



Original Research Article

Prevalence and determinants of overweight and obesity among adolescent school children of Rajkot city, India

Nidhi Y Mangrola^{1*}, RG Mahajan², Kshama D Gajera³, Kuntalkumar H. Patel¹¹Dept. of Community Medicine, Dr.Kiran C.Patel Medical College and Research Institute, Bharuch, Gujarat, India²Dept. of Community Medicine, B.J. Medical College and Civil Hospita, Ahmedabad, Gujarat, India³Dept. of Community Medicine, PDU Govt. Medical College, Rajkot, Gujarat, India

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ABSTRACT

Background: Adolescent obesity is becoming more prevalent due to changing lifestyles, and it has negative effects like a higher incidence of non-communicable diseases. Identification of risk factors leading to the rapid rise in adolescent obesity is a crucial first step in preventing and controlling it. Therefore, this study was carried out in Rajkot.

Objectives: The primary objective was to find the prevalence of obesity among the school going adolescents aged 14-19 years and to identify the determinants associated with obesity.

Materials and Methods: A cross-sectional study among the adolescents studying in school was carried out by using multistage sampling method. A predesigned questionnaire with personal and family history and details of dietary habits and physical activity was filled by the participants. Anthropometric measurements of the participants including height, weight, waist and hip circumference were taken.

Results: Out of total 1120 participants, 25.8% were underweight, 11.1% were overweight and 6.9% were obese. Overweight and obesity was significantly associated with the occupation of participant's father and mother, lack of physical activity, more screen time, non-vegetarian diet and daily consumption of carbonated drinks and chocolates. ($p < 0.001$).

Conclusion: The determinants like physical activity and dietary habits were found to be associated with overweight and obesity. Modifying one's lifestyle can be very helpful in preventing adolescent obesity as well as developing healthy routines for later life.

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1. Introduction

According to the World Health Organization, obesity and overweight are conditions in which there is an abnormal or excessive buildup of fat. Overweight and obesity, once thought to be an issue only in high-income nations, are increasingly becoming more prevalent in low- and middle-income nations, especially in metropolitan areas. The "New World Syndrome" is a group of non-communicable diseases that includes obesity and is causing a significant socio-

economic and public health burden in developing nations.

Worldwide the prevalence of obesity has tripled since 1975. In 2020, an estimated 39 million children under the age of 5 years were overweight or obese. Almost half of the children under 5 who were overweight or obese in 2019 lived in Asia. The prevalence of overweight and obesity among adolescents aged 5-19 has increased considerably from just 4% in 1975 to just over 18% in 2016. Both boys and girls have seen an increase in weight, with 18% of girls and 19% of boys being overweight in 2016.¹

Obesity is becoming a significant public health issue in India, especially in urban areas where it paradoxically

* Corresponding author.

E-mail address: mangrola.nidhi@gmail.com (N. Y. Mangrola).

coexists with undernutrition, creating a "Double Burden of Disease Obesity." According to the most recent National Family Health Survey (NFHS-5) statistics, the frequency of obesity among Indians has grown between 2019-21 compared to 2015-16.² In comparison to one in five people before, about one in four people now are overweight. The likelihood that obesity will continue into adulthood and, thus, the induction of obesity-induced morbidities such as prehypertension and hypertension, depends on the degree of obesity and the age at which it first appears.

There is a dearth of research on the prevalence of adolescent obesity in India. Children's undernutrition has been India's top public health concern for decades, but up until recently, childhood overweight and obesity received little attention. Regarding the prevalence of obesity and overweight among schoolchildren and adolescents in the Saurashtra region, insufficient statistics are available. In light of this, the current study sought to determine the prevalence of obesity and overweight among schoolchildren and adolescents enrolled in grades 9 through 12 in Rajkot, India's Saurashtra area.

2. Materials and Methods

Rajkot city is situated in Gujarat state and it is the administrative headquarters of Rajkot District. A cross sectional study was conducted in the selected schools of Rajkot city from 1st June 2016 to 31st March 2017. The study was conducted among the adolescents of age group 13-18 years, so the students studying in standard 9th to 12th were included.

Sample size was calculated taking the expected prevalence of obesity in adolescents 15% and the allowable error of 15%.^{3,4} A sample of 1007 subjects was obtained after sample size

calculations were carried out. Assuming a nonresponse rate of 10%, the sample size was 1107. So, for equal distribution 1120 adolescents studying in standards 9th to 12th were selected for the study. Multistage sampling strategy was used. Total 275 schools were there in Rajkot city during my study period according to list given by DEO (District Education Officer) office which out of which 105 were government granted and 170 were private schools. List of schools formed the primary sampling unit. Out of total, 14 schools were selected by simple random sampling. In each school, 10 boys and 10 girls were selected from each section of std. 9th, 10th, 11th & 12th with the help of their attendance register using lottery method. So, from each school total 80 students were selected to complete the sample size of 1120.

2.1. Inclusion criteria

All adolescents studying in standard 9th to 12th willing to participate in the study and studying in one of the fourteen

selected schools and were present when the study was being conducted.

2.2. Exclusion criteria

Adolescents studying in standard 9th to 12th who do not agree to participate in the study and who were not present when it was being conducted.

Pre tested and semi structured questionnaire was used. Prior permission was taken from the principal of the school. At first the students were explained about the purpose of the study and after obtaining verbal consent the questionnaire was given to them. It was a self-administered questionnaire so after distributing it, everything written in it was explained to them in detail first and then they were asked to fill it. The questionnaire included demographic information of student, their parents, and history of any disease, their dietary habits and daily physical activity. After completion of forms, anthropometric measurements- height, weight, waist and hip circumference was taken as well as blood pressure of each student was measured. Height was measured in centimetres by non-stretchable measuring tape with 0.5 cm accuracy. Height was recorded after removing foot wear. Weight was recorded in Kilograms on bathroom scale type of weighing machine. Throughout the study same weighing machine was used and it was calibrated with other standard instruments. Waist and hip circumference were measured by using a measuring tape. Blood pressure was measured manually using sphygmomanometer.

2.3. Statistical analysis

Data was in Microsoft Office Excel 2007 and analysis was done using the software package Epi Info (Version 7.1.5) from CDC, Atlanta, U.S.A. The data was analysed by applying 'students t test' and 'chi-square', 'p value' of less than 0.05 was considered statistically significant.

Ethical Permission for the study was taken from the Human Research Ethics Committee of the P.D.U. Government Medical College, Rajkot.

3. Results

A total 1120 adolescents studying in standard 9th to 12th were enrolled in the study. Equal number of children (80) were taken from each class from fourteen selected schools. Maximum number of study participants, 273 (24.4%) were belonging to 14 years of age and minimum number of study participants, 15 (01.3%) of 18 years. (Figure 1) Most of the participants (93.3%) were Hindus followed by Muslims (4.2%), Christians (1%) and Sikh (0.3%).

Boys consistently had higher average heights and weights than girls across all age categories. In all the different age groups, the mean waist circumference was more in boys compared with girls but the mean BMI was more in girls compared to boys (Table 1).

The prevalence of overweight was 11.1% and obesity 7%. Fifty-six percent participants were normal while 26% were underweight. (Figure 2) Maximum prevalence of overweight and obesity was in 18 years of age (46.7% and 13.3% respectively) followed by 16 years. On applying chi-square test the difference in BMI status among various age groups was found out to be statistically significant ($p < 0.001$).

Overweight and obesity was related to family characteristics like place of residence, parents' occupation and history of obesity in parents. The association between these variables was found to be statistically significant with obesity. (Table 2) While no association was found between the literacy status of both father and mother with overweight/obesity.

Physical activity for less than 60 minutes (15.3%) and screen time of more than 2 hours (12.7%) was significantly associated with Overweight/obesity while playing indoor games, mode of transportation used to reach school and afternoon sleep was not associated with overweight/obesity (Table 3)

The problem of overweight and obesity was more in participants with consumption of non-vegetarian diet (22.2%), daily consumption of carbonated drinks (36.4%) and chocolates (26.2%), less intake of vegetables (12.4%) and who visited restaurants more than once in a week (21.6%). These dietary practises were statistically significantly associated with overweight and obesity in study participants. These dietary practises were statistically significantly associated with overweight and obesity in study participants. While frequency of eating breakfast, fruits and consumption of fast food has no effect on overweight/ obesity. (Table 4)

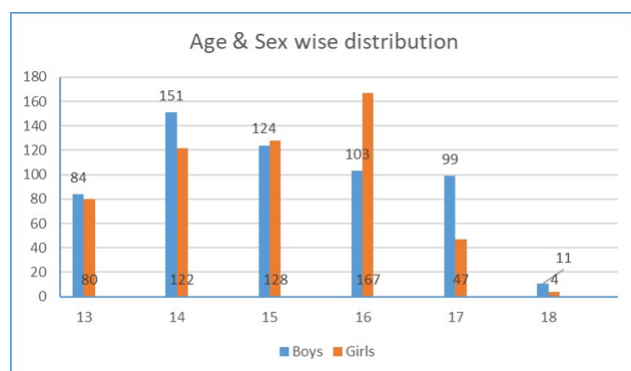


Figure 1: Age & Sex wise distribution of study participants

4. Discussion

In this study, the prevalence of overweight was 11.1% and obesity was 7%. Similar results were obtained by a study done in Rajkot city among affluent school students aged 8–18 Years by Eshwar TK et al where he reported

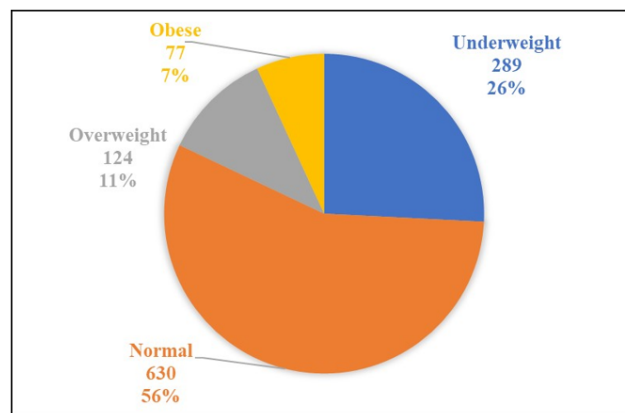


Figure 2: Distribution of participants according to their BMI status (n=1120)

that 15.3% were overweight and 11% were obese by WHO standards.⁵ A cross sectional study was conducted in six zones of Ahmedabad Municipal Corporation among children aged 10-19 years. Brambhath KR et al in this study observed that 13.3% adolescents were overweight and 5.4% were obese.³

Prevalence of obesity was 07.0 % for adolescents staying at home while it was 3.8 % for those staying in hostel. In contrast to the findings of present study, John M. de Castro et al study results indicate that being at home or away from home has differential effects on BMI groups. Overweight/obese individuals eat more when they are away from home while normal weight individuals eat about the same at home as away.⁶ The difference in results of both studies may be because in the present study maximum i.e., 95.3% participants stay at home.

In present study it was observed that participants whose father were involved in sedentary activities had more prevalence of overweight. Similar findings were observed in a cross-sectional and institutional study done among adolescents of Hyderabad in South India.⁷ Prevalence of overweight and obesity was more in the children whose mothers were employed (17.7% and 14.2% respectively) than those who were housewife (10.1% and 05.8% respectively). A cross sectional study done in Wardha city by Bharati DR et al also reported that children whose mothers were involved in service/business were significantly associated with overweight/ obesity among the study population.⁸

Among 1120 adolescents, prevalence of obesity was found more in those who spent <60 minutes' time in physical activity per day (08.3%) than those who spent ≥60 minutes' time (05.8%). A cross sectional study was conducted among school children in Latur city by Ashtekar SV et al.⁹ Similar to the findings of present study, it was observed that prevalence of obesity was higher in children involved in physical activity for less than 30 minutes per

Table 1: Descriptive statistics of participants according to their anthropometric measurements

Variables	Minimum		Maximum		Mean		Standard Deviation	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Age (years)	13	13	18	18	15.4	15.2	1.30	1.22
Height (m)	1.44	1.43	1.71	1.68	1.62	1.56	0.05	0.04
Weight (kg)	30.9	30	89.5	79.5	56.3	52.5	11.83	11.01
BMI (kg/m ²)	14.10	11.43	33.3	32.7	21.2	21.4	4.23	4.33
Waist Hip Ratio	0.71	0.69	0.99	0.97	0.86	0.81	0.06	0.05
Waist Circumference (cm)	61	54	109	100	78.95	73.19	11.96	8.81

Table 2: Determinants of overweight/obesity: Family Characteristics

Variables	BMI					p-value
	Underweight	Normal	Overweight	Obese	Total	
Place of residence						
Home	279 (26.1)	591(55.4)	122 (11.4)	75(07.0)	1067(100.0)	$\chi^2=4.08$, df=1, p=0.043
Hostel	10 (18.9)	39 (73.6)	02 (03.8)	02 (03.8)	53 (100.0)	
Father's Occupation						
Manual	32 (23.8)	86 (64.1)	6 (4.5)	10 (7.4)	134 (100.0)	$\chi^2=3.548$, df=1, p=0.05
Non-Manual	250 (26.1)	530 (55.3)	114 (11.8)	64 (6.7)	958 (100.0)	
Mother's Occupation						
Housewife	259 (26.4)	564 (57.6)	99 (10.1)	57 (05.8)	979 (100.0)	$\chi^2=21.97$, df=1, p<0.001
Employed	30 (21.3)	66 (46.8)	25 (17.7)	20 (14.2)	141 (100.0)	
Father Obese						
Yes	21 (11.6)	109 (60.2)	29 (16.0)	22 (12.2)	181 (100.0)	$\chi^2=14.74$, df=1, p<0.001
No	241 (28.1)	480 (55.9)	89 (10.4)	49 (05.7)	859 (100.0)	
Mother Obese						
Yes	17 (09.7)	110 (62.9)	33(18.9)	15 (08.6)	175 (100.0)	$\chi^2=12.81$, df=1, p<0.001
No	252 (28.7)	485 (55.2)	85 (09.7)	56 (06.4)	878 (100.0)	

Table 3: Determinants of overweight/obesity: Individual characteristics of physical activities

Variables	BMI					p-value
	Underweight	Normal	Overweight	Obese	Total	
Time spent in physical activity per day						
<60 minutes	99 (20.5)	270 (55.9)	74 (15.3)	40 (08.3)	483 (100.0)	$\chi^2=18.45$, df=1, p<0.001
≥60 minutes	190 (29.8)	360 (56.5)	50 (07.8)	37 (05.8)	637 (100.0)	
Screen time/ Day						
≤2 hours	148 (27.1)	321 (58.8)	51 (09.3)	26 (04.7)	546 (100.0)	$\chi^2=10.69$, df=1, p=0.001
>2 hours	141 (24.5)	309 (53.8)	73 (12.7)	51 (08.8)	574 (100.0)	
Duration of sleep at night						
<7 h/day	110 (22.5)	308 (63.1)	40 (08.2)	30 (06.1)	488 (100.0)	$\chi^2=7.62$, df=1, p=0.006
≥7 h/day	179 (28.3)	322 (50.9)	84 (13.3)	47 (7.4)	632 (100.0)	

day than those with more than 30 minutes per day. This difference was found statistically significant.(p<0.05) Gupta R et al¹⁰ in his study also showed that, proportion of study subjects who were overweight and obese significantly increases as the TV viewing hours increased to more than 2 hours as compared to those who were watching TV less than or equal to 2 hours/day. Similar findings were observed in this study.

In this study, prevalence of obesity was more in non-vegetarians (19.4%) than vegetarians (10.7%). Subashini K et al¹¹ found similar findings with more prevalence of overweight in those consuming non-vegetarian diet.In

this study 77.7% participants ate vegetables daily. Similar findings were observed by Jain et al¹² with 64.2% participants eating vegetables daily and the frequency of eating vegetables was significantly associated with BMI.(p<0.05) A positive co-relationship was found between overweight and obesity with the consumption of energy drinks in a cross sectional study which included 500 participants from 10 selected schools in Udupi and Dakshina Kannada districts.¹³ Similar to the findings of this study, Goyal RK et al¹⁴ observed that obesity was found more in children visiting restaurant more than once a week (87.9%) than those who visit once or don't visit

Table 4: Determinants of overweight/obesity: Individual characteristics of dietary habits

Variables	BMI					p-value
	Underweight	Normal	Overweight	Obese	Total	
Food Preference						
Vegetarian	282 (26.1)	611(56.6)	116 (10.7)	70 (06.5)	1079(100.0)	$\chi^2=19.71$, df=1, p<0.001
Non-vegetarian	07 (17.1)	19 (46.3)	08 (22.2)	07 (19.4)	41 (100.0)	
Frequency of eating vegetables						
Daily	248 (28.5)	471(54.1)	93 (10.7)	59 (06.8)	871 (100.0)	$\chi^2=16.47$, df=4, p=0.002
Occasionally	41 (16.4)	159 (63.8)	31 (12.4)	18 (7.2)	249 (100.0)	
Frequency of consuming carbonated drinks						
Daily	12 (27.3)	10 (22.7)	16 (36.4)	06 (13.6)	44 (03.9)	$\chi^2=44.87$, df=4, p<0.001
Twice a week	22 (18.6)	89 (75.4)	02 (01.7)	05 (04.2)	118 (10.5)	
Thrice a week	14 (58.3)	4 (16.7)	3 (12.5)	03 (12.5)	24 (02.1)	
Occasionally	219 (25.7)	486(57.0)	90 (10.6)	57 (06.7)	852 (76.1)	
Never	22 (26.8)	41 (50.0)	13 (15.9)	06 (07.3)	82 (07.3)	
Frequency of visiting restaurant in a week						
Once	152 (26.5)	295(51.4)	78 (13.6)	49 (08.5)	574 (51.3)	$\chi^2=50.85$, df=2, p<0.001
More than once	19 (16.4)	59 (50.9)	25 (21.6)	13 (11.2)	116 (10.4)	
Don't visit	118 (27.4)	276(64.2)	21 (04.9)	15 (03.5)	430 (38.4)	
Frequency of eating chocolates						
Daily	31 (16.2)	77 (40.3)	50 (26.2)	33 (17.3)	191 (100.0)	$\chi^2=102.12$, df=2, p<0.001
Occasionally	258 (28.1)	545(59.3)	74 (08.1)	42 (04.6)	971 (100.0)	
Never	0	08 (80.0)	0	02 (20.0)	10 (100.0)	

at all (12.1%). In this study, the prevalence of overweight/obesity is higher in participants who ate chocolates daily (26.2%) than those who ate it occasionally (8.1%). Wate JT et al¹⁵ found that frequent consumption of chocolates has statistically significant association with BMI.(p<0.05) Goyal RK et al¹⁴ reported that chocolate eating habit have positive relation with prevalence of obesity and overweight.

5. Conclusion

Occupation of parents, family history of obesity, lack of physical activity, higher screen time, daily consumption of higher calories like carbonated drinks and chocolates, and frequent restaurant visits are some of the determinants associated with overweight and obesity. While education of parents, number of sports periods in school, time spent in indoor games per day, type of transportation used to reach school, duration of daytime sleep, frequency of eating fruits, fast foods and breakfast habits were not associated with obesity.

6. Recommendation

School is an attractive setting to promote positive health behaviour as adolescents spend most of their time in school environment. Partnership between health care and educational professional will be required to promote physical health of adolescents, thereby reducing risk and public health burden of Obesity. As a part of primordial prevention, parents should promote healthy habits in their children. Children should be encouraged to play outdoor

games, limit television viewing and use of electronic gadgets. Parents should encourage children at home to eat regular breakfast and healthy regular diet which includes major amount of fruits and vegetables. Restrict the intake of energy dense foods, soft drinks and frequent restaurant visits. School building and surrounding environment should be designed in such a way that it encourages sports and recreational activities. For encouraging healthy food habits in children selling of junk food should be restricted in school canteens.

7. Limitation

The first limitation in our study is the reliance on the answers of the students regarding their physical activity and dietary pattern. Efforts were made to make these answers as accurate as possible by explaining the meaning of each question and the choices. Due to large sample size detailed dietary history was not taken.

8. Additional Contributions

We thank the Heads of the institutions of the schools and the students for having helped us in the collection of data.

9. Conflict of Interest

None.

10. Source of Funding

None.

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Author biography

Nidhi Y Mangrola, Assistant Professor  <https://orcid.org/0000-0003-2958-1972>

RG Mahajan, Associate Professor

Kshama D Gajera, Assistant Professor

Kuntalkumar H. Patel, Assistant Professor

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