PREVALENCE AND PREDICTORS OF OVERWEIGHT/ OBESITY AMONG SCHOOL-GOING ADOLESCENTS OF AJMER CITY: A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: The prevalence of overweight and obesity among children and adolescents aged 5-19 years has risen dramatically from just 4% in 1975 to just over 18% in 2016. Indian population comprises adolescents in the age group of 10-19 years which represents almost 22.8% which is nearly 230 million. Adolescence is generally understood as the period of transition from childhood to adulthood. According to NFHS-4(2015-16) in India, 20.70% of females and 18.60% of males are overweight and obese and in Rajasthan, 14.10% of females and 13.20% of males are overweight and obese. There is a need to provide a better future and bring awareness about health. This made the investigator take up the study on assessment of the prevalence of overweight and obesity and its predictors amongst school-going adolescents of Ajmer city. **Aim:** To find the prevalence of overweight, and obesity and to identify its predictors among school-going adolescents in selected schools of Ajmer City. **Methodology:** A cross-sectional study, carried out in Government and Private schools which were selected randomly, located within Ajmer city. After identifying the school, adolescents were selected according to inclusion criteria. Out of 1600 study participants, age group of 10 to 19 years, 800 participants were from government schools and 800 from private schools. After obtaining permission from the concerned authorities the investigator explained the nature of the study and its purpose. Informed consent was obtained from the parents of the students. Data was collected using a predesigned pretested semi-structured self-administered questionnaire. In each standard, the height and weight were measured using standard equipment and procedure in all students except the disabled. The data were analyzed using Epi info 7.2 software. The chi-square test, odds ratio, and p-value were used to find out the association of obesity with various factors. **Results:** The prevalence of overweight (BMI 23 – 24.9) was 11.63% and obesity (BMI >/= 25) was 7.31%. The overall prevalence of overweight/ obesity was found to be 18.94%. **Conclusion:** The high prevalence of overweight and obesity observed in the adolescent age group in the present study emphasizes the need to reinforce the importance of health in the early formative years of an individual's life as there are strong indications that childhood obesity tends to track into adulthood and control of adult obesity is more difficult. The measures to control childhood and adolescent obesity should involve indidual, family, community, and administrative coordination.

Keywords: Overweight, Obesity, Prevalence, School going adolescents

INTRODUCTION

The World Health Organization has described obesity as one of today's most neglected public health problems, affecting every region of the globe.[1] The prevalence of obesity is increasing rapidly worldwide both in developing and developed countries[2]. It is associated with several risk factors for heart diseases including hyperlipidemia, hypertension and early atherosclerosis.[3-5]

Obesity is also defined as an abnormal growth of the adipose tissue due to an enlargement of fat cell size (hypertrophic obesity) or an increase in fat cell number (hyper-plastic obesity) or a combination of both. Obesity is often expressed in terms of Body Mass Index (BMI). BMI is defined as the weight in kilograms divided by the square of height in meters (kg/m^2).[6]

Obesity results from an imbalance of caloric intake and energy expenditure. Individual adiposity is the result of a complex interplay among genetically determined body habitus (The physique or body built), appetite, nutritional intake, physical activity, and energy expenditure, these are also known as predictors of obesity. Childhood obesity is associated with higher chance of obesity, premature death and disability in adulthood. Obesity in adolescence may be associated with depression in adulthood and also with increased risk of cancer and asthma.[7-9]

According to WHO, worldwide obesity has nearly tripled since 1975. The prevalence of overweight and obesity among children and adolescents aged 5-19 years has risen dramatically from just 4% in 1975 to over 18% in 2016.[7] The pace at which the obesity epidemic is threatening the world's children and adolescents has raised immediate public health concern. Since the early 1970s, obesity has sharply and constantly increased among children from all socioeconomic levels, racial and ethnic groups, and regions.[10]

Indian population comprises of adolescents in the age group of 10-19 years which represent almost 22.8% that is nearly 230 million. This is almost 2/3 of the world adolescent population. Adolescence is generally understood as the period of transition from childhood to adulthood.[11]

In India 12.60% female and 9.30% males in NFHS-3 [12] (2005-06) as compared to 20.70% female and 18.60% males are overweight and obese according to NFHS-4 [13] (2015-16) and in Rajasthan 8.90% female and 6.20% males in NFHS-3 compared to 14.10% female and 13.20% males are overweight and obese according to NFHS-4.

At present children are changing the nature of their leisure activities, from actively participating in sports to electronically played games while seated asserts that at present, more than ever, life is sedentary, whereby children spend more time playing with electronic devices, in computers and handheld video games, than actively participating in physical activities, these are a number of things which contribute to a person becoming overweight.[14]

Today's children are tomorrow's future of the world. Obesity in children causes numerous health issues and illness which affects the next generation. There is a need to provide better future and bring awareness about health. This made the investigator to take up this which was conducted with the objective to find the prevalence of overweight, obesity and to identify its predictors among school going adolescents in selected schools of Ajmer City.

METHOD AND MATERIALS

It is a school based cross-sectional study, carried out in Government and Private schools, located within Ajmer city. The study was undertaken with girls and boys of VI, VII, VIII, IX, X, XI & XII classes of government and private schools.

During the year 2018- 2019, there were total 93 senior secondary schools with grades 1st to 12th; it was a random sampling procedure to select the 10 schools. Prevalence of overweight & obesity in NFHS-4 (2015-16) is 19.65%, therefore assuming a current prevalence of overweight and obesity 20%, with 95% confidence interval, 10% allowable error (d), using the formula for determination of sample size: $n=4PQ/d^2$. Sample size calculated was 1600.

A list of government and private schools was procured and permission was taken from the District Education Officer (DEO) for conduction of this study. It was planned that if the school management refused for conduction of the study, in that case another school would be taken, by the simple random sampling method, till the required number of 1600 study subjects were covered.

After identifying the school, adolescents were selected according to inclusion criteria. Inclusion Criteria: Students of standard - 6th to 12th and aged 10 to 19 years of Ajmer city, students who were willing to participate in the study, consent from parents for study. Out of 1600 study participants, age group of 10 to 19 years, 800 participants were from government schools and 800 from private schools. After obtaining permission from the concerned authorities the investigator introduced self to the study participants and explained the nature of the study and its purpose. Informed consent was obtained from parents of the students.

Data was collected using predesigned pretested semi structured self-administered questionnaire. In each standard, the height and weight were measured using standard equipment and procedure in all students except disabled. The measurements were carried out in their respective class rooms. Weight was measured in kilograms without any footwear with minimal clothing to the nearest 0.1 kg. Scales was zeroed before each session and the instrument was regularly standardized throughout the study. The response of the students was recorded by the investigator who provided any clarification for the queries.

Data Analysis: Data was entered into Microsoft excel 2007 worksheet in the form of master chart. Analysis was done using Epi info 7.2 software. The data obtained were planned to be analysed by using both descriptive and inferential statistics.

The statistical significance was evaluated at 95% confidence level and p value below 0.05 was considered statistically significant.

RESULTS

Out of 1600 study subjects, all the classes from 6th to 10th had the same number of students i.e. 228, 11th and 12th had 230 each. Total numbers of girls were 796 and boys were 804. Among 804(50.25%) boys, 405(25.31%) were from government schools and 399(24.93%) from private schools. Similarly 395(24.68%) girls were from government schools and 401(25.06%) from private schools among 796(49.75%) girls. Maximum number of students 522(32.63%) were 16-17 years of age followed by 425 (26.57%), 412 (25.75%), 150 (9.38%) & 91 (5.69%) students which were 14-15, 12-13, 18-19 & 10-11 years of age respectively. The overall mean age of study subjects was 14.77 ± 2.08 years. The mean age of girls was 14.81 ± 2.12 years and that of boys was 14.72 ± 2.04 years with a range from 10 to 19 years.

Table 1: Socio-demographic profile of study subjects

	Boys n (%)	Girls n (%)	Total n (%)
Distribution of the study subjects according to class and gender			
6th class	117(7.31)	111(6.93)	**228**(14.25)
7th class	116(7.25)	112(7.00)	**228**(14.25)
8th class	118(7.37)	110(6.87)	**228**(14.25)
9th class	112(7.00)	116(7.25)	**228**(14.25)
10th class	114(7.12)	114(7.12)	**228**(14.25)
11th class	113(7.06)	117(7.31)	**230**(14.38)
12th class	114(7.12)	116(7.25)	**230**(14.38)
Distribution of the study subjects according to type of school and gender			
Government	405(25.31)	395(24.68)	800 (50.00)
Private	399(24.93)	401(25.06)	800 (50.00)
Distribution of the study subjects according different age groups and gender			
10-11	46(2.87)	45(**2.81**)	91(**5.69**)

12-13	206(12.87)	206(12.87)	412(**25.75**)
14-15	221(13.81)	204(**12.75**)	425(**26.57**)
16-17	271(16.93)	251(**15.68**)	522(**32.63**)
18-19	60(3.75)	90(**5.62**)	150(**9.38**)
Distribution of the study subjects according to religion and gender			
Hindu	675(42.18)	642(40.12)	**1317**(82.31)
Muslim	91(5.68)	94(5.87)	**185**(11.56)
Christian	7(0.43)	11(0.68)	**18**(1.13)
Jain and Sikh	31(1.93)	49(3.06)	**80**(5.00)
Distribution of the study subjects according to type of family and gender			
Joint	348(21.75)	284(17.75)	632(39.50)
Nuclear	456(28.50)	512(32.00)	968(60.50)
Total	804(50.25)	796(49.75)	1600(100)

Figure 1: Distribution of study subjects according to age group
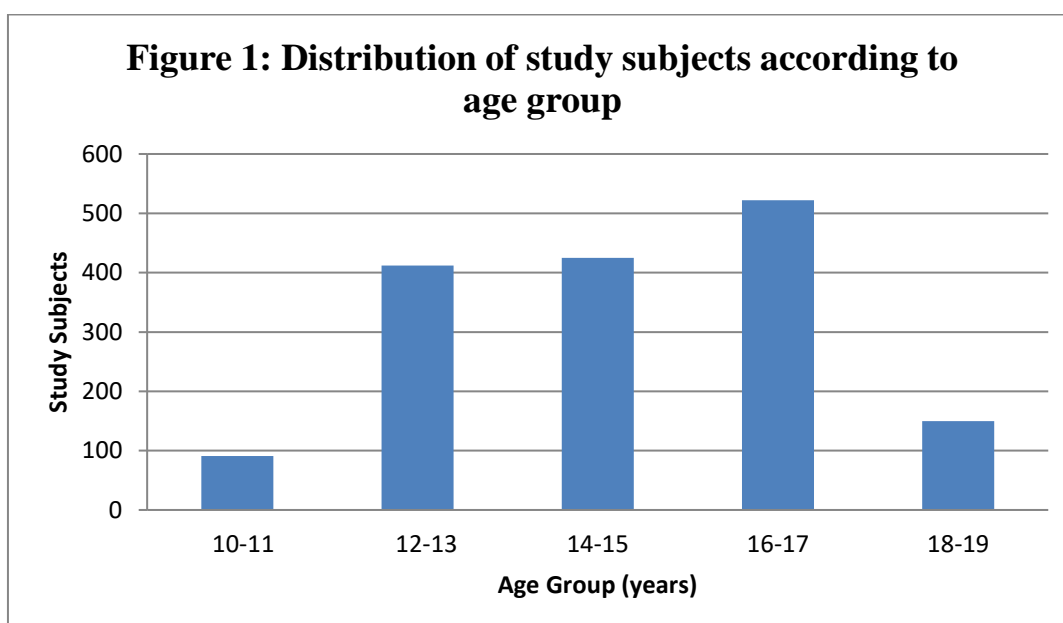
Table 2: Prevalence and predictors contributing to overweight and obesity.

	Non overweight /non-obese n(%)	Overweight / obesity n(%)	Total n(%)
Association of overweight / obesity with gender			
Boys	683(42.68)	121(7.56)	804(50.25)
Girls	614(38.37)	182(11.37)	796(49.75)
$\chi2=15.406$ $p < 0.001$ df- 1 significant at $p<0.05$			
Association of the overweight / obesity with type of school			
Government	680(42.50)	120(7.50)	800(50)
Private	617(38.56)	183(11.43)	800(50)
$\chi2=15.65$ $p < 0.001$ df- 1 significant at $p<0.05$			
Association of overweight / obesity with type of family			
Joint	591(36.93)	41(2.56)	632(39.50)
Nuclear	706(44.12)	262(16.37)	968(60.50)
$\chi2=104.14$ $p < 0.001$ df- 1 significant at $p<0.05$			
Association of BMI and family history of overweight / obesity			
Positive family history of	271(16.93)	207(12.93)	478(29.88)

overweight/obesity			
Negative family history of overweight/obesity	1026(64.12)	96(6.00)	1122(70.12)
χ2=261.40 p < 0.001 df- 1 significant at p<0.05			
Association of overweight / obesity with sleeping hours			
Less than 6 hrs	243(15.18)	248(15.50)	491(30.69)
More than or equal to 6 hrs	1054(65.87)	55(3.43)	1109(69.31)
χ2=456.99 p < 0.001 df- 1 significant at p<0.05			

Out of 1600 study participants, 303 (18.94%) were overweight/obese and 1297 (81.06%) were non-overweight/non-obese. Out of 796 girls, 182 (11.37%) were overweight/ obese and 614 (38.37%) were non-overweight/non-obese and among 804 boys, 121 (7.56%) were overweight/obese and 683 (42.68%) were non-overweight/non-obese. Statistically significant association was found between overweight/obesity and gender of study participants with $p < 0.001$ ($\chi2$=15.406). Overweight and obesity was observed to be more in girls as compared to boys.

Out of 1600 adolescents, the prevalence of overweight/obesity was 183 (11.43%) in private schools and 120 (7.50%) in government schools. Rest all were non-overweight/ non-obese 1297 (81.06%). Statistically significant association was found in prevalence of overweight / obesity and type of schools with $\chi2$= 15.65 (p value < 0.001). The prevalence of overweight/ obesity was observed higher in private schools as compared to the government schools.

Among 303(18.94%) overweight/obese study participants, 41 (2.56%) belonged to joint family and 262 (16.37%) belonged to nuclear family. Rest all were non-overweight/ non-obese 1297 (81.06%). Statistically significant association was found between overweight/obesity and type of family of study participants with $p < 0.001$ ($\chi2$- 104.14). Overweight / obesity were observed more in adolescents belonging to nuclear family as compared to the ones belonging to joint family.

Out of 303(18.94%) overweight/ obese adolescents, 207 (12.93%) had positive history of overweight/obesity and 96 (6.00%) adolescents who did not have positive family history of overweight / obesity were obese. Rest all study subjects were non-overweight/ non-obese 1297 (81.06%). The prevalence of overweight / obesity was found to be statistically significant with respect to family history with $p < 0.001$ ($\chi2$ = 261.40).

Figure 2: Distribution of study subjects according to BMI with relation to family history of overweight / obesity
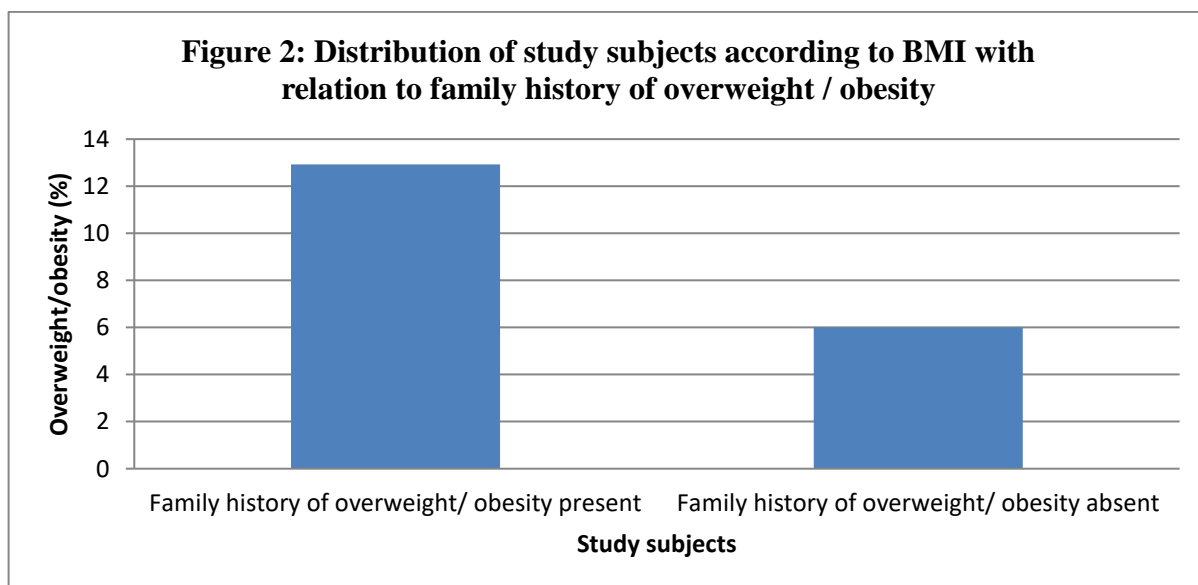
Among total overweight/obese adolescents, 12.93% had positive family history and 6.0% had no family history of being overweight/ obese. The prevalence of overweight / obesity was found to be statistically significant with respect to family history. (Figure 2)

Out of total overweight/ obese study subjects 303(18.94%), majority 248 (15.50%) were those who were sleeping less than 6 hours in a day and 55 (3.43%) of overweight/obese study subjects were sleeping more than or equal to 6 hours in a day. Rest all study subjects were non-overweight/ non-obese 1297 (81.06%). Statistically significant association was found between overweight/obesity and duration of sleeping less than or equal to 6 hours in a day with $p < 0.001$ ($\chi 2$ -456.99).

DISCUSSION

In the present study students who had Body Mass Index (BMI) ≤18.5 were classified underweight, 18.5-22.9 were classified normal weight, 23.0-24.9 were classified overweight, 25.0-29.9 were classified Obesity Class I and ≥30.0 were classified Obesity Class II using the Classification of BMI in Asia-Pacific guidelines by WHO15. The cut off values for overweight and obesity was obtained from WHO growth chart for 5-19 years age group. These values are equivalent to overweight and obesity cut-off for adults.

PREVALENCE OF OVERWEIGHT AND OBESITY

In this study, the overall prevalence of overweight/obesity among school going adolescents of Ajmer city was 18.95%. The prevalence of overweight and obesity separately was found to be 11.63% and 7.32% respectively. This is comparable to National Family Health Survey (NFHS)-4 [13] nutritional indicators where females and males overweight/ obesity was observed to be 20.7% and 18.6% respectively and overall overweight/obesity was 19.65%. Similarly in urban area of Rajasthan, 23.7% and 19.7% of overweight/ obesity was observed in females and males respectively (NFHS-4)[13]

M Premanath, et al, (2008)[15] conducted similar study in Mysore and reported the prevalence of overweight (8.5%) and obesity (3.4%) on school children. Soniya V et al., (2014)[16] in Latur City reported the overall prevalence of overweight/obesity as 9.98% and that of overweight and obesity as 8.54% and 1.44% respectively. Sunil Kumar DR et al., (2019)[17] study done in Bangalore, reported the prevalence of overweight and obesity among the students as 7.09% and 4.08% respectively which is comparable to the present study.

Variations in the prevalence of obesity in adolescents reported in studies, which were made in different times, at different places. Hence an exact comparison drawing a conclusion seems inappropriate. However they give reasonable idea regarding prevalence of obesity in school going adolescents in different parts of the country.

OVERWEIGHT / OBESITY AND GENDER

In the present study, girls were observed to be more overweight/ obese as compared to boys. Among total 303(18.96%) overweight/obese study subjects, 182(11.36%) were girls and 121(7.55%) boys. Statistically significant association ($p < 0.001$) was found between overweight/obesity and gender of study subjects.

A study done by Mudur in three major Indian cities found that more girls were overweight than boys. (Mudur G et al.,(2003)[18]. A study conducted by Solanki et al., (2018)[19] also showed similar results, the prevalence of overweight/obesity was found more in girls (12.60%) as compared to boys (8.60%) which may be due to the fact that during puberty, females have tendency to accumulate more fat. It is a recognized fact that weight gain during puberty is physiological, and is accompanied by increase in BMI and subcutaneous adiposity (Christine M et al., 2010)[20]. Thus the girls are more overweight / obese as compared to boys. In contrast to the above findings, the prevalence of overweight / obesity was found high in boys as compared to girls in study done at Aligarh city by Nawab T et al (2014)[21].

OVERWEIGHT / OBESITY AND TYPE OF SCHOOL

In the present study, the prevalence of overweight / obesity was high in private schools (11.43%) than government schools (7.5%). The prevalence of overweight/obesity was found to be significantly high among the students of private schools as compared to the government ones (p < 0.001). Similar results were observed in a study conducted at Shimla city (Anjali Mahajan et al., 2014)[22]. Since adolescents studying in private schools come from higher socio-economic group as compared to adolescents studying in Government schools which shows that socio-economic status plays a major role in the availability of food and determination of overweight/obesity.

OVERWEIGHT/ OBESITY AND TYPE OF FAMILY

In the present study majority of overweight/obesity was found in adolescents belonging to nuclear family as compared to the ones belonging to joint family.

Among 303(18.94%) overweight/obese study participants, (2.56%) belonged to joint family and (16.37%) belonged to nuclear family. The association was found to be statistically significant (p < 0.001). Similar findings were reported in the studies done at Udaipur city, Rohtak city and Dakshina Kannada and Udupi districts (Solanki et al., 2018)[19], Ravi Rohilla at el., (2014)[23]; Keerthan Kumar M et al., (2011)[24]. This may be due to the fact that lesser mouths to feed, therefore lesser division of food and more availability of food in nuclear families.

OVERWEIGHT / OBESITY AND FAMILY HISTORY

In the present study, majority of study subjects who had family history were overweight / obese. The prevalence of overweight/obesity was found to be significantly (p < 0.001) high among the students who had family history of overweight/obesity. Similar association was seen in studies done at Vadodara city (Uma Iyer et al., 2011)[25] & Udaipur city (Meharda B et al., 2017)[26]. Studies conducted at Kerala and Mysore city also supported the same results. (Ramesh K, 2010[27]; Kavita et al., 2013[28]). Here it is to be noted that family history of overweight/obesity leading to increased prevalence of overweight/obesity in their children is not only due to the genetic factor but also because of the life style practices and diet pattern followed in that household.

OVERWEIGHT/ OBESITY AND SLEEPING HOURS

Majority (15.50%) of overweight/obese study subjects were those who were sleeping less than 6 hours in a day and (3.43%) of overweight/obese study subjects were sleeping more than or equal to 6 hours in a day. Statistical significance was found between overweight/obesity and duration of sleeping hours in a day. Overweight /obesity were found to be inversely proportional to sleeping hours.

A study done by (Kuriyan R et al., 2007)[29] also showed that children who slept less than 8.5 hours / day had significantly higher odds (6.7) of being overweight when compared to children who slept more than 9.5 hours/day. A study done by Qi Sun (Sun Q et al., 2018)[30] in China also showed different levels of short sleep duration for 7–12, 13–15 and 16–18 year age groups increased the risk of becoming overweight/obese. Similar findings were observed in study conducted at Mandya city but it was not statistically significant (Asha B et al., 2015).[31] A previous study has demonstrated that sleep restriction may reduce the excretion of growth hormone (GH) (Nieminen P et al., 2002)[32].

Reduced leptin and elevated ghrelin were observed in a large sample of adults, which was associated with increased hunger and appetite—especially for high carbohydrate content, including sweets, salty snacks, and starchy foods—which in turn could alter the balance of energy intake and energy expenditure. (Spiegel K et al., 2004)[33] (Dashti H.S et al., 2015)[34]

CONCLUSION

Overall prevalence of overweight / obesity in the present study was 18.94%. Out of 1600 study subjects, overweight was observed as 186 (11.63%), obesity I - 94 (5.88%) and obesity II - 23 (1.44%). The prevalence of overweight and obesity was higher in private schools 11.43% than

government schools 7.50%. The prevalence of overweight (BMI 23 – 24.9 kg/m^2) was 11.63% and obesity (BMI $>/=$ 25 kg/m^2) was 7.31%. The prevalence of overweight and obesity was slightly more 11.36% in girls than boys 7.55%. Most of the overweight/obese adolescents belonged to nuclear family (16.37%) with the odds of 5.34. Majority of overweight/obese adolescents (12.93%) were those who were having family history for overweight/obesity.

RECOMMENDATIONS

The high prevalence of overweight and obesity observed in adolescent age group in present study emphasize need to reinforce importance of health in early formative years of an individual's life as there are strong indications that childhood obesity tends to track into adulthood and control of adult obesity is more difficult.

Obese children to be counselled to restrain taking high energy foods and to adopt the healthy life style practices with sports and physical activities. Creation and maintenance of play grounds and gardens, inclusion of playground facilities and safe play area for children and adolescents, provide safe and level pedestrian path for the public to walk. School health programmes including periodic screening of children for overweight/ obesity followed by counselling of students, parents and teachers through IEC activities regarding possible adverse effects of being overweight /obese and regular participation in physical activities should be made compulsory which can be useful for early detection of childhood obesity.

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