in cluj-napoca school children (12). Higher prevalence in girls (8.82%) than boys (4.1), (P<0.001). in a study among affluent adolescent school girls, prevalence of overweight and obesity according to CDC BMI for age criteria was found to be 13.1% and 5.0% respectively (15).

The rate of overweight (20.5%) seen in the present study was higher but highest rate (28.5%) was reported among school going girls of Kolkata (27) when compared to the prevalence rate from different parts of India, and when compared to rates from USA and Great Britain (16.5% and 11.7%, respectively). A previous study (23) from Kolkata had shown that overweight and obesity among school girls were 17.63% and 5.1% respectively. The prevalence of overweight among the children from Punjab and Chennai, India, was 14.3% (22) and 15.8% (30), respectively. But Delhi children showed much lower rates (7.4%) of overweight (25). In a study (26) among school going

children of Wardha city, Central India, a higher prevalence (9.7%) was found among English medium schools compared to other schools (3.7%). Studies on urban Indian school children from selected regions report a high prevalence of obese and overweight children (37). In addition, studies on Indian school children have also demonstrated that the prevalence of hypertension in overweight children is significantly higher than that among normal children, (38-40). Elevated BP was seen in high percentages in children with overweight and obesity when compared with children who were neither overweight nor obese. Central obesity has been associated with the risk of cardiovascular and metabolic disease in children and anthropometric indices predictive of childhood central obesity include waist circumference (WC), waist-hip ratio (WHR) and waist-height ratio (WHtR), (28-32). Significant and positive correlation was found between BMI, WHR and blood pressure in the present study.

A higher percentage of children (38.7%), who belonged to overweight / obese category had both their parents to be overweight / obese, in the present study. When the number of hours spent in various activities was seen, statistically significant difference was observed between normal and overweight/obese children. This finding suggests that students in these school settings may be less involved in physical activities. All the variables such as height, weight, BMI, WHR, SBP and DBP had higher mean values among overweight and obese as compared to normal children. Overweight and Obesity was found significantly higher among children in 5-10 years age group (P=0.001), with family H/O obesity (P=0.000), watching TV, Computer more than 2 hours daily (P = 0.002), and consuming junk food regularly (P=0.000) overweight and obesity in adolescents in affluent school was significantly associated with TV watching > 2 hours, not playing outdoor games daily and frequently eating junk foods (16). The study among school children of 12-15 years reported higher prevalence obese children with physical activity of < 1 hour and watching TV, computer > 2 hours daily. Similarly a significant difference between obese and overweight children and the lean children with regard to the frequency of consumption of fast food was reported (19). Significant association between overweight and obesity with family history of obestiy, lack of physical activity and snacking of high energy foods (P<0.001) was found among affluent children of devangre city, (13).

The present study was conducted only in two affluent schools of Delhi, therefore, the data could not be compared with non affluent schools of Delhi. The study is not representative of all school going children. Most importantly, it is a cross-sectional study and there can be temporal ambigutiy. Hence causal claims cannot be made. To conclude, considering the burden of overweight and obesity among the school children, there is a need for periodic screening of overweight in schools which should be followed by counseling of parents of overweight childen. Counseling of children on lifestyle modification should be emphasized. School health programmes with special focus on educating students and teachers regarding possible adverse effect of overweight and obesity should be conducted.

References

[1] Dietz WH, Robinson TN: Overweight children and adolescents. N Engl J Med 2005, 352:2100-09.
[2] Popkin B M,Doak CM,The obesity epidemic is a worldwide phenomenon. Nutrition Reviews 1998;56(4);106-114.
[3] Kelishadi, R. Childhood Overweight, obesity and metabolic syndrome in Developing countries. Epidemiologic reviews 2007. Hopkins Bloomberg School of Public plealth.
[4] Misra A, Vikram NK, Arya S, Pandey RM, Dhingra V, Chatterjee A, Dwivedi M, Sharma R, Luthra K, Guleria R, Talwar KK. High prevalence of insulin resistance in postipu- bertal Asian Indian children is associated with adverse truncal body fat patterning, abdominal adiposity and excess body fat. Int J Obes Relat Metab Disord. 2004;28:1217-26.
[5] Misra A, Khurana L, Vikram NK, Goel A, Wasir JS. Metabolic Syndrome in Children: Current Issues and South Asian Perspective. Nutrition. 2007;23:895-910
[6] Ehtisham S, Barrett TG, Shaw NJ. Type 2 diabetes mellitus in UK children--an emerging problem. Diabet Med. 2000;17:867-71. 6. 10. Sharma A, Sharma K, Mathur KP. Growth pattern and prevalence of obesity in affluent schoolchildren of Delhi. Public Health Nutr. 2007;10:485-91.
[7] Shetty PS. Obesity in children in developing societies: indicator of economic progress or a prelude to a health disaster? Indian Pediatr 1999; 36: 11-5 (12).
[8] Goyal RK, Shah VN, Saboo BD, Phatak SR, Shah NN, Gohel MC, Raval PB, Patel SS. Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factorsJ Assoc Physicians India. 2010 Mar;58:151-8.
[9] Ramachandran V, Snehalatha C, Vinitha R, et al. Prevalence of overweight in urban Indian adolescent school children. Diabetes Research and Clinical Practice 2002; 57: 185-90
[10] Kapil U, Singh P, Pathak P, et al. Prevalence of obesity among Affluent adolescent school children in Delhi. Indian Pediatrics 2002; 39: 449-52
[11] S Patnaik, L Patnaik, S Patnaik, M Hussain. Prevalence of Overweight And Obesity, in A Private School Of Orissa, India. The Internet Journal of Epidemiology. 2010 Volume 10 Number 1
[12] Valean C, Tatar S, Nanulescu M, Leucuta A, Ichim G. Prevalence of obesity and overweight among school children in Cluj-Napoca. Acta Endocrinologica (Buc) 2009; 5:213 - 219.
[13] Kumar S, Mahabalaraju DK,Anuroopa MS. Prevalence obesity and its influencing factor among affluent school children of Devangre city. Indian J Community Medicine 2007;1:15-17.
[14] Sood A, Sundararaj P, Sharma S, Kurpad AV, Muthayya S. BMI and Body Fat Percent: Affluent Adolescent Girls in Bangalore City. Indian Pediatr 2007;44:587-591.
[15] Weiner, J.S. & Lourie A 1981. Human biology: A guide to field method. IBP Handbook No.9. Blackwell.Sci.Publ.Oxford.

[16] Jain S, Pant B, Chopra H, Tiwari R. Obesity among adolescents of affluent public schools in Merut. Indian J Public Health 2010; 54:158-160.
[17] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. British Medical Journal 2000; 320: 1240-3
[18] Kotian MS, Kumar G, Kotian SS. Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. Indian J Community Medicine 2010; 35:176-178.
[19] Amin TT, Al-Sultan Al, Ali A. Overweight and obesity and their association with dietary habits and sociodemographic characteristics among male primary school children in Al-Hassa, Kingdom of Saudi Arabia. Indian J Community Medicine 2008; 33:172-181.
[20] Misra A, Vikram NK, Arya S, Pandey RM, Dhingra V, Chatterjee A, Dwivedi M, Sharma R, Luthra K, Guleria R, Talwar KK. High prevalence of insulin resistance in postpu- bertal Asian Indian Children is associated with adverse turncal body fat patterning, abdominal adiposity and excess body fat. Int Jobes R et ak Netab Disord 2004; 28:1217-26.
[21] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. British Medical Journal 2000; 320: 1240-3.
[22] Sidhu S, Kaur N, Kaur R. Overweight and obesity in affluent school children of Punjab. Annals of Human Biology 2006; 33: 255-9 (30)
[23] Bose K, Bisai S, Mukhopadhyay A, Bhadra M. Overweight and obesity among affluent Bengalee school girls of Lake Town, Kolkata, India. Maternal and Child Nutrition 2007; 3: 141-5
[24] Dutta Banik S. Health and nutritional status of three adult male populations of Eastern India- an appraisal. Ital J Public Health 2009; 6: 294-302.
[25] Mandal GC, Bose K, Bisai S, Ganguly S. Undernutrition among Integrated Child Development Services (ICDS) Scheme children aged 2-6 years Arambag, Hooghly District, West Bengal, India: a serious public health problem. In! J Public Health 2008; 5: 28-33.
[26] Mandal S, Sinha N, Samanta P, et al. Anthropometric assessment of nutritional status among college women of Midnapore, West Bengal, India. International J Life Sciences Pharma Res 2011; 1: 81-7
[27] Arpita Mandal A, MandalG.C. Prevalence of overweight and obesity among the urban adolescent English Medium School girls of Kolkata, India MPH - 2012, Volume 9, Number 3.7535-1.
[28] Freedman DS, Dietz WH, Srinivasan SR, Berenson GS: The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatr 1999, 103:1175-82.
[29] Kahn HS, Valdez R: Metabolic risks identified by the combination of enlarged waist and elevated trilglycerol concentration. Am J Clin Nutr 2003, 78:928-934.
[30] Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, Berenson GS: Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. Pediatrics 2004, 114(2):e198-205.
[31] Gower BA, Nagy TR, Goran MI: Visceral fat, insulin sensitivity, and lipids in prepubertal children. Diabetes 1999, 48:1515-21.
[32] Kelishadi R, Gheiratmand R, Ardalan G, et al: Association of anthropometric indices with cardiovascular disease risk factors among children and adolescents: CASPIAN Study. Int J Cardiol 2007, 117:340-48.
[33] Chhatwal J. Verma M, Riar SK. Obesity among pre-adolescent and adolescents of a developing country (India) Asia Pac J Clin Nutr. 2004;13:231-5. [PubMed]
[34] Ramachandra A. Snehalatha C, Vinitha R, Thayyil M, Kumar CK, Sheeba L, et al. Prevalence of overweight in urban Indian adolescent school children. Diabetes Res Olin Pract. 2002;57:185-90.[PubMed].
[35] Marwaha RK, Tandon N, Singh Y, Aggarwal R, Greawal 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. [PubMed].
[36] Khadikar VV, Khadikar AV. Prevalence of obesity in affluent school body in Pune. Indian Pediatr. 204;41:857-8. [PubMed].
[37] Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prealence of obesity amongst affluent adolescent school children in Delhi. Indian Pediatr.2002;39:449-52.[PedMed].
[38] Verma M, Chhatwal J, George SM. Obesity and hypertension in children. Indian Pediatr. 1994;31:1065-9. [PedMed].
[39] Mohan B, Kuamr N, Aslam N, Rangbulla A, Kumbkarni S, Sood NK, et al. Prevalence of sustained hypertension and obesity in urban and rural school going children in Ludhiana Heart J.2004;56:310-4.[PedMed]
[40] Anand NK, Tandon L. Prevalence of hypertension in school going children. Indian Pediatr. 1996;33:337-81. [PedMed].
[41] Bhardwaj S, Misra A, Khurana L, Gulati S, Shah P and Vikram Naval K. Childhood obesity in Asian Indain: a burgeoning cause of insulin resistance, diabetes and sub-clinical inforamation. Asia Pac.J Clin Nutr 2008:17(SI):172-175.
[42] Syamala P and, Jaganathan D. Assessment of Nutritional status of Life style modification of obese children. Ind.J.Nutr. Dietet. 2011.48,139-145.
[43] National Family Health Survey (NFHS-3) 2005-06. http://www.nfhsindia.org.
[44] Shaver Essentials of exercise physiology Burgers publishing company. 1981, 7108. Ohms lane, Minneapolis, Minnesota 55435.
[45] WHO-TRS 894: Obesity. Preventing and managing the global epidemic. Geneva. WHO 2000. Available from www.who.int/nutrition/pubications/obesity/chlindes.html (Accessed in April 2011).
[46] Wong, JPS, HO SY, Lai MK, et al. Overweight, obesity, weight related concerns and behaviours in Hong Kong Chinese Children and adolescents. Acta Paediatr 2005; 94;595-601.
[47] Ratan B, Parizkova J and Hills AP. Childhood obesity prevention and treatment.2005.522.

[48] Luepker RV. Jacobs Dr. Prinacs RJ. Sinaiko A.R. Secular trends of blood pressure and body size in a multiethnic adolescent population. 1986 to 1996. J Pediatr 1999.134:668-674
[49] Morrison J.A, James F W, Sprecher DL, Khoury PR, Daniels SR. Sex and Race differences in cardiovascular disease risk factors changes in school children. 1975-1990: The Princeton School study. Am J Public Health 1989; 89: 1708-1714.
[50] Rosner B, Prineas R, Daniels SR, Loggie J. Blood pressure differences between Black and Whites in relation to body size among US children and adolescents. Am J E pidemiol. 2000.151: 1007-1019.
[51] Phadnis S. 4% school children from city have high BP. Study : TNN. Nov 13, 2014, 03.51 AM IST.