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Original Article

Overweight and obesity in early adolescents and its relation to dietary habit and physical activity: A study in Dibrugarh town

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ABSTRACT

Background: The increasing prevalence of overweight and obesity among adolescents is a public health concern. Increase in prevalence and severity of obesity among children and adolescents has been attributed largely to behavioral factors.

Objectives: (1) To assess the prevalence of overweight and obesity among the early adolescents studying in the schools of Dibrugarh town. (2) To assess the association of dietary habits and physical activities of the study participants with overweight and obesity.

Methods: School-based cross-sectional study was done among 800 adolescents (10–14 years). Weight status was assessed using WHO-2007 reference for body mass index. For diet, food frequency method was used. Physical activity questions were according to Global Physical Activity Questionnaire. Chi-square test, Fisher's test, and odds ratio were used to analyze associations.

Results: Of the total adolescents, 46% were girls. Prevalence of overweight and obesity was 22.5% and 9.7% respectively and was more in girls ($p < 0.05$) and younger age ($p < 0.05$). Less frequency of major meals, extra snacks, irregular food habit, breakfast skipping, and increased restaurant visits were associated with increase in overweight/obesity ($p < 0.05$). Obesity was more in adolescents who never took green vegetables (OR = 1.9, $p < 0.05$) and fruits (OR = 5.9, $p < 0.05$) and with daily intake of soft drinks (OR = 2.2, $p = 0.002$), bakery products (OR = 2.6, $p < 0.0001$), chocolate (OR = 3.5, $p < 0.0001$), and deep fried foods (OR = 2.9, $p = 0.0001$). 26.6% adolescents were leading sedentary life. Decreased involvement in physical activity was associated with overweight and obesity ($p < 0.0001$).

Conclusion: Prevalence of overweight/obesity in adolescents is substantial. Dietary behavior and physical activity significantly affect weight of adolescents.

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1. Introduction

Obesity is now recognized globally as one of the public health problems. Once considered a high-income country problem, overweight/obesity is now increasing in low and middle-income countries, particularly in urban settings. Globally, about 200 million school children are overweight and obese, of which 40–50 million are obese.¹ In the South-East Asia Region, 300,000 die of overweight/obesity.² In India too, an increase in trend in the prevalence of overweight and obesity has been seen among children and adolescents.^{3–9}

Adolescents (10–19 years) form about 30% of the population in the World and 35% in India and are often thought of as a healthy group.^{10,11} Nevertheless, many adolescents do die prematurely due to various factors that are either preventable or treatable. Tobacco use, alcohol intake, poor eating, and exercise habits lead to illness or premature death later in life.¹¹ These modifiable behavioral risk factors lead to various metabolic/physiological changes like overweight/obesity.¹² There is scientific evidence that physical activity and a healthy diet are important elements for prevention of non-communicable diseases and their risk factors including overweight/obesity.¹³

Children and adolescents who are obese are likely to be obese during their later life.¹⁴ Moreover, they are more at risk for non-communicable diseases such as cardiovascular diseases, type 2 diabetes, stroke, cancers, and osteoarthritis.^{13,14}

Due to such adverse effects of adolescent obesity, it has been recognized as a public health priority.¹⁵ Seeing the growing concern, the following study was carried out to measure the prevalence of overweight and obesity among the early adolescents studying in the schools of Dibrugarh town and to determine the association of dietary habits and physical activities with overweight and obesity.

2. Materials and methods

2.1. Study setting

According to Prasad in India, about 80% of the adolescents are enrolled in schools and 65–85% of those enrolled are regularly attending school for an average of 200 days in a year. Thus, a bulk of the school age adolescents is in schools on majority of the days in a year, providing an opportunity to reach the adolescent population of the community.¹⁶ So a school-based cross-sectional study was done for a period of 6 months, May–October 2015. The study was done among students of 10–14 years studying in the schools of Dibrugarh town.

2.2. Sample size

Sample size was calculated using the prevalence of overweight/obesity as 18.1%¹⁷ and relative precision of 15% which came to be 772 and was rounded to 800.

2.3. Inclusion criteria

All the students of 10–14 years studying in classes V, VI, VII, VIII, and IX of the schools of Dibrugarh town.

2.4. Exclusion criteria

While selecting the schools, for administrative feasibility, schools with less than 20 students in each class or where the annual enrolment per class per year is less than 20 were excluded from the study. The students who were unwilling to participate in the study were also excluded.

2.5. Study design

Multistage sampling technique was used to select the study participants (Fig. 1). First, the schools of Dibrugarh town were divided into two categories: Government School and Private School. Schools having less than 20 numbers of students in each class and schools with only Standard-IX and X were excluded from the list. In the second stage, 8 schools were selected randomly – 4 schools from private category and 4 schools from government category. Then, from each school, 20 students were enrolled from each of the classes – Class-V, Class-VI, Class-VII, Class-VIII, and Class-IX. The selection of the students from different classes was done by using simple random sampling technique.

2.6. Study method

Each student was interviewed personally by using a schedule and anthropometric measurements were done. A questionnaire, to be filled by parents/guardians, was sent home to obtain data on cooking medium used in home.

The anthropometric measurements included height and weight. Height was measured to the nearest 0.1 cm using stadiometer. Weight was measured to the nearest 0.1 kg using digital weighing machine. body mass index (BMI) was calculated by using the equation $BMI = \text{weight (kg)} / \text{square of height (m}^2\text{)}$. To determine the weight status of the study, participants' age and sex-specific WHO 2007 reference for BMI for 5–19-year-old children (z-score) were used. The students were categorized as severe thinness, thinness, normal, overweight, and obese.

To obtain data on study participants' dietary habits, food frequency method was used. Questions on cooking medium used at home, breakfast eating frequency, meal frequency, number of extra snacks (excluding morning tea and evening snacks), and restaurant visits frequency per week were included. To obtain data on physical activity of the study participants, questions according to the Global Physical Activity Questionnaire¹⁸ were used. While considering the sedentary activities, time spent in studies was excluded.

2.7. Ethical consideration

Ethical clearance was obtained from the Institutional Ethics Committee (Human) of Assam Medical College and Hospital. Written consent was taken from the parents and assent was taken from the students.

Fig. 1 – Process of selection of study participants.

2.8. Data analysis

Rate and percentage were used to analyze the data. Chi-square test, Fisher's exact test, and odds ratio were used to analyze the relation of the dietary factors and physical activity with overweight and obesity.

3. Results

The present study included 800 students. However, the completed data were obtained only from 752 students. As such, the results were analyzed on the basis of those 752 students.

3.1. Prevalence of overweight/obesity

Out of the 752 adolescents, 346 (46%) were girls and 406 (54%) boys. The mean age of the study participants was 12 ± 1.33 years. The prevalence of overweight and obesity was found to be 22.5% and 9.7% respectively. The prevalence of overweight and obesity in boys was 20.4% and 10.3% respectively and in

girls 24.9% and 9.7% respectively; a significant difference ($\chi^2 = 12.207$, $df = 4$, $p = 0.016$) was found between girls and boys. Overweight/obesity was found to be more in the younger age groups (10–11 years). 52.1% of the overweight adolescents (p value = 0.005 in comparison to normal weight adolescents) and 42.4% of the obese adolescents (p value = 0.01 in comparison to normal weight adolescents) were between 10 and 11 years of age (Table 1). A significant difference ($\chi^2 = 79.472$, $df = 4$, $p < 0.05$) was found in the prevalence of overweight and obesity among private and government schools.

3.2. Overweight/obesity and dietary habits

The study showed that majority (61.8%) of the study participants had three major meals per day. Boys had significantly more meals per day than girls (p value = 0.018), 30.5% boys (124) and 20.2% girls (70) having four or more meals per day. It was seen that 47.3% boys (192) and 47.9% girls (166) had no fixed time for taking meals. Out of the 752 adolescents, 5.5% girls and 11.6% boys skipped breakfast for more than three days a week. Majority of the adolescents (84.6%) were

Table 1 – Distribution of weight status among the study participants by their age.

Age (in years)	Severe thinness (%)	Thinness (%)	Normal (%)	Overweight (%)	Obese (%)	Total (%)
10	0 (0.0)	2 (1.6)	67 (52.3)	40 (31.3)	19 (14.8)	128 (100.0)
11	5 (2.8)	7 (4.0)	105 (59.3)	48 (27.1)	12 (6.8)	177 (100.0)
12	4 (2.0)	14 (6.9)	132 (65.0)	37 (18.2)	16 (7.9)	203 (100.0)
13	4 (3.4)	10 (8.6)	78 (67.3)	16 (13.8)	8 (6.9)	116 (100.0)
14	4 (3.1)	12 (9.4)	66 (51.6)	28 (21.9)	18 (14.1)	128 (100.0)

non-vegetarians. 6.9% boys (28) and 2.3% girls (8) visited restaurants for more than three days per week (p value = 0.013).

Daily intake of green leafy vegetables, fruits, and milk was seen in 27.3% (205), 55.2% (415), and 59.8% (450) adolescents respectively. Daily intake of deep fried food, bakery products, chocolate/sweets, carbonated soft drinks, and sharbat/syrups was seen in 34.0% (256), 28.9% (217), 32.2% (242), 34.8% (262), 31.3% (238), and 28.6% (215) of adolescents respectively. Fish and meat were consumed daily by 29.5% and 29.2% of the adolescents.

It was seen that 18.2% overweight/obese adolescents had less than 3 meals per day. Normal weight adolescents (258, 57.6%) were found to have their meals more regularly than overweight and obese adolescents (108, 44.6%). Also, 14.9% (36) of the overweight and obese adolescents skipped breakfast for more than 3 days a week in comparison to 4% (18) of normal weight adolescents. In more overweight/obese adolescents, 17.4% (42) were having three or more extra snacks per day as compared to 7.1% (32) normal weight adolescents. As seen in the study, 62.0% (278) normal weight adolescent did not have any extra snacks. [Tables 2 and 3](#) show the association of dietary pattern of the adolescents with their weight status.

3.3. Overweight/obesity and physical activity

The study showed that 26.6% of the children were leading a sedentary lifestyle ([Table 4](#)). More boys were involved in

vigorous activity than girls (68.7% and 58.1% respectively, p value = 0.003). Likewise, boys were more involved in moderate activity than girls (60.8% and 50.6% respectively, p value = 0.005). Girls spent significantly more hours in sedentary activities than boys [63 (18.2%) versus 46 (11.3%) respectively for more than 4 h per day, p value < 0.05]. Mean time spent in sedentary activities was 2.63 ± 1.089 h. Among the sedentary activities, watching TV (506, 67.3%) and using computers (407, 54.1%) were the most common activities followed by playing sedentary games (300, 39.9%) and video games (144, 19.1%). Association of physical activity with overweight and obesity is shown in [Table 5](#).

4. Discussion

In the present study, the prevalence of overweight and obesity was found to be 22.5% and 9.7% respectively. In a study done by Nawab et al. in Aligarh in 2014, the prevalence of overweight and obesity was found to be 9.8% and 4.8% respectively.¹⁹ In another study done by Chakraborty et al. in Kolkata in 2008–2009, the prevalence of overweight was found to be 22.57% in preadolescent age group (9–12 years) followed by the adolescent (17.12%).²⁰ In our study, the overall prevalence of overweight and obesity was significantly more in girls (33.9%, $p = 0.016$). This might be because girls are significantly less involved in vigorous activity than boys (58.1% vs 68.7%, $p = 0.003$). According to Cherman et al., the prevalence of

Table 2 – Association of different dietary habits of the study participants with their weight status (comparison of overweight and obese adolescents with normal weight adolescents).

	Variables		OR	95% CI	p value
1.	Meal frequency (per day)	Less than 3 meals	2.0769	1.3078–3.2982	0.001
		3 meals	1		
		4 or more meals	0.8644	0.5958–1.2542	0.4
2.	Breakfast eating habit (per week)	Never skipped	1		
		Skipped <1 day	1.4603	0.8474–2.5165	0.1727
		Skipped 1–3 days	2.7905	1.6481–4.7246	0.0001
		Skipped >3 days	4.6242	2.5481–8.3920	<0.0001
3.	Timing of meals	Fixed timing	1		
		Irregular	2.9368	2.0941–4.1186	<0.0001
4.	Type of diet	Vegetarian	1		
		Non vegetarian	1.4221	0.934–2.1654	0.09
5.	Restaurant visits (per week)	Never	1		
		<1 day	0.5524	0.3527–0.8654	0.01
		1–3 days	1.6188	0.9417–2.7826	0.08
		>3 days	2.554	1.3208–4.9400	0.005
6.	Number of extra snacks (per day)	None	1		
		1–2 times	1.4588	1.0309–2.0642	0.03
		3 times or more	3.1455	1.8919–5.2297	<0.0001

OR – odds ratio, CI – confidence interval.

Table 3 – Association of frequency of intake of various food items by the study participants with overweight and obesity.

Variables		OR	95% CI	P value
Green leafy vegetables	Never	1.9	1.330–2.751	0.0004
	Less than 1 day/week	2.3	1.311–4.378	0.003
	1–3 days/week	1.8	0.629–1.870	0.761
	4–6 days/week	1.4	0.803–2.759	0.204
	Always	1.0		
Fruits	Never	5.9	2.941–11.97	<0.0001
	Less than 1 day/week	0.7	0.403–1.256	0.2
	1–3 days/week	0.9	0.626–1.546	1.0
	4–6 days/week	1.4	0.869–2.166	0.1
	Always	1.0		
Deep fried food/fast food	Never	1.0		
	Less than 1 day/week	0.4981	0.2616–0.9484	0.03
	1–3 days/week	1.6529	0.9108–2.9995	0.09
	4–6 days/week	2.3273	1.1627–4.6584	0.017
	Always	2.9597	1.7101–5.1223	0.0001
Bakery products	Never	1.0		
	Less than 1 day/week	0.9976	0.6112–1.6283	0.9
	1–3 days/week	0.7086	0.3943–1.2733	0.2
	4–6 days/week	1.6344	0.9338–2.8605	0.3
	Always	2.6350	1.7099–4.0606	<0.0001
Butter/ghee/cheese	Never	1.0		
	Less than 1 day/week	0.4974	0.3057–0.8091	0.004
	1–3 days/week	0.3624	0.2077–0.6325	0.0004
	4–6 days/week	1.1637	0.6913–1.9589	0.5
	Always	1.1002	0.7312–1.6553	0.6
Chocolate/sweets	Never	1.0		
	Less than 1 day/week	1.1934	0.6466–2.2024	0.6
	1–3 days/week	1.7538	0.9105–3.3784	0.09
	4–6 days/week	2.9059	1.5778–5.3520	0.0006
	Always	3.5424	2.0298–6.1822	<0.0001
Lemonade/syrups	Never	1.0		
	Less than 1 day/week	1.09	0.683–1.76	0.7
	1–3 days/week	1.07	0.634–1.838	0.8
	4–6 days/week	1.2	0.705–2.16	0.4
	Always	2.0	1.335–3.06	0.0008
Carbonated soft drinks	Never	1.0		
	Less than 1 day/week	0.7	0.413–1.199	0.2
	1–3 days/week	0.6	0.366–1.199	0.17
	4–6 days/week	2.2	1.145–4.289	0.01
	Always	2.2	1.336–3.592	0.002
Meat	Never	1.0		
	Less than 1 day/week	0.7	0.412–1.129	0.1
	1–3 days/week	0.6	0.389–1.014	0.05
	4–6 days/week	0.6	0.380–1.183	0.16
	Always	0.7	0.488–1.188	0.2

OR – odds ratio, CI – confidence interval.

overweight/obesity in girls (17.4%) was more than boys (15.2%) ($p = 0.028$).²¹ Nawab et al. in their study reported the prevalence of overweight and obesity to be more among males (11.3% and 5.5%, respectively) than females (7.9% and 3.9%,

respectively).¹⁹ Our study is in accordance with Cherian et al.²¹ In the present study, the prevalence of overweight and obesity was highest in 10 years age (31.3% and 14.8% respectively). In a study done by Chakraborty et al., the prevalence was highest in 10 years age group (11.54%).²

It was found that overweight/obese adolescents were having significantly less major meals per day. Similarly in studies done by Toschke et al.²² and Jennings et al.,²³ they reported that daily eating frequency was inversely associated with overweight. Moreover, in the present study, boys had significantly more major meals per day than girls ($p = 0.019$). In our study, overweight and obese adolescents were found to be skipping breakfast which was significantly more than normal weight adolescents ($p = 0.002$ and 0.00007 respectively).

Table 4 – Distribution of study participants according to their involvement in physical activity.

Physical activity	No. of participants	Percentage
Vigorous + moderate	350	46.5
Only vigorous	130	17.3
Only moderate	72	9.6
Sedentary	200	26.6

Table 5 – Association of physical activity with overweight and obesity.

Variables	Time spent in different types of physical activity	OR	95% CI	p value
Sedentary activities (hrs/day)	<3 h	1		
	3–4 h	1.3173	0.9312–1.8633	0.11
	5–6 h	0.7128	0.406–1.2514	0.23
	>6 h	0.5883	0.3101–1.1162	0.1
Moderate activities (days/week)	Never or <1 day	0.9777	0.5882–1.6750	0.9
	1–3 days	0.7059	0.4007–1.2435	0.2
	4–6 days	0.8615	0.4740–1.5657	0.6
	7 days	1		
Vigorous activities (days/week)	Never or <1 day	2.9834	1.9290–4.6140	<0.0001
	1–3 days	3.0991	1.8963–5.0650	<0.0001
	4–6 days	1.6913	1.0528–2.7172	0.02
	7 days	1		

OR – odds ratio, CI – confidence interval.

Similarly, a study done by Natalijia et al. reported that overweight and obese children and adolescents skipped breakfast more often than those of normal or low weight.²⁴ Baldinger et al. also reported in their study that children consuming breakfast almost every day had a significantly ($p < 0.05$) lower BMI compared with children eating breakfast only sometimes or almost never.²⁵ In our study, we found that vegetarian adolescents were more at risk of becoming obese; however, no association was seen between overweight and the type of diet. Nawab et al. in their study found that adolescents with vegetarian diet were more at risk of overweight.¹⁹

The present study also showed that significantly more overweight/obese adolescents were having three or more extra snacks in between meals. This may have some association with breakfast skipping habits and less number of major meals per day among overweight and obese adolescents. As we can see in the present study, overweight and obesity were significantly more in adolescents who skip breakfast and had less number of major meals per day. This might be because skipping meals may lead to more snacks and junk food intake whenever they were hungry. Also, increased intake of junk food leads to early satiety which decreases their regular meal intake.

In our study, 26.6% of the adolescents never took green leafy vegetables and were found to be significantly associated with obesity. The study also showed significant association of daily intake of deep fried/fast food, bakery products, butter/ghee, carbonated soft drinks, chocolate, and sharbat/syrups with overweight and obesity. In a study done by Nawab et al., fast food intake was found to have direct association with overweight.¹⁹

In the present study, girls were found to spend more time in sedentary activities than boys. TV watching (67.3%) and using computer (54.1%) were most common sedentary activities. In the present study, no association was seen between weight status of the adolescents and time spent in sedentary activities per day. This might be because there are multiple factors affecting overweight/obesity in adolescents. Natalija et al. also in their study did not find any association between sedentary activity and obesity.²⁴ In our study, it was found that overweight and obese adolescent were significantly less involved in vigorous physical activity. It is similar to a study done by Nawab et al. where risk of overweight was found to increase with decrease physical activity level.¹⁹

Girls were less involved in physical activity and skipping more meals than boys. A changing body image during this period might be a reason which needs to be further studied.

Limitations of our study are: (1) As it is a cross-sectional study, causal relationship could not be established. (2) Only food frequency was taken; amount of food consumed was not taken. As a result, balance between calorie intake and output was not done, and (3) there might be recall bias on part of the participants as the study depended on the memory of the participants.

5. Conclusion

It is concluded from this study that overweight/obesity is substantial among adolescents in urban settings. Unhealthy diet and decreased physical activities have important roles in increasing overweight and obesity. Irregular eating habits and increased junk foods with decreased intake of vegetables and fruits are important risk factors. Awareness on healthy diet and physical activity among the students and teachers may have positive impacts on decreasing this epidemic.

Conflicts of interest

The authors have none to declare.

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